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The role of Spatial Data Infrastructures in the Digital Government Transformation of Public Administrations

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Contents

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Abstract

Spatial Data Infrastructures (SDIs) play a pivotal role in Digital Government Transformation (DGT) of countries. They constitute one of the main building blocks for effective data sharing and their development in the past years has taught some important lessons to public authorities in terms of collaboration across sectors, centricity of users' needs as well as usefulness of platforms and Application Programming Interfaces (APIs). However, the specific analysis of the role that SDIs play in Digital Government Transformation has not been the object of many studies so far. With practitioners and academics acknowledging more and more the links between these two concepts, there is a need to provide an initial picture of how SDIs have contributed to Digital Government Transformation until now and what could be their role in the future.

The present study is a first attempt to examine this relation and develop a methodology for apprehending the role of SDIs in the Digital Transformation of the public sector. It first develops an analytical framework for examining different aspects that can provide an explanation of the relationship between SDIs and DGT and notably institutional aspects, technical aspects and impact aspects. It then tests this framework on twenty-nine countries (all European Member States plus Norway) in order to assess the validity of this instrument for the collection of data as well as for the wider understanding of this topic. From these analytical and data collection efforts, it emerged the strength of the relationship that SDIs and Digital Government Transformation entertain and the variety of ways in which countries have understood and cultivated it. The study also provides an attempt to link the OECD Recommendation on Digital Governments with the SDIs and Digital Transformation experience of the countries in scope. This also helped understanding that SDIs already significantly support Digital Government Transformation, even from the OECD perspective, and that this relationship will only be stronger in the future.

Executive Summary

Spatial Data Infrastructures (SDIs) can be defined as "policies, access networks and data handling facilities, standards, and human resources necessary for the effective collection, management, access, delivery and utilization of spatial data for a specific jurisdiction or community.[1]" They therefore constitute a key instruments for countries' data usage and sharing and, thanks to the INSPIRE Directive[2], they also play a pivotal role in data sharing across countries. As such, SDIs entertain a close relationship with Digital Government Transformation (DGT). This concept refers to the "fusion of advanced technologies and the integration of physical and digital systems, the predominance of innovative business models and new processes, and the creation of smart products and services[3]" happening within governments. Recently, more and more attention has been paid to the relation between these two aspects. However, there seemed to be no comprehensive study on the role of SDIs in Digital Government Transformation. This assignment constitutes a first attempt to fill this knowledge gap and explore how SDIs support Digital Government Transformation of countries in Europe.

Due to the lack of pre-existing methods for this analysis, this study first focused on the development of an analytical framework for understanding the relation between SDIs and DGT. Such a framework was developed from stretch but building on the experience of the INSPIRE Country factsheets[4] and the eGovernment factsheets[5]. Initially composed of seven categories and twenty-nine indicators, throughout the data collection and analysis processes the number of indicators was reduced to seventeen indicators, mainly by deleting the least relevant and combining overlapping indicators. These seventeen indicators were also restructured around three main categories:

- **Institutional setting**: which gathers indicators related to the governance, strategy and (national) legal framework underpinning the relationship between SDI and Digital Government Transformation;
- **Technical infrastructure**: which includes all technical aspects related to the SDI for instance in terms of breadth of the SDI infrastructure, magnitude of the interoperability efforts done as well as innovativeness of the approach;
- **Impact**: which gathers the indicators concerning both the width of the usage of the SDI as well as the benefits derived from it, also from a cross-border perspective.

Within each of these three categories, sub-groups of related indicators were also identified. This analytical framework was then tested on all the countries in scope of the assignment and notably all the EU Member States plus Norway. The data collection consisted mainly in desk research and literature review on the different countries but a few interviews were organised for some specific countries and at an early phase (i.e. Slovakia, France) and additional interviews took place for the four countries which were selected for in-depth analysis and notably: Spain, Poland, Belgium and the Netherlands. The testing of the analytical framework on these countries had a twofold objective: on the one hand, it aimed at confirming/rejecting the validity of the framework for apprehending the links between the SDIs and DGT phenomena. On the other, it served to compile some key facts, figures and lessons learnt on the experiences of the countries in scope in terms of SDIs conception and implementation in the context of Digital Government Transformation.

Concerning the first objective, this approach allowed finding that, although not perfect, the framework is overall relevant for studying the relation between SDIs and DGT. When examined through the lenses of *relevance, applicability, comparability and completeness* (which constituted the main criteria for evaluating its performance), the framework proved sufficiently reliable and it helped collecting some very interesting

[1] Abbas Rajabifard et al., Future Directions for SDI Development, International Journal of Applied Earth Observation and Geoinformation, 2002 in Abbas Rajabifard et al., SDI Conceptual Modelling for Disaster Management, ISPRS Workshop on Service and Application of Spatial Data Infrastructure, Hangzhou, XXXVI, 4/W6, 14-16 October 2005, pp. 125-130, http://www.isprs.org/proceedings/XXXVI/4-W6/papers/125-130AliMansourian-A037.pdf

[2] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE), OJ L 108, 25 April 2007, pp. 1–14, https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32007L0002

[3] See: 'Digital transformation', https://ec.europa.eu/growth/industry/policy/digital-transformation_en

[4] https://inspire.ec.europa.eu/INSPIRE-in-your-Country

[5] https://joinup.ec.europa.eu/collection/nifo-national-interoperability-framework-observatory/digital-government-factsheets-2018

evidence on the different countries. Nonetheless, further work will be necessary to refine it, provide more clarity on the significance and perimeter of each indicator and improve some of its weakest parts.

Building on the information collected on the different areas covered by the analytical framework, and notably institutional framework, technical infrastructure and impacts of SDIs in DGT, this study proved that **Spatial Data Infrastructures have paved the way for more data sharing in Europe and for a better-organised Digital Government Transformation**. The implementation of the INSPIRE Directive helped as it has led to the obligation of sharing data in a certain way and building interoperable infrastructures across countries and sectors. It has also obliged countries to think about cross-domain cooperation and to take into account different types of users. This experience with SDIs (within and outside the context of the INSPIRE Directive) is precious for countries which are more and more confronted with the intense process of Digital Government Transformation.

More concretely, when looking at the different areas of indicators, several interesting findings emerged:

— From an **institutional setting perspective**, this study showed that different countries have adopted different approaches for dealing with the governance, strategy and national legal framework of the SDIs in the context of DGT. Sometimes, such differences also exist within countries, with federated entities having developed their own specific trajectories. Overall, all countries have established some forms of *governance and coordination* between the SDI and DGT communities but the structure and intensity of these links vary. Some countries for instance have a central body responsible for both SDIs and DGT while others have many different structures involved but cooperation processes in place. Some countries have formalised cooperation while others keep it at the informal levels. The study also shows that these governance approaches are not "frozen" over time: as the case of Poland suggests, governance structures can change and evolve and the approach chosen at a certain point can be changed at a later stage. However, in general, an increased proximity of the SDI and Digital Government Transformation community could be found across all countries and there is an increased institutionalisation of contacts and coordination mechanisms. The analysis of national *strategies* also highlights this variety of approaches ranging from the development of a national strategy dedicated to SDIs to the inclusion of SDIs aspects in the eGovernment strategies or no strategy at all. The situation in terms of national *legal framework* underpinning SDIs is very similar: some countries have developed additional rules on top of the INSPIRE Directive and concerning for instance the compulsory use of registries for development of public services or the obligation to recur to a national open data license. Others have opted for soft approaches involving no binding rules but other forms of persuasion or have not yet intervened in this domain. In general however, there seems to be a push for the development of measures fostering the use of SDIs at the national level and harmonising SDIs and open data approaches.

— From a **technical infrastructure** perspective, when looking at the indicators concerning the *extended infrastructure*, this study found that most countries have developed and implemented services going well beyond the INSPIRE requirements and which serve as a basis for eGovernment services. These services can include, but are not restricted to, web processing services, gazetteers services, sensors' services and invoke services. It also emerged that countries' strategies have evolved over time and based on user centric considerations: in the past few years, some countries have moved from developing many services to developing fewer services but of a better quality. There is also a growing focus on platforms developed on top of the infrastructure and for different purposes and on provision of Application Programming Interfaces (APIs) which facilitate users' life. The analysis of *interoperability* aspects showed that countries have done considerable efforts in harmonizing and interoperable data, mainly within particular thematic communities (e.g. transport, soil and geology) and sometimes across borders. However, cross-sectoral and cross-domains efforts in the areas of semantic and technical interoperability can be stepped up. Furthermore, the reuse of generic solutions could also be. Finally, *innovation* has become a key concern for both the SDIs and DGT communities. This translates in efforts to collaborate with external stakeholders (most often universities and research centres) to stay ahead of technological progresses and in an increased attention to users' demand as driver for innovation in all countries.

— The analysis of the **impact** of SDIs on Digital Government Transformation focused on the aspects of usage and benefits of these infrastructures. The evidence collected on *usage* shows very clearly that take up of SDIs is increasing year after year within both the public and private sectors. In the public sector, the SDIs are used to increase efficiencies and deliver better and more user-friendly services to citizens. In the private sector, they allow the development of innovative services and products. In both cases, citizens benefit from this increased usage as "consumers" of better public services and of

innovative market offerings. These *benefits* resulting from this increased usage also become clearer. This study identified five macro-categories of benefits and notably: 1) efficiency gains, 2) better, smoother and optimized processes, 3) better cooperation and exchange between stakeholders, 4) better policy outcomes and 5) more innovative processes and services. For each of these benefits, qualitative and sometimes quantitative evidence was found in different countries. Although most of the literature and evidence available refer to the efficiency gains and the optimization of processes, the other benefits are not to be forgotten and in particular the role that SDIs play in driving innovation in policies and services.

Building on these findings and on the evidence collected on these different aspects, the study also tried to understand the relevance and level of implementation of the OECD's Recommendation on Digital Government Strategies[6] in the context of SDIs and DGT. The twelve principles were examined individually to capture: a) whether they are valuable when looking at the links between SDIs and DGT and b) whether there is evidence available suggesting that the principles are already implemented. The study found that most of the OECD principles are actually relevant for SDI and are already put in practices by the countries in scope of this assignment in their SDIs and DGT activities. This confirmed the strong relation between SDIs and DGT and the need to tackle these two aspects together.

Finally, this study established a number of lessons learnt which might be helpful for future work in this area:

- SDIs in Europe already play a key role in the Digital Transformation of Government and that this role is more and more explicitly acknowledged. SDI INSPIRE contributes to the Digital Transformation in many different ways and principally as *key data infrastructure* on which services, platforms and policies can be built. Furthermore, *the SDIs experience of data sharing has taught many important lessons to countries* in terms of collaboration across domains, listening to the data users and having a dialogue between different stakeholders. In some cases, *SDI INSPIRE is even the main driver of this governmental transformation*.
- There is a diversity across countries concerning how SDIs are governed and how national legal frameworks and digital strategies are conceived. For this reason, while looking at countries in a comparative way is relevant and best or common practices can be detected, it is not helpful to make rankings of approaches or identify methods that could or should be generalised. In fact, each country has its own specificities and trajectories in terms of the role SDIs can play in Digital Government Transformation, and these require customised and context related approaches.
- Considerably efforts have been deployed to develop further SDI infrastructures beyond the traditional SDIs in order to strengthen the effective role of SDIs in line with the digital transformation of government and society. These efforts include the development of new components, such as new web services, registries and others, the harmonization of geospatial and non-geospatial data across thematic domains and borders, new approaches of making geospatial data accessible and reusable, via APIs and platforms, and experimenting with and implementing new technological developments.
- The actual impact of SDIs on the digital transformation of government can be seen in the use of geospatial data and services provided by the SDIs paving the way for more data sharing as well as collaboration between sectors and stakeholders. These in turn results in significant benefits for public administrations themselves, business and citizens achieved through the use and integration of these data and services. Citizens are the ultimate beneficiaries of SDIs usage in their interaction with public authorities but also as consumer of better services and products.
- The important role of SDIs in Digital Government Transformation in Europe is also shown by concrete links between SDI INSPIRE implementation and the OECD Recommendation on Digital Government Strategies. For each of these twelve principles and across all countries in scope, evidence was found of how SDIs have been putting them into practice. In fact, many of the practices, policies and developments at country level that have been discussed in this report, are contributing to digital transformation of governments and can be seen as good practices in implementing the OECD Recommendation.
- The investigation of the role of SDIs in Digital Transformation of Government requires a particular analytical approach and framework, which is different from previous approaches for studying and assessing SDIs, placing it as a part of a broader national government digital strategy and context. In this study, an attempt was made to develop such a framework. Although this has been improved in an

[6] OECD, Recommendation of the Council on Digital Government Strategies, 2014, https://www.oecd.org/gov/digital-government/recommendation-on-digital-government-strategies.htm

iterative way all through this study, the current version should not be considered as a final and perfect product.

1 Introduction

1.1 Purpose and context of the study

1.1.1 Purpose of this document

This document is the Final Report on "*The Role of Spatial Data Infrastructure in the Digital Transformation of Public Administration*" carried out for the European Commission, Joint Research Center by Deloitte Consulting and Advisory CVBA and the Katholieke Universiteit te Leuven (KU Leuven).

The general objective of this study was "to provide an overall view of what has been implemented and the organisational processes followed to achieve the objectives, the policy drivers at National and/or European level, the partnerships created, trends and plans in its implementation regarding innovative solutions and new technologic developments, existing relations with other elements of National Infrastructures, new opportunities for business and better quality service delivery and also main faced barriers".[7]

Such general objective can be broken down in four specific objectives:

- To provide an overall view of what has been implemented and the organisational processes followed to implement INSPIRE and the Digital Transformation,
- To examine the impact of INSPIRE implementation in public private partnerships, in particular with SMEs, in creating new business models for public and private bodies,
- To collect and structure qualitative and quantitative information about benefits from the use of infrastructure,
- To map and analyse the results of INSPIRE implementation in terms of Digital Government according to OECD's recommendations.

This report contains the outcome of the analysis of all these aspects and particularly provides a *first general assessment of the overall role that Spatial Data Infrastructure (SDI) play in Digital Government Transformation*. The study focused more specifically on:

a) analysing the institutional setting underpinning SDI and Digital Government Transformation in the countries in scope;

b) examining the technical infrastructure put in place and its relation with eGovernment services and reuse of data and services;

c) assessing the usage and benefits of the infrastructure for citizens, businesses and the public sector and

d) considering the relevance of the OECD Recommendation on Digital Government Strategies[8] in the context of Spatial Data Infrastructure policies and strategies.

The countries in scope for this assignment consist in all EU28 Member States plus Norway. The following section provides a description of the precise scope of this analysis as well as the definitions of the key terms used (Spatial Data Infrastructure, eGovernment, Digital Government Transformation) and their relation.

1.1.2 Context: the link between Spatial Data Infrastructure and Digital Government Transformation

1.1.2.1 Scope and definition of key terms

Due to the complex and multi-disciplinary nature of this assignment, we need to provide ex ante the definitions of the key relevant concepts and to present at this stage how they relate to each other in the current policy and technological context.

[7] Annex I Technical Annex for Specific Contract N° ABC IV – 68 based on framework Contract No: DI-07624-00 — Lot 3; "The role of the Spatial Data Infrastructure in the Digital Transformation on Public Administration", European Commission Directorate-General Informatics, 2018, p. 8.

[8] OECD Recommendation on Digital Government Strategies, 2014, https://www.oecd.org/gov/digital-government/recommendation-on-digital-government-strategies.htm

Considering that multiple definitions for each key concept exist, we also need to analyse and discuss a few of them before explaining which the preferred definitions are and why. In particular, the next paragraphs discuss three pivotal concepts, which constitute the key focus of our analysis, and notably:

- Spatial Data Infrastructure
- eGovernment
- Digital Government Transformation

The term '**Spatial Data Infrastructure" (SDI)** is frequently used to "denote the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data."[9]

In 2004, he U.S Federal Geographic Data Committee further defined National Spatial Data Infrastructure as "the technologies, policies, and people necessary to promote sharing of geospatial data throughout all levels of government, the private and non-profit sectors and the academic community".[10] This definition, compared to the previous, also takes into account the different actors involved in a National SDI and is therefore broader. However, for the purpose of this assignment, we decided to use a third definition of SDI which keeps this broad scope in terms of constitutive elements (technological, human, organisational) and also includes aspects related to utilisation of spatial data (and not only facilitation of access and sharing). SDI in this study is thus defined as a dynamic set of components that:

"*Encompasses the policies, access networks and data handling facilities (based on the available technologies), standards, and human resources necessary for the effective collection, management, access, delivery and utilization of spatial data for a specific jurisdiction or community*."[11]

According to available literature and given this broad definition which also focuses on usage of spatial data by governments, SDIs are increasingly conceived as the 'geo-information technology realm' of *eGovernment* and are more and more linked to the phenomenon of *Government Digital Transformation*. [12]

For this reason, it is important to also define these two concepts (eGovernment and Digital Government Transformation) and identify whether these definitions look at the same, similar or completely different phenomena.

The OECD originally defined **eGovernment** (back in the early 2000s) as "the use by the governments of information and communication technologies (ICTs), and particularly the Internet, as a tool to achieve better government[13]." This was a relatively narrow and simple definition and there have been other attempts to provide further details on the core characteristics of eGovernment in the following years. In this respect, the Word Bank puts forward the following definition:

eGovernment is "the use by government agencies of information technologies (such as Wide Area Networks, the Internet, and mobile computing) that have the ability to transform relations with citizens, businesses, and other arms of government. These technologies can serve a variety of different ends: better delivery of government services to citizens, improved interactions with business and industry, citizen empowerment

[9] See: Douglas D. Nebert (Ed.) (2014), GSDI, The SDI cookbook http://gsdiassociation.org/images/publications/cookbooks/SDI_Cookbook_GSDI_2004_ver2.pdf, p.8

[10] See: Abdulharis, R., van Loenen, B., & Zevenbergen, B. (2005). Legal aspects of access to geo-information within Indonesian spatial data infrastructure. In ISPRS Workshop on Service and Application of Spatial Data Infrastructure, XXXVI (4/W6), p.148, https://www.researchgate.net/profile/J_Zevenbergen/publication/228846844_Legal_Aspects_of_Access_to_Geo-Information_within_Indonesian_Spatial_Data_Infrastructure/links/0912f50ed45ac8704d000000.pdf

[11] See: Abbas Rajabifard et al., Future Directions for SDI Development, International Journal of Applied Earth Observation and Geoinformation, 2002 in Abbas Rajabifard et al., SDI Conceptual Modelling for Disaster Management, ISPRS Workshop on Service and Application of Spatial Data Infrastructure, Hangzhou, XXXVI, 4/W6, 14-16 October 2005, pp. 125-130, http://www.isprs.org/proceedings/XXXVI/4-W6/papers/125-130AliMansourian-A037.pdf

[12] See: Yola Georgiadou, Orlando Rodriguez-Pabón & Kate Trinka Lance, Spatial Data Infrastructure (SDI) and E-governance: A Quest For Appropriate Evaluation Approaches, URISA Journal, Vol. 18, No. 2, January 2006, pp. 43-55, https://pdfs.semanticscholar.org/7697/43cd3a52b69183bb6659afaaeb27c781b48c.pdf

[13] OECD, Background paper: implementing e-government in OECD countries: experiences and challenges, 2005, http://www.oecd.org/mena/governance/36853121.pdf

through access to information, or more efficient government management. The resulting benefits can be less corruption, increased transparency, greater convenience, revenue growth, and/or cost reductions."[14]

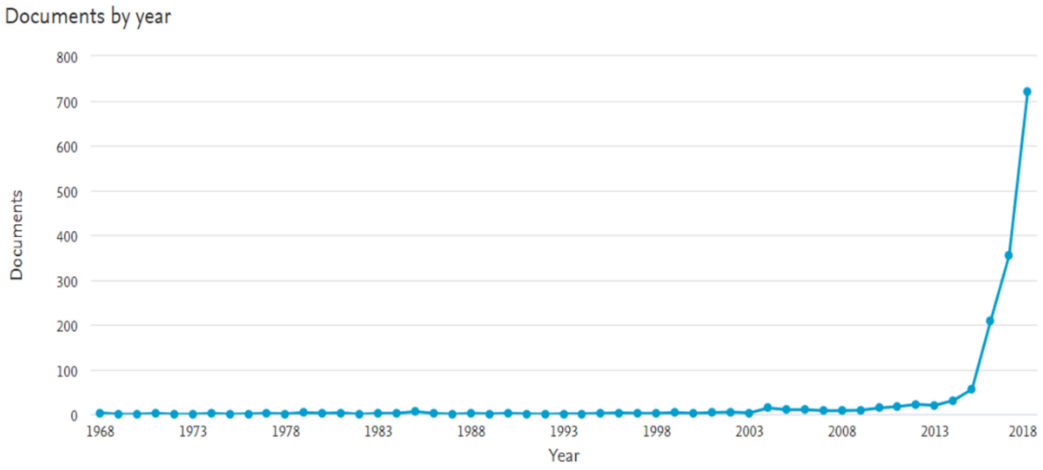
The World Bank definition thus goes a step forward in linking eGovernment to a broader context, possibly characterised by Digital Government Transformation but without establishing a formal connection yet. Thus, eGovernment can be seen as part of the process of Government Digital transformation and probably as one of the first steps undertaken by public authorities.

With this in mind and considering the need of conceiving eGovernment as the step of a process but also as an organisational mind-set of public administrations, for this study we define this concept as

"*the extensive use of information and communication technologies by government bodies, the rethinking of organisations and processes, and a shift in behaviour so that public services are delivered more efficiently as it happens in enterprises.*"[15]

While closely interlinked with eGovernment, the concept of **Government Digital Transformation** has known an increasing success in the past few years (as shown in the picture below) and seems to be characterised by a wider scope.

Figure 1 – Number of references to the concept of "Digital Government Transformation", years 1968-2018



Source: Scopus, 2019[16]

This becomes visible in the definition of Digital government used by the OECD:

"*Digital Government refers to the use of digital technologies, as an integrated part of governments' modernisation strategies, to create public value. It relies on a digital government ecosystem comprised of government actors, non-governmental organisations, businesses, citizens' associations and individuals which supports the production of and access to data, services and content through interactions with the government.*[17]"

This clearly shows that by making public services function more efficiently through the extensive use of ICTs, eGovernment can be seen as an important step in the digital transformation of governments but it is not the only one. The involvement of stakeholders and the interactions with new actors for the creation of public value are also crucial components of Digital Government Transformation.

[14] See: Palvia, S. C. J., & Sharma, S. S. (2007, December). E-government and e-governance: definitions/domain framework and status around the world. In International Conference on E-governance (pp. 1-12), p.1

[15] See: OECD Recommendation of the Council on Digital Government Strategies, OECD, 2014, p. 6, http://www.oecd.org/gov/digital-government/Recommendation-digital-government-strategies.pdf and 'eGovernment & Digital Public Services', https://ec.europa.eu/digital-single-market/en/policies/egovernment

[16] https://www.scopus.com/home.uri

[17] See: OECD Recommendation of the Council on Digital Government Strategies, OECD, 2014, p. 6, http://www.oecd.org/gov/digital-government/Recommendation-digital-government-strategies.pdf

For this study, this concept is hence defined as a "fusion of advanced technologies and the integration of physical and digital systems, the predominance of innovative business models and new processes, and the creation of smart products and services"[18] in the context of governments. This does not only show the wider scope, Government Digital Transformation has in comparison to eGovernment but also shows the innovativeness of it. From this perspective, Spatial Data infrastructures (SDIs) are one of the building blocks for eGovernment (as also recognised in the eGovernment Action Plan of the European Commission[19]) and, consequently, a stepping stone for the digital transformation of governments.

1.1.2.2 The evolving relation between Spatial Data Infrastructure and Digital Government Transformation

"Truly transforming government through the power of digital technologies will be a journey" as a recent Deloitte Digital global survey emphasises.[20] While government Digital Transformation is a well-known challenge but most importantly an opportunity for EU Member States and countries around the world, governments, within and outside Europe, are found to be at very different stages and to have very different strategies and approaches.

Within the European Union (EU), government Digital Transformation can strengthen public governance by increasing its "transparency, responsiveness, reliability, and integrity" as the Tallinn Declaration on eGovernment recently reinstated.[21] Digital Transformation is also a key element to the success of the (Digital) Single Market and therefore the European Commission has continuously invested in the advancement of the modernisation of national public administrations.[22] As the Organisation for Economic Co-operation and Development (OECD) highlights, an established and functioning digital government, integrates digital technologies in modernisation strategies and creates public value. [23] Modernisation of governments also relies on an "ecosystem comprising of a variety of actors which support the production of and access to data, services and content through interactions with the government.[24] Questions linked to data are hence at the heart of a successful Digital Government Transformation.

Governments face numerous challenges and obstacles in their Digital Transformation. In conjunction with the role of data in Digital Transformation those include, most notably, shortcomings in cross-border public services and information sharing, emerging regulatory gaps and lacking skills from citizens, businesses and administrations on new technologies.[25] While data-driven decision-making and data sharing across public administration is acknowledged to be pivotal by all countries, the above-mentioned challenges prevent them from fully exploiting the potential of the data economy and reduce the speed of the digitalisation of public services and administrations.

For many years already, the European Commission has been closely assisting and monitoring progresses and challenges in government Digital Transformation and has been pushing for more data sharing and cooperation between countries. More recently, since 2016, the programme Interoperability Solutions and

[18] See: 'Digital transformation', https://ec.europa.eu/growth/industry/policy/digital-transformation_en

[19] See in particular recommendations number 19 of the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, EU eGovernment Action Plan 2016-2020, Accelerating the digital transformation of government, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52016DC0179

[20] William D. Eggers & Joel Bellman, The journey to government's digital transformation; A Deloitte Digital global survey, Deloitte University Press, 2015, p. 1, https://www2.deloitte.com/content/dam/insights/us/articles/digital-transformation-in-government/DUP_1081_Journey-to-govt-digital-future_MASTER.pdf

[21] Tallinn Declaration on eGovernment at the ministerial meeting during Estonian Presidency of the Council of the EU on 6 October 2017, p. 2, https://ec.europa.eu/newsroom/document.cfm?doc_id=47559

[22] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions; EU eGovernment Action Plan 2016-2020: Accelerating the digital transformation of government, COM(2016) 179 final, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0179&from=EN

[23] See: OECD Recommendation of the Council on Digital Government Strategies, OECD, 2014, p. 6, http://www.oecd.org/gov/digital-government/Recommendation-digital-government-strategies.pdf

[24] See: OECD Recommendation of the Council on Digital Government Strategies, OECD, 2014, p. 7, http://www.oecd.org/gov/digital-government/Recommendation-digital-government-strategies.pdf

[25] See: Developments in ELISE, Francesco Pignatelli in Digital transformation and the future of SDIs Interactive Workshop, INSPIRE Conference 2018, Antwerp, 21 September 2018, https://inspire.ec.europa.eu/events/conferences/inspire_2018/submissions/339.html

Common Frameworks for European Public Administrations, Businesses and Citizens (ISA^2 Programme)[26] has been facilitating cross-border and cross-sector interaction between European public administrations, businesses and citizens, enabling the delivery of electronic public services and ensuring the availability of common solutions.[27] Within ISA^2 Programme, the European commission has developed a series of solutions monitoring the significant progresses in terms of eGovernment and digital services across Europe.[28] A notable example is the National Interoperability Framework observatory (NIFO).[29] NIFO continuously reviews the latest Interoperability initiatives at national levels and allows sharing of best practices and challenges. Moreover, the annually released eGovernment factsheets also describe the eGovernment progresses and initiatives and publish benchmark reports comparing progresses of Member States and other participating countries to each other.[30]

Lastly, the 'European Location Interoperability Solutions for e-Government' action (ELISE) [31] also supports many of the EU initiatives on digital government. ELISE aims at enabling digital government through location intelligence (defined as the capability to understand and visualise spatial data to identify and analyse relationships[32]) that eventually lead into interoperable cross-border and cross-sector public services.[33] In this context, both location intelligence and digital platforms, as an instrument, are crucial for the transformation towards digital government.

In parallel, and ever since its adoption in 2007, the INSPIRE Directive (INSPIRE) has been the driver behind the legal and technical interoperability of spatial data and network services ultimately aiming at creating a European SDI.[34] The existence of SDIs has been initially considered of importance in support of EU environmental policies and activities affecting the environment. However, location is becoming pervasive across all policy domains and the relevance of SDI is not restricted to environmental policy alone. On the contrary, as the existence of the SDI enables use of spatial information across the public sector, facilitates public access to spatial data across Europe and assists cross-border policy-making, elements linking INSPIRE to better integrated public eGovernment services that go beyond the realm of environment have been increasingly noticeable.[35] As INSPIRE full implementation is foreseen by 2020, EU Member States continuously and more closely monitor its implementation and effects in this direction.

Processes on INSPIRE and on government Digital Transformation are closely interrelated. Availability of digital platforms[36] in general, and SDIs in specific, is a pre-condition for development of sound eGovernment services and for the digitalisation of policies.[37] In principle, digital platforms provide services such as identity management, reusable application services, analytics and digital public services, to improve and coordinate

[26] Decision (EU) 2015/2240 of the European Parliament and of the Council of 25 November 2015 establishing a programme on interoperability solutions and common frameworks for European public administrations, businesses and citizens (ISA^2 programme) as a means for modernising the public sector, OJ L 318, 4 December 2015, p. 1–16, https://ec.europa.eu/isa2/sites/isa/files/celex_en.pdf

[27] See: 'About ISA^2', https://ec.europa.eu/isa2/isa2_en

[28] See : 'Solutions', https://ec.europa.eu/isa2/solutions_en

[29] See: 'NIFO', https://ec.europa.eu/isa2/solutions/nifo_en

[30] See: 'eGovernment Factsheets and Infographics', https://joinup.ec.europa.eu/collection/national-interoperability-framework-observatory-nifo/egovernment-factsheets-and-infographics

[31] See: 'About ELISE - European Location Interoperability Solutions for e-Government', https://joinup.ec.europa.eu/collection/elise-european-location-interoperability-solutions-e-government/about

[32] https://carto.com/blog/what-is-location-intelligence-and-its-benefits/

[33] See: Developments in ELISE, Francesco Pignatelli in Digital transformation and the future of SDIs Interactive Workshop, INSPIRE Conference 2018, Antwerp, 21 September 2018, https://inspire.ec.europa.eu/events/conferences/inspire_2018/submissions/339.html

[34] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE), OJ L 108, 25 April 2007, pp. 1–14, https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32007L0002

[35] Vlado Cetl, et al., Summary Report on Status of implementation of the INSPIRE Directive in EU, 2017, p.9, http://publications.jrc.ec.europa.eu/repository/bitstream/JRC109035/jrc109035_jrc109035_jrc_inspire_eu_summaryreport_online.pdf

[36] See: A country perspective: opportunities and challenges, Thorben Hansen in Digital transformation and the future of SDIs Interactive Workshop, INSPIRE Conference 2018, Antwerp, 21 September 2018, https://inspire.ec.europa.eu/events/conferences/inspire_2018/submissions/339.html

[37] See: OECD Recommendation of the Council on Digital Government Strategies, OECD, 2014, p. 6, http://www.oecd.org/gov/digital-government/Recommendation-digital-government-strategies.pdf

government services across multiple domains.[38] The national/regional SDIs that countries developed (also) as a consequence of INSPIRE can be considered as digital platforms. As recital 6 of the INSPIRE Directive puts forth, an efficient use of government resources requires that:

"Spatial data is stored, made available and maintained at the most appropriate level and that it is possible to combine spatial data from different sources and share them between several users and applications."[39]

As a result, the INSPIRE-driven SDI development has contributed to the establishment of digital platforms for governments and to a better and wider understanding of European data policies. The INSPIRE implementation, in fact, promoted access to public and open data, simplified licensing, supported the drive towards data harmonisation and, in certain cases, further amplified data initiatives such as the 'once-only principle'. Such link between the distinct initiatives in the SDI and eGovernment domain should not come as a surprise: geospatial data and SDIs seem to underpin transformation towards digital government as governments mobilise more and more a digital government 'platform approach' to enable capabilities, simplify processes, improve citizen interactions and reduce costs.[40]

However, the link between the SDI/INPIRE implementation and the wider government Digital Transformation agenda has not always been clear and explicit at the national level. In several European countries, we assisted to the emergence of parallel coordination and governance structures and distinct communities of actors, which have been evolving separately. Progresses on SDI development and on Digital Government Transformation have also been monitored and evaluated disjointedly by the European Commission.[41] Nonetheless, after progressively realising the importance of joining efforts and creating synergies for accelerating Digital Transformation, there are indications that the communities of actors increasingly coming together[42]. Joint governance structures, a strategic framework on the use of data, common institutional and information technology (IT) infrastructure, shared data arrangements and other cross-border initiatives are crucial for achieving the full digitalisation of governments in Europe. It is therefore high time we better understand the relation between progresses in Digital Government Transformation and the implementation of SDI and highlight the role of SDI as building block for digital governments in order to most effectively tap into the outmost potential and make the most out of both worlds.

1.2 Methodology for data collection and analysis

In this section, we describe our methodological approach for carrying out the assignment and notably how we developed the analytical framework and the indicators that were used for the analysis and how we collected the data for the different countries in scope.

1.2.1 Development of the analytical framework

The main aim of this study was to explore and better understand the current and potential role of SDI in the Digital Transformation of government and, for this purpose, a specific analytical framework had to be set up. For the development of the analytical framework, we started from the seven topics that were also central in

[38] See: Digital Government Transformation, Digital Information and the Future of SDIs, Gartner, in Digital transformation and the future of SDIs Interactive Workshop, INSPIRE Conference 2018, Antwerp, 21 September 2018, https://inspire.ec.europa.eu/events/conferences/inspire_2018/submissions/339.html

[39] See: Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing INSPIRE, p. 2, https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32007L0002

[40] See: Digital Government Transformation, Digital Information and the Future of SDIs, Gartner, in Digital transformation and the future of SDIs Interactive Workshop, INSPIRE Conference 2018, Antwerp, 21 September 2018, https://inspire.ec.europa.eu/events/conferences/inspire_2018/submissions/339.html

[41] INSPIRE implementation is monitored and evaluated according to the provisions of Article 21 of the INSPIRE Directive: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32007L0002 and the more detailed implementing rules adopted with the Commission Decision of 5 June 2009 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards monitoring and reporting: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:148:0018:0026:EN:PDF. In contrast, progress on eGovernment in the EU is based on different dashboards capturing different aspects (e.g. overall eGovernment, open data, interoperability). Some good examples are the eGovernment benchmark: https://ec.europa.eu/digital-single-market/en/news/egovernment-benchmark-2018-digital-efforts-european-countries-are-visibly-paying, the open data maturity index: https://www.europeandataportal.eu/en/dashboard#2018, and the State of Play of Interoperability in of the Europe National Interoperability Framework observatory (NIFO): https://ec.europa.eu/isa2/solutions/nifo_en

[42] https://joinup.ec.europa.eu/collection/elise-european-location-interoperability-solutions-e-government/elise-contribution-digital-government

the INSPIRE Country Reports[43] and considered how these topics are treated in the eGovernment factsheets[44] (which covered most of them, although in a different way). These seven central topics include: 1) Coordination and governance; 2) Strategic view and strategic planning; 3) Functioning and innovation of the infrastructure; 4) Data sharing arrangements; 5) Cross-border initiatives; 6) Usage of the infrastructure; and 7) Benefits.

For each of the seven topics, we aimed to investigate the extent to which and the way in which SDIs are contributing to Digital Government Transformation, are taking advantage of policies, initiatives and components related to Digital Government Transformation and/or are being aligned or even integrated with these other policies, initiatives and components. So the focus of our study was not on INSPIRE (or SDI) implementation in itself, but on the role of SDIs in Digital Government Transformation. The scope of each of the seven topics from the INSPIRE Country Reports, which constituted the starting point for the development of the framework, can be defined as followed:

1. **Coordination and governance** deals with the structures, functions and processes for decision making and coordination on the role of SDI/INSPIRE in Digital Government Transformation, with clear leadership and involvement of all relevant stakeholder groups
2. **Strategic view and strategic planning** is about the strategic planning and management process on SDI/INSPIRE in the broader context of Digital Government, via strategic plans on geographic information, SDI, e-Government and Digital Transformation.
3. **Functioning and innovation of the infrastructure** focuses on the technical components of the infrastructure, beyond the components as required by INSPIRE
4. **Data sharing arrangements** deals with various types of arrangements on sharing of spatial data, and related aspects such as data security and data (re-)use.
5. **Cross-border initiatives** is about cross-national cooperation on setting up SDIs and SDI components, but also on using the SDI in cross-border service delivery.
6. **Usage of the infrastructure** focuses on the use and users of the SDI, and the use of SDI data and services for decision-making and the delivery of new or improved products and services.
7. **Benefits** is about the advances brought by SDI and INSPIRE, to government but also to other stakeholders such as citizens and businesses.

For each of these seven topics, a set of multiple indicators was originally developed to guide and support the data collection and analysis processes, in order to ensure all relevant aspects would be explored and investigated. Starting from a set of 29 different indicators, throughout the data collection and analysis processes the number of indicators was reduced to 17 indicators, mainly by deleting less relevant indicators and combining overlapping indicators. These 17 indicators were also restructured around three main categories:

- **Institutional setting**: which gathers indicators related to the governance, strategy and legal framework underpinning the relationship between SDI and Digital Government Transformation;
- **Technical infrastructure**: which includes all technical aspects related to the SDI for instance in terms of breadth of the SDI infrastructure, magnitude of the interoperability efforts done as well as innovativeness of the approach;
- **Impact**: which gathers the indicators concerning both the width of the usage of the SDI as well as the benefits derived from it, also from a cross-border perspective.

Within each of these three categories, sub-groups of related indicators can also be identified. This structure mirrors the approach taken by the Open Data Barometer, which is based on a tripartite structure with sub-indexes[45]. The figure shows the overall structure of our framework.

[43] https://inspire.ec.europa.eu/INSPIRE-in-your-Country

[44] https://joinup.ec.europa.eu/collection/nifo-national-interoperability-framework-observatory/digital-government-factsheets-2018

[45] Open Data Barometer - Leaders Edition, ODB Methodology - v1.0 | 15 September 2017, http://opendatabarometer.org/doc/leadersEdition/ODB-leadersEdition-Methodology.pdf

Table 1 - Overall structure of the framework

Institutional setting		
Governance *(2 indicators)*	***Strategy*** *(2 indicators)*	***Legal framework*** *(2 indicators)*
Technical infrastructure		
Extended infrastructure *(2 indicators)*	***Interoperability*** *(2 indicators)*	***Innovation*** *(2 indicators)*
Impact		
Usage *(3 indicators)*	***Benefits*** *(2 indicators)*	

Source: Deloitte and KU Leuven, 2019

Each of the categories of our framework has a number of sub-categories, which goes from two (for the impact indicators) to three (for the institutional setting and technical infrastructure indicators). The three tables below present the categories and related sub-categories of indicators suggested for the updated framework.

Table 2 - Updated framework – Institutional setting indicators

Group of indicators	**Sub-category**	**Number**	**Indicator**
Institutional setting	Governance	1	A governance structure/mechanism is in place in which different communities, domains, administrative levels and sectors, are involved in decision making on the role of SDI in Digital Transformation.
	Governance	2	There is a central organisation responsible for leading and coordinating the implementation of policies on the role of SDI in Digital Transformation.
	Strategy	3	A strategy exists on the role of spatial data and the SDI in Digital Transformation.
	Strategy	4	A strategic approach exists on skills and training related to innovative geospatial solutions.
	Legal framework	5	The use of SDI for eGovernment services is mandated/defined by law.
	Legal framework	6	A well-defined government-wide policy on open data is in place and also applies to geospatial data.

Table 3 - Technical infrastructure indicators

Group of indicators	**Sub-category**	**Number**	**Indicator**
Technical infrastructure	Extended infrastructure	1	The SDI goes beyond what a traditional SDI or INSPIRE requires by developing additional components in the infrastructure
	Extended infrastructure	2	API's have been developed on top of INSPIRE/SDI
	Interoperability	3	Joint efforts have been made to improve the interoperability of reference/core thematic data and/or integrate different data collection flows.
	Interoperability	4	There are different platforms, portals and catalogues operational that link to each other and exchange information and other components for stimulating the reuse and uptake of geospatial data.
	Innovation	5	Generic ICT solutions, such as those designed by the ISA/ISA^2 programme, are (re-)used in the SDI.

	Innovation	6	A procedure is in place to discover, explore and incorporate new technological features or emerging technologies.

Table 4 - Impact indicators

Group of indicators	Sub-category	Number	Indicator
Impacts	Usage	1	Public administrations use consistently SDI to in decision- making and service delivery processes.
	Usage	2	There is a considerable take up of the SDI by private sector and other organisations (e.g. NGOs) for delivery of – new and innovative – applications, products and services.
	Usage	3	The country uses the SDI in the deployment of cross-border eGovernment services.
	Benefits	4	The use of SDI has delivered measurable benefits to public administration.
	Benefits	5	The use of SDI has delivered measurable benefits to businesses, citizens and society more broadly.

Further details on the key aspects of each of these indicators and their scoring criteria are provided in Annex 4 – Analytical Framework. In the next section, we describe how we leveraged this analytical framework for collecting evidence on the role of SDIs in Digital Government Transformation for the 29 countries in scope of the assignment.

1.2.2 Data collection activities

Our data collection and analysis strategy started from the analytical framework described above and involved two main stages:

- Overall explorative analysis of the 29 countries in scope
- In-depth analysis of 4 particular countries

The first stage of the data collection and analysis process aimed to gain insight in the overall status in Europe with regard to the role of SDIs in the Digital Transformation of public administration and discover relevant practices and developments in the different countries. The analytical framework presented in the previous section guided our key questions for the data collection. Data were mainly collected through desk research and interviews. For the desk research, we focused on the collection of

- Documents and information related to *SDI implementation* and coming from the SDI and INSPIRE literature.
- Documents and information related to eGovernment/Digital Government developments and digital transformation of governments.

Other primary sources (e.g. websites, portals and platforms) that relate to the national legislation and strategies, reviews, evaluations and studies have also been collected and consulted.

Table 5 – Desk Research sources

INSPIRE	**eGovernment**

INSPIRE conference documentation (2018 and previous editions)	eGovernment factsheets[46]
2013 and 2016 INSPIRE Country Reports	National eGovernment strategies (e.g. 'A Stronger and More Secure Digital Denmark; The Digital strategy 2016-2020' [47], 'Operational Programme; Digital Poland for 2014-2020'[48])
INSPIRE Country fiches	
JRC webinars	
Other sources	
Primary (e.g. 'La loi pour une République numérique'[49], and platforms)	Greek National Cyber Security Strategy[50], national websites, portals
Secondary (e.g. 'PwC Follow-up study on the impact of the open geographical data'[51], annual EuroGeographics Reviews[52])	

Source: Deloitte and KU Leuven, 2019

To gather additional evidence and supplement the data collected through desk research and participation in the 2018 INSPIRE Conference, we conducted additional interviews with experts from several countries (Austria, France, Poland and Slovakia). It should be noticed that participation of the study team in the INSPIRE 2018 Conference in 2018 provided valuable input to both data collection activities. During the conference, several INSPIRE National Contact Points (NCP's) were contacted and informed about the project, some preliminary interviews with relevant experts were carried out and relevant initiatives and projects with regard to SDI/INSPIRE and Digital Transformation were detected.

In the second stage of the study, we focused on four countries for a more in-depth analysis of the role of SDIs in the Digital Transformation of Government. The aim of this stage was to perform a complete analysis of the situation in a particular country. This means that for each country shortlisted for in-depth analysis, information was collected on all 17 indicators of the analytical framework. The selection of the countries was based on the results and findings of the overall explorative analysis carried out during the first stage of the study. Countries were selected on the basis of relevant and/or innovative practices and developments related to the role of SDI/INSPIRE in the Digital Transformation of Government. The study team also aimed at seeking a fair geographic distribution by selecting countries from different European regions (north, south, east and west).

The in-depth analysis allowed to investigate further these practices and developments but also to collect additional information on the other indicators. The selected countries include Spain, Poland, the Netherlands and Belgium. Data were collected through interviews with experts from the SDI and Digital Government communities of the different Member States. The number of interviews and profiles of the interviewees varied across countries but the team strived to ensure that both the SDI and Digital Government communities were represented in the interview pools. In addition to these, a second round of desk research and literature review was executed to complement the list of documents and information already available for the countries in scope.

1.3 Structure of the document

The document is structured as follows:

[46] See: 'eGovernment Factsheets and Infographics', https://joinup.ec.europa.eu/collection/national-interoperability-framework-observatory-nifo/egovernment-factsheets-and-infographics

[47] See: A Stronger and More Secure Digital Denmark; The Digital strategy 2016-2020, May 2016, https://en.digst.dk/media/14143/ds_singlepage_uk_web.pdf

[48] See: Operational Programme; Digital Poland for 2014-2020, 2014, https://www.polskacyfrowa.gov.pl/media/10410/POPC_eng_1632015.pdf

[49] French Law n° 2016-1321 of 7 October 2016 for a Digital Republic, https://www.legifrance.gouv.fr/affichLoiPubliee.do?idDocument=JORFDOLE000031589829&type=general&legislature=14

[50] Greek National Cyber Security Strategy, Version 2.0, 21 September 2017 https://www.enisa.europa.eu/topics/national-cyber-security-strategies/ncss-map/GRNCSS_EN.pdf

[51] See: PwC Follow-up study on the impact of the open geographical data, https://sdfe.dk/media/2917052/20170317-the-impact-of-the-open-geographical-data-management-summary-version-13-pwc-qrvkvdr.pdf

[52] See: 'EuroGeographics Annual Reviews', https://eurogeographics.org/about-us/annual-reviews/

— **Chapter 1** offers an overview of the objectives and methodology underpinning this assignment and provides some key definitions for understanding its context.

— **Chapter 2** provides the outcome of the analysis concerning the institutional setting indicators for the 29 countries in scope and with a focus on the four countries that were examined more in-depth.

— **Chapter 3** presents the results of the assessment of technical infrastructure indicators, for all countries in scope and with a special focus on the four shortlisted countries.

— **Chapter 4** illustrates the findings related to impact indicators (usage and benefits) for all the countries analysed and the four selected for in-depth analysis in particular.

— **Chapter 5** considers the relevance of the OECD Recommendation on Digital Government Strategies from the perspective of SDI and Digital Government Transformation.

— **Chapter 6** provides some conclusions on the analytical framework used for this assignment, on the main findings and on the possible next steps.

In addition, the document includes the following annexes:

— **Annex 1**: includes visual summaries of the main findings of the present report per macro-category of indicators (institutional setting, technical infrastructure, impact);

— **Annex 2**: provides a table detailing the main findings for each indicator and each of the four countries analysed in-depth.

— **Annex 3**: provides some selected insights for the four countries examined in-depth (Belgium, the Netherlands, Poland and Spain).

— **Annex 4:** includes further details on the analytical framework and indicators developed and provides a scoring guidance.

2 Analysis of the institutional setting

Institutional setting indicators aim at capturing those organisational, governance and strategic aspects, which help explaining how the role of SDI in Digital Government Transformation differed across countries and how different approaches in managing SDI implementation and digital transformation led to different results and impacts. What these indicators do not tell however is who is doing better or worse amongst the countries in scope but rather which approaches and trajectories lead to which results in which context.

In fact, when starting the data collection, we expected countries to have, *de facto*, different approaches and objectives in terms of SDI and Digital Government Transformation, based on their needs and characteristics, which cannot be overlooked. For instance, federal and centralised countries will not have the same governance approaches for managing Digital Government Transformation and SDI implementation and countries might not have the same strategies and agenda in terms of alignment between SDI and Open Data policies. Far from identifying what is right and what is wrong, the suggested institutional setting indicators allow to analyse and compare these differences across countries and, when possible, to identify relations between certain characteristics and certain impacts or between certain "clusters" of countries and certain preferred approaches.

Institutional setting indicators hence cover three important aspects and notably:

- **Governance:** that is to say who drives and decides on SDI coordination, organisation, implementation and digital transformation, whom is consulted and to what extent different communities (SDI and Digital Government Transformation stakeholders, public and private bodies, different levels of government) come together around these topics.
- **Strategy:** intended as the plan or vision behind SDI and INSPIRE implementation, which can be more or less wide in scope, more or less ambitious, more or less coordinated with other strategies at the country level and more or less participative. These indicators also cover the strategies put in place for the upskilling of the public sector, citizens and businesses and the development of trainings.
- **Legal framework:** these indicators cover the legal and policy requirements behind SDI implementation and use in Digital Government Transformation, both in terms of obligation of using SDI for developing eGovernment services and in terms of open data rules and provisions.

In the sections below, we describe in details each of these aspects and the related indicators and we provide an analysis of the situation in the 29 countries in scope but with a particular focus on the four countries analysed in-depth: Belgium, Poland, Spain and the Netherlands.

2.1 Governance

Main messages:

- Historically, the INSPIRE and eGovernment communities have been developing and working in parallel but from a short distance, also thanks to the fact that the INSPIRE Directive requires some form of coordination to be set up. This distance seems now to be further reducing due to the need to cooperate more and better towards the same goal: digital government transformation.
- Governance indicators try to assess not only to what extent these two communities are cooperating today but also who else participates in the discussions (e.g. private sector, academia), who decides on what and whether there is an ultimate decision maker (central body) which drives the progresses on SDI and Digital Government Transformation.
- The analysis shows that a central body driving in a combined way the development of SDI and Digital Transformation exists in a limited number of countries (based on the available information, six countries – including the Netherlands - plus Belgium in which such body exists at the regional level in Flanders). For all others this is not the case or it is very difficult to judge based only on desk research and literature review. The absence of an ultimate decision maker responsible for both SDI and Digital Government Transformation does not necessarily entail that there is a lack of leadership in this domain but rather that other mechanisms for decision-making are preferred.
- When looking at whom participates in decision making and to what extent, it is clear that differences between countries exist in terms of types and set-up of governance bodies, closeness of communities and levels of stakeholders participation. While in some countries the SDI and eGovernment

communities are strongly integrated in the same structures and decision making bodies (joint governance bodies) or rely on de facto coordination due to the existence of a central body responsible for both (see above),, in others they do not yet talk to each other's through official channels and relations are rather based on ad hoc and personal contacts. In between, stands the majority of countries where structured forms of collaboration exists, including joint meetings and events, but not always fully institutionalised. The main mechanisms identified for coordinating between SDI and Digital Government Transformation communities hence include:

- Joint Governance bodies
- De facto coordination and coordination through central digitisation agencies or other bodies
- Representation of Digital Government Transformation community in SDI bodies or vice-versa
- Informal or ad hoc coordination

— Similarly, the inclusion of different stakeholders (lower governmental levels, academia, business and NGOs) in the discussions and decisions about SDIs and Digital Government Transformation is very developed in some countries (Spain, Denmark, Finland and Croatia) and very limited in others, while the majority of countries is situated somewhere in between of this continuum. Additionally, it is worth noting that within the same country there could be a very participative approach within the SDI or the Digital Government Transformation community but not in both at the same time. In such cases, the integration of the SDI and Digital Government communities can entail that best practices in terms of inclusion of stakeholders are transferred from one community to another.

— To summarise, there are different approaches for governing SDI and Digital Government Transformation and bringing them together. Furthermore, within the same country, the approach is not "frozen" but can change over time (see the example of Poland). Regional differences within countries also exist and especially in the most decentralised and regionalised countries (i.e. Spain, Italy, Germany etc.).

— The analysis did not allow to identify a best practice in this domain, as governance approaches are path dependent from the characteristics of the countries and tailored to their needs (as shown by the examples from federal countries). In general, an increased proximity of the SDI and Digital Government Transformation community could be found across all countries and there is an increased institutionalisation of contacts and coordination mechanisms.

According to many experts and most of the interviewees contacted for this assignment, the SDI and eGovernment communities have historically been evolving separately, sometimes also due to the different ministries that were in charge of leading these initiatives (often the ministry of environment or ministry of agriculture for the SDI and ministry of economy or public administration for eGovernment processes).

However, the provisions of the INSPIRE Directive imposed some sort of coordination between these different activities since the very beginning[53]. For this and other reasons, in several countries the implementation of INSPIRE started in close link with the eGovernment initiatives, reinforcing each other the political momentum. Furthermore, there is a growing feeling amongst practitioners that these two communities are now slowly coming together under the umbrella of the overall government digital transformation[54]. For this reason, and in order to look at the extent to which digital transformation is the result of a participative process and/or driven by a central entity, governance indicators focus on:

— The existence of a central organisation responsible for leading and coordinating the implementation of policies on the role of SDI in Digital Transformation.

— The existence of a governance structure/mechanism in which different communities, domains, administrative levels and sectors, are involved in decision making on the role of SDI in Digital Transformation.

53 Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE), OJ L 108, 25 April 2007, pp. 1–14, https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32007L0002

54 See also the ELISE Rapid Study Webinar on the role of Geospatial for Digital Government Transformation, https://joinup.ec.europa.eu/event/elise-action-webinar-role-geospatial-digital-government-transformation

By looking at these two aspects, the governance indicators can provide insights on the role and impact of the different communities on digital government transformation as well as on the effects of more or less centralised and participative governance approaches. **It must be highlighted here that governance approaches are highly "country and path dependent[55]" both in terms of categories of stakeholders which are involved in the decision making structure and in terms of existence of one or more central bodies**. For instance, the governance approaches put in place by federal countries are based of course on stronger regional involvement and foresee a stronger decision making role for federal entities than those adopted by more centralised countries. Similarly, the extent to which academia and private sector participate in the Digital Government Transformation discussions depends largely on the national history of the relations between the government and these communities[56]. Therefore, **the analysis of governance and coordination requires also looking closely at the structures of the countries and their institutional settings**, which could not be entirely done in the scope of this report. In this respect, this preliminary analysis of the governance of SDI in the context of Digital Government Transformation could be enriched and strengthened by future research on how the governance approach choses is tight to country's history and characteristics and how these in turn impact the usage and benefits linked to SDI (see chapter 4 in this respect).

In the next sections, we describe how governance of SDI and Digital Government Transformation varies across countries and we try to identify clusters of countries or trends, by first looking at the 29 countries in scope of the assignment and then analysing more in depth to the four shortlisted countries.

2.1.1 Analysis of the 29 countries in scope

2.1.1.1 Existence of a central organisation

The first governance indicator presented above looks at whether a key central structure for leading the activities of SDI and digital transformation exists in different countries. **Having a central organisation does not necessarily entail having better coordination and governance of activities as this represent only one of the possible approaches for ensuring that SDI plays a role in Digital Government Transformation**. However, this indicators helps answering the question of "who decides and who is responsible" for leading on these topics and therefore highlights the chain of command which underpin the strategy and approach chosen by the different countries.

When looking at the available evidence, it seems that, for the vast majority of the countries, there is no central organisation playing the role of ultimate front driver for SDI and Digital Government Transformation. There are six countries for which this is the case and which constitute exceptions. These countries are:

- Bulgaria, in which the state eGovernment agency SEGA is also in charge of SDI since 2016;
- Denmark, in which the agency for digitalisation is in charge of leading and coordinating both SDI and Digital Government Transformation.
- Finland, in which the Ministry of Finance has the lead based on the renewed Spatial Data Strategy 2016[57];
- Malta, where the MITA drives SDI and digital transformation altogether;
- Norway, where this role is played by the Ministry for Local Government and Modernisation and more precisely by its agency for Public Management and eGovernment (DIFI);
- The Netherlands, in which Geonovum takes the driving seat.

For all other countries, the answer is either negative or not so straightforward. In certain countries it is clear that no central body of this kind exists and notably in Greece, Czech Republic, Cyprus, Hungary, Ireland and Romania. For other countries there are either different bodies which play this role (e.g. in Belgium there are

55 For a definition of the path dependency theory see for instance "The Europeanisation of National Administrations: Patterns of Institutional change and resistance", Christoph Knill and Andreas Fellésdal, Cambridge University Press, 2001

56 See for instance: Jeroen van der Heijden, "Friends, enemies or strangers? On relationships between public and private sector service providers in hybrid forms of governance", Law & Policy, Volume 33, Issue 3, 2011, https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-9930.2011.00344.x

57 Finnish Spatial Data Strategy 2016, http://www.paikkatietoikkuna.fi/documents/108478/c42195c3-881a-43af-8e7b-09bcba4df7d2

different structures in Flanders, Wallonia and Brussels region) or there is a body which drives the strategy, development and implementation of SDI but has very limited competences in terms of digital government.

This happens for instance in Estonia, where Maa-amet is responsible for the developments of a strategy for spatial data services but it is not responsible for any coordination of the decisions on the overall role of SDI in digital government or in Luxembourg, where the CTIE's mandate seems mainly focused on spatial data. These are just two examples but the majority of the countries fall in this last category,

However, as mentioned above, the absence of such a central organisation should not be considered as a shortcoming or a proof that the SDI and Digital Government Transformation communities are not coming together. In fact, having a centralised body is only one of the possible approaches for governing SDI and Digital Government Transformation altogether and other possible approaches and mechanisms are further discussed in the next section.

2.1.1.2 Existence of "common" governance structure and mechanisms in which different communities, domains, administrative levels and sectors are involved in decision making on the role of SDI in Digital Government Transformation

Similarly to what found for the first governance indicator, the evidence for the second suggests that there is a limited number of countries where governance structures in which different communities (INSPIRE and eGovernment, public and private sectors, local, regional and national levels) *come together and make decisions* on SDI and Digital Government Transformation. The emphasis of this indicator is on the "joint decision making process" on SDI, as most countries have well-established mechanisms of cooperation between different bodies (e.g. SDI and eGovernment decision-making bodies) and most of them involves many different players and domains in these structures thus showing quite participative approaches to decision making. Furthermore, it must be mentioned here that the level of involvement in decision making of local regional authorities and private sector is of course not the same: the former are much more often involved in decisions than the latter. Therefore, different communities do come together around these topics but the extent to which they make decisions together varies and, in general, is more limited.

Notably, a joint governance structure and/or very strong coordination mechanisms seem to exist in Croatia, Denmark, Germany, Malta, and Norway. However, each of these countries has a specific approach relying for instance on:

- **Joint governance bodies**
  - Croatia established a specific working group linking the aspects of SDI and eGovernment58. The objective of this working group is to harmonise the activities of e-Croatia and NSDI by supporting the determinations and fulfilment of mutual needs and its work consists in analysing the connection between the e-government strategies and NSDI, defining commonalities as well as creating suggestions of institutional connection/communication between e-government and NSDI-Stakeholders. This working group hence constitutes a very good example of joint governance structure as conceived in the framework of this first governance indicator.
  - In Denmark there are two separate bodies in charge of INSPIRE and eGovernment/Digital Transformation and notably the Agency for Digitalisation on the one hand and the Agency for Data Supply and Efficiency on the other. However, in 2010 the country established a Coordination Committee in which sit representatives of both agencies. The Coordination Committee decides upon matters related to SDI and eGovernment and it constitutes a second example of common governance structure.
- **De facto coordination** based on the localisation of INSPIRE/SDI and eGovernment responsible bodies in the same organisation/under the same umbrella.
  - In Malta, both communities come together under the umbrella of Malta Information Technology Agency (MITA), which is the competent authority for both SDI implementation and digital transformation. Although the departments in charge of these initiatives are different, they

[58] See: INSPIRE in Croatia: Shifting from NSDI 1.0 to NSDI 2.0, National Implementation Webinars, https://ies-svn.jrc.ec.europa.eu/attachments/download/1695/Croatia_INSPIRE_implementation_20160525.pdf; & INSPIRE National Country Report 2016, Croatia, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/HR

share the same offices and chairman and a strong connection between the two is de facto ensured.

- In Norway, the NSDI organisation Norway Digital was established back in 2005 and has been coordinated by the Ministry for Local Government and Modernisation ever since. The latter has competences both in the area of INSPIRE and with respect to eGovernment and digital transformation and can hence make the link between the different communities.
- Similarly, in Germany, it is the LG GDI-DE Steering Committee that controls and coordinates the development of the GDI-DE including the implementation of the INSPIRE Directive. The Steering Committee is made up of representatives of the federal government, the federal states and local umbrella organisations. It advises and decides on the national SDI strategy and work program. Both politically and technically, the implementation of the German SDI takes place within the context of e-government. The LG GDI-DE Steering Committee has to report to the IT Planning Council of the federal and state governments, the steering committee for federal IT cooperation.

Although these countries seem to be those in which the governance proximity between the two communities is the highest and the closest to having "joint decision making", most of the countries have nowadays established mechanisms for coordinating activities related to SDI and Digital Government Transformation. These links can however take different forms:

— **Representation of eGovernment community in INSPIRE bodies:** for instance, in **Finland**, the Ministry of Finance, which is in charge of eGovernment, participates in the National Council for Geographic Information that deals with everything related to INSPIRE[59]. It is difficult to say to what extent this participation in INSPIRE bodies translates in direct influence and coordination between the communities and, as the example described in the next chapter shows, things can also vary significantly over time, depending on the leadership and the changes in the political environment (see Section 2.1.2).

— **Joint meetings:** as it is the case in **Czech Republic** between the Ministry of Environment in charge of INSPIRE and the Ministry of Interior in charge of eGovernment. Joint meetings between communities also happens, on ad hoc basis, in many other countries (i.e. Spain, see also Section 2.1.2).

— **Informal or ad hoc coordination:** in **France**, where no formal mechanisms is available, informal contacts between officials happen on a regular basis[60]. In **Slovakia**, according to the interviewee, coordination happens on a need basis and it goes through the Coordination Council of the Ministry of Environment or the Working Group on Better Data[61].

— **Coordination through central digitisation agencies or other bodies:** in **Italy**, the Agenzia per l'Italia Digitale (AgID) has a role in driving the debate on data driven governments and seems to make the link also with the SDI communities although the agency's missions are not so focused on this aspect. In Spain, the Commission for ICT Strategy might debate topics linked to the SDI development but this is not its primary mission[62].

It is also important to note here that there is a limited number of countries in which there is no formal governance/coordination activities across SDI and eGovernment and, in certain cases, these are not perceived as needed either. **In Estonia for instance, given the long-standing relationship between the two communities, there was no need to establish formal coordination mechanisms**[63]. For other countries (e.g. Hungary or Greece), it is unclear however whether this is a conscious choice or more a de facto situation. In the case of Greece, the governance and coordination structure were actually called into question in the latest INSPIRE Country Report and there seems to be a need to reform the system in-depth[64].

[59] INSPIRE National Country Report 2016, Finland, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/FI

[60] Interview 2, France.

[61] Interview 1, Slovakia.

[62] Spain eGovernment Factsheet 2017, https://joinup.ec.europa.eu/sites/default/files/inline-files/eGovernment_in_Spain_March_2017_v3_00.pdf

[63] INSPIRE National Country Report 2016, Estonia, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/EE

[64] INSPIRE National Country Report 2016, Greece, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/GR

It should be acknowledged here that, in many cases, it was very difficult (based on desk research and in absence of clear existing joint/formal governance structures) to assess this first governance indicator. This was the case for Austria, Bulgaria, Luxembourg and Lithuania. **In other countries and especially federal countries, a more in-depth analysis of the situation at the regional level would also be required as linkages and coordination might exist at the sub-national level**.

In Flanders, an integrated governance structure for SDI and ICT/e-government was established in 2016, with the creation of the steering committee of Flemish Information and ICT-policy. This new committee replaced two existing – separate – governance bodies for SDI and e-government. In the Walloon Region and the Brussels Capital Region consultation and decision-making on the regional SDI still takes place in a separate governance bodies for SDI.

In terms of representativeness of the governance bodies and involvement of stakeholders from different sectors and domains in the governance structures, the situations is also very different across Member States and sometimes there can be a strong inclusiveness on the SDI side and not on the eGovernment side or vice-versa.

Some countries are characterised by a very strong stakeholder's representation and openness towards inputs from the academia and private sector. This is the case for some of the Nordic countries (Finland and Denmark in particular) but also for Croatia and Spain. As explained in Section 2.1.2, the latter is one of the best example of inclusiveness of stakeholders: the governance approach for the INSPIRE implementation in Spain has been historically open to involvement of different types of stakeholders including private sector and academia. From a "Nordic" perspective, Finland has National Spatial Data Network, which includes more than 350 experts from around 150 organisations. The network consists of public administrations, private companies, municipalities and academic institutions[65]. However, it is unclear which role the network plays in taking decisions about SDI developments. In Croatia and Denmark, the participation to the Working Group on SDI and eGovernment and Coordination Committee is open to any natural person (coming from any type of organisation, public, private or academia)[6667]. This means that openness to non-public stakeholders input does not necessarily entail establishment of large networks as it happens in Finland and Spain.

At the other extreme of the continuum, there are countries in which stakeholders' participation is very limited and in particular Bulgaria, Greece, and Hungary to name a few. In these countries, the participation in the SDI related discussions is reserved to public authorities only and involvement of non-public players is not contemplated. In the extreme cases, there is no representation of lower levels of governments either. Generally, for these countries stakeholders 'representation is also limited in the framework of eGovernment governance structures.

In between, there are all those countries in which there is a certain level of representation of stakeholders but it is limited either in magnitude (e.g. only a few stakeholders from the non-public sector) or in the type of players involved (e.g. only regional/local level, only academia etc.). To give a few examples, in Luxembourg the SDI responsible body (CC-ILDG) includes different public bodies (e.g. the army) and some para-public bodies (e.g. La Poste) but not academia nor fully private bodies[68]. In Italy, three members out of the 50 composing the CNITA comes from lower governance levels (local and regional authorities) but there is no involvement of private sector and academia[69]. Finally, in Czech Republic the members of the relevant SDI structure (KOVIN) are representatives of all the central bodies (Ministries) of the country (16 members), plus two representatives of associations for regional and local authorities and one representative of private sector, users and universities[70].

Interestingly enough, in one of the countries mentioned above and notably Luxembourg the eGovernment decision-making structures seem to be a bit more open to non-public stakeholder involvement that the SDI/Inspire governance structures. In fact, in this country and within the framework of the national

[65] INSPIRE National Country Report 2016, Finland, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/FI

[66] INSPIRE National Country Report 2016, Croatia, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/HR

[67] INSPIRE National Country Report 2016, Denmark, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/DK

[68] INSPIRE National Country Report 2016, Luxembourg, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/LU

[69] INSPIRE National Country Report 2016, Italy, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/IT

[70] INSPIRE National Country Report 2016, Czech Republic, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/CZ

eGovernment strategy there is the possibility for stakeholders to submit ideas of projects[71] and there is a strong emphasis on participatory decision-making[72]. However, in Italy the involvement of stakeholder seems to be also limited on the eGovernment side[73] while in Czech Republic this is not clear.

These findings regarding the governance approaches of the 29 countries in scope suggest that:

(a) There is a **limited number of central organisations tasked with leading both SDI and Digital Government Transformation altogether**. However, this does not mean that coordination and joint decision-making does not occur nor that there is no strong lead in developing these initiatives but rather that other approaches are preferred.

(b) **Countries have a differentiated set of approaches for coordinating between SDI and Digital Government Transformation communities**, going from establishment of central or coordination bodies to ad hoc and informal mechanisms.

(c) **Countries also have different approaches in terms of involving private sector, academia, NGOs and other non-public stakeholders in decision making** around these topics and very often the approaches differ according to the stakeholders (i.e. academia is involved more often than private sector). Some have very participative approaches while others are more reluctant to involve, for instance, private sector in the governance of SDI and Digital Government Transformation. It is also interesting to note here that, in a number of countries, the SDI and Digital Government communities have different traditions in terms of inclusiveness of stakeholders. This can play a role when the two communities come together as diverging tradition must come to a synthesis.

2.1.2 In-depth analysis of Spain, Poland, the Netherlands and Belgium

The in-depth analysis of four countries reinforces the findings highlighted in the previous section and provides further material for reflection.

2.1.2.1 Existence of a central organisation

First, concerning the existence of a central organisation leading the efforts on SDI and Digital Government Transformation, the in-depth analysis shows that such as structure does not entirely exist (at the national level) in two of the shortlisted countries and notably Poland and Spain.

In the two abovementioned countries, SDI and Digital Government Transformation are managed by different bodies and fall under the responsibility of different ministries although there are (strong) coordination and collaboration mechanisms and links put in place in both countries (as explained further below). In both cases, stakeholders agree that there is no "central organisation in charge" leading on these two fronts. **In Poland there was a central organisation (the Ministry of d Digital Affairs - MDA) which was in charge of leading** both the development of SDI and the broader digital government transformation of the country until 2018. **The situation changed in 2018** and the responsibility of leading on SDI was transferred to the Ministry of Infrastructure and Development (MID). This indicates that **governance approaches, far from being static, can change and evolve over time and not only in one direction and towards more centralisation**. On the other hand, in Spain, some stakeholders argued in favour of more centralisation of leadership and responsibility, eventually by extending the mandate of the General Secretary for Digital Administration (SGAD)[74]. As mentioned by one of the interviewees, the SGAD has a very strong political mandate[75]. Hence, it would be interesting to include also SDI aspects or, at least, to have a similar body for the development of SDI since currently none of the existing bodies has a legal mandate as strong as the SGAD's mandate in terms of guiding and directing other public authorities[76].

[71] www.vosidees.lu

[72] Luxembourg eGovernment Factsheet 2017, https://joinup.ec.europa.eu/sites/default/files/inline-files/eGovernment_in_Luxembourg%20_March_2017_v1_00.pdf

[73] https://www.agid.gov.it/it/agenzia/organi

[74] eGovernment in Spain, 2018, https://joinup.ec.europa.eu/collection/national-interoperability-framework-observatory-nifo/egovernment-factsheets

[75] Interview 3, Spain.

[76] Interview 3, Spain.

In Belgium, the role of the National Geographic Institute (NGI) at the federal level evolved from mapping agency producing data towards geobroker in the federal SDI[77]. As a geobroker, the NGI supports other data providers in publishing and disseminating data, but also in developing applications on top of these data in order to enhance the use and reuse of data. NGI also supports other departments and agencies at the federal level in the procurement of geospatial technologies and services. This is mainly done via cooperation procurement procedures, in which multiple public buyers buy certain services or products 'in bulk'[78]. The NGI also increasingly collaborates with the Directorate-General Digital Transformation of the Federal Public Service Policy and Support[79]. The Directorate-General Digital Transformation supports the government and the federal organisations in their digital policies and is the driving force behind the evolution and the digital reforms of the federal government. At the regional level, there is a high level of integration between SDI and digital government in both the Brussels Capital Region and the Flemish Region. *In the Brussels Capital Region*, integration of geospatial data policy and e-government and information policy took place already many years ago and a leading role is played today by the Brussels Regional Informatics Centre which is also leading the development and operation of the geoportal and of the reference base map of the Brussels Capital Region. *In Flanders* newly established the Information Flanders agency was established in 2016 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. With regard to the role of SDI in Digital Transformation, the Agency Information Flanders is responsible for the operational coordination of the implementation and operation of the Flemish SDI. Therefore, as it could be expected due to the federal structure of the country, Belgium does not have one centralised and leading body in terms of SDI and Digital Government Transformation but rather several at the regional level.

Compared to Spain, Poland and (partly) Belgium, the situation **in the Netherlands** is more straightforward and especially after the inauguration of the third Rutte Cabinet in 2017, when **responsibilities and tasks related to geo-information policy were shifted to the Ministry of the Interior and Kingdom Relations, the ministry that also is responsible for the digital government and open data in the Netherlands**. Hence, the overall role of leader in linking SDI and Digital Government Transformation is played by **the Ministry of Interior and Kingdom Relations, which is the ultimate decision maker for all these matters**. Therefore, to the question "who decides on SDI and Digital Government Transformation", the answer in the Netherlands is quite clear, as the Ministry decides and then also relies on Geonovum, the Dutch Kadaster and other government organisations and agencies to execute its decisions. Geonovum[80] can be seen as the main executive body of the Dutch NSDI. In its work, Geonovum cooperates with various government organisations and sectors and notably with the Government ICT Unit (ICTU) which supports governments with the development, introduction and implementation of innovative ICT applications and with Logius, an agency of the Ministry of the Interior and Kingdom Relations which manages government-wide ICT solutions and common standards and supplies products relating to access, data exchange, standardisation and information security.

2.1.2.2 Existence of "common" governance structure and mechanisms in which different communities, domains, administrative levels and sectors are involved in decision making on the role of SDI in Digital Government Transformation

Concerning the stakeholders consulted, **the Netherlands** has a tradition of collaboration and openness towards private sector, academia and non-governmental organisations[81]. The country set up for instance an INSPIRE Consultative Group, in which besides INSPIRE data providers also users, universities and the business community are represented. Furthermore, close collaboration and consultation between government, business and academia took place during the development of the Partners in Geo Vision[82] that was released in 2014. With the launch of the vision, an additional coordination structure was put in place, in which the public sector, private sector and academic sector were equally represented[83]. However, even outside the context of these

[77] https://eurogeographics.org/wp-content/uploads/2018/05/EGAR-2017-Belgium.pdf

[78] Interview 1, Belgium.

[79] https://bosa.belgium.be/en/activities/dg-digital-transformation

[80] https://www.geonovum.nl/over-geonovum#voorwiewerken

[81] Interview 1, the Netherlands.

[82] https://geosamen.nl/

[83] Interview 1, the Netherlands.

coordination structures there is a high level of consultation and collaboration between stakeholders. Public consultations are regularly organised, focused on a very specific topic, to allow stakeholders to provide their views and comments. This evidence suggests that, in the Netherlands, there is a clear "central" decision maker in terms of SDI and Digital Government Transformation but also an inclusive and participative approach towards external stakeholders.

In Spain, Poland and Belgium on the other hand, the question of "who decides and which stakeholders are involved in the decision making processes" requires a more elaborated answer, which also needs to highlight the link between different communities (SDI and Digital Government Transformation) in the absence of a common leader or decision-making structure.

- As previously mentioned, **in Poland**, from its establishment in 2015[84] and until 2018, the Ministry of Administration and Digital Affairs (MDA) was the central body in charge of deciding and leading on both SDI and Digital Government Transformation. More precisely, the Council of the Infrastructure for Spatial Information (CSI), which is an advisory body at the heart of the SDI building in Poland, was put directly under the responsibility of the Ministry of Administration and Digital Affairs that was established precisely for coordinating eGovernment initiatives[85]. The Council of the Infrastructure for Spatial Information "is an advisor body which gives opinion and supervises the construction of SDI as an element of community policy and actions related to construction of the national SDI structure"[86]. The fact that the Council was under the direct responsibility of the MDA contributed to promote a strong relationship between the SDI and Digital Government Communities and this strong link is also shown in the strategic documents developed during this period (see section below on Strategy). **One year ago however, the responsibility for the coordination and management of the SDI was shifted from the MDA to the Ministry of Investment (MID) which now leads the work of the Council of Infrastructure for Spatial Information, chaired by the Surveyor General of Poland**. Today, the Council of Infrastructure for Spatial Information is composed of representatives from the Ministry of Administration and Digital Affairs, representatives from other national administrations, local and regional government representatives as well as academic experts. There is **no direct representation of the private sector in the Council and this body meets once of a month**[87]. The composition of this body and its governance setting is one of the reasons why, according to the interviewees and despite the presence of the Ministry of Administration and Digital Affairs in the meetings of the Council, the links between SDI and Digital Government Transformation communities are currently not as strong as they could be or as they were[88]. Indeed, the Ministry of Administration and Digital Affairs, which is responsible for the overall Polish digital government strategy and was also in charge of the SDI in the past, does not play a coordinator role in the Council anymore[89]. However, other links exist between these two communities and especially through the Committee of Council of Ministers on Digital Affairs. This Committee, which is chaired by the Ministry for Digital Affairs, includes representatives from the Ministry of Infrastructure and Development (MID) and is in charge of discussing all major IT projects of the polish public administration. This body ensures a strong coordination between ministries and has a strong political mandate[90]. In this respect, the Committee seems to be more important than the Council in terms of potential of bringing the SDI and Digital Government communities together, at least for the moment.
- In Spain, SDI and Digital Government are still managed through separate governance structures which have different ways or working and different objectives although links between them exist as further explained below. The governance of the INSPIRE SDI is detailed in the INSPIRE Country Report 2016 and

[84] "*Understanding that in order to successfully implement the necessary reforms to achieve eGovernment and interoperability in Poland, it is important to coordinate and streamline efforts, the Polish government created a new Ministry of Digital Affairs43. Established in 2015, the ministry is responsible for coordinating the eGovernment initiatives in Poland. The mission of the ministry is to create a digital boost for the development of Poland*", eGovernment factsheets anniversary report, European Commission – DIGIT, 2019, https://ec.europa.eu/isa2/sites/isa/files/docs/news/10egov_anniv_report.pdf

[85] eGovernment factsheets anniversary report, European Commission – DIGIT, 2019, https://ec.europa.eu/isa2/sites/isa/files/docs/news/10egov_anniv_report.pdf

[86] https://www.geoportal.gov.pl/en/o-geoportalu/powiazania-geoportalu/powiazanie-z-inspire

[87] Interview 1, Poland.

[88] Interview 1, Poland.

[89] Interview 1, Poland.

[90] Interview 1, Poland.

it involves the Consejo Superior Geográfico (CSG) and the Consejo Directivo de la Infraestructura de Información Geográfica de España (CODIIGE). The former depends from the Ministry for Infrastructure (Ministerio de Fomento) and it is a collegial body with a consultative role with respect to the Spanish SDI. It also represents the INSPIRE point of contact. It also represents the INSPIRE point of contact. The CODIIGE on the other hand is the body in charge of the coordination, deployment and management of the national SDI. It is composed of around 20 members:

- A president and three vice-presidents, all in charge of one or more of the special committees shown in the picture below.
- A secretary and fourteen experts in SDI coming from different organisations and in particular:
- Three representatives of the state general administration (AGE)
- Six representatives from the autonomous communities
- Two representative from the local community
- Three representatives coming from organisations in charge of data provision or portals, which are integrated in the SDI.

Concerning the development of eGovernment and the support for Digital Government Transformation aspects on the other hand, it is the Ministry of Territorial Policy and Public Function that plays a pivotal role and more specifically the General Secretary for Digital Administration (SGAD)[91]. The Secretary was only recently established (by the royal decree 769/2017[92]) and the SGAD is "responsible for the direction, coordination and execution of the powers attributed to the Ministry in terms of digital administration, rationalisation of information technologies and communications in the field of the General Administration of the State and its Public Organisms"[93]. More in details, this body is responsible for the Digital transformation Plan of the General administration of the state and its Government Agencies - the strategy TIC[94]. According to one of the interviewees, "*the SGAD provide lots of things which are useful from an SDI perspective, like a communication infrastructure (government network), or some common/shared services, for example, the General Access Point, where you can find all the procedures of the General State Administration available electronically*"[95]. However, as it emerges from the description above, **the responsibilities of SDI and Digital Government Transformation do not fall under the same ministry and the same bodies and "the SGAD and the CODIIGE and CSG are different structures with different goals"[96]. This does not prevent however collaboration and coordination between the SDI and Digital Government Transformation representatives** and, as one of the interviewee put it, "communities are getting closer and there are many points in common"[97]. This is particularly true at the technical level: as highlighted during the interviews in fact, **representatives from all ministries as well as from regional and local administrations participate in the committees established for the SDI governance.** Furthermore, the persons who are "responsible of ICT within Ministries possessing a lot of spatial data information belong to both communities and this is the case for instance for the Ministry of Agriculture, Ministry for the Ecological Transition, Ministry of Territorial Politics, Ministry of Finances (Cadastre) etc.[98]". This is a way of creating a link between different government bodies although this link is maybe not equally strong at higher levels of hierarchy[99]. A second link or point in common, which is more political than technical, is due to

[91] eGovernment in Spain, 2018, https://joinup.ec.europa.eu/collection/national-interoperability-framework-observatory-nifo/egovernment-factsheets

[92] Boletin Oficial Del Estado, Real Decreto 769/2017, de 28 de julio, por el que se desarrolla la estructura orgánica básica del Ministerio de Hacienda y Función Pública y se modifica el Real Decreto 424/2016, de 11 de noviembre, por el que se establece la estructura orgánica básica de los departamentos ministeriales, 29/07/2017, https://www.boe.es/boe/dias/2017/07/29/pdfs/BOE-A-2017-9012.pdf

[93] eGovernment in Spain, 2018, https://joinup.ec.europa.eu/collection/national-interoperability-framework-observatory-nifo/egovernment-factsheets

[94] https://administracionelectronica.gob.es/pae_Home/en/pae_Estrategias/Estrategia-TIC-AGE.html?idioma=en#.XIzC0ChKhGM

[95] Interview 3, Spain.

[96] Interview 3, Spain.

[97] Interview 1 and 3, Spain.

[98] Interview 3, Spain.

[99] Interview 1, Spain.

the fact that the SGAD has the overall responsibility for the implementation of the Public Sector Information Directive[100], which also concerns spatial data and therefore the SDI. In this domain, the CSG and CODIIGE need to follow the SGAD guidance[101]. Furthermore, all interviewees and data suggest that the **governance of the SDI has been always very open to participation of different stakeholders and players thus ensuring high levels of inclusiveness**. This was already the case with the Working Group on SDI - GT IDEE before 2010 and it has continued ever since[102]. This working group in fact gathers 400 people from 160 public, private and academic institutions[103] and it is structured around seven sub-groups on: metadata, architecture, data policy, SDI observatory, legal aspects and certainty, local SDI and cartographic patrimony[104]. In the period 2013-2018 there have been twelve meetings of this group, the last one taking place in Mahón in October 2018[105]. The role of the Working Groups is to discuss and express ideas and advices on these different SDI related topics. Although there is no formal decision making responsibility established for the GT IDEE, this advisory role is very important and the interviewees highlighted the quality of the contributions expressed by this working group[106]. Further than that, Spain has established coordination mechanisms for collaborating with the (autonomous) regions and has a very strong relation with universities and academic partners. Finally, one interviewee mentioned the strong relationship that some of the SDI related players (e.g. the Cadastre) have with private sector and especially infomediaries[107] and re-users of data[108]. Concerning infomediaries, in Spain there is a very strong organisation representing their interests (Asociación Multisectorial de la Información – ASEDIE) which is a key partner in discussion concerning needs and use for (spatial) data. Furthermore, data providers (to the SDI) also foster close relationships with their different user communities of private companies[109]. From the Digital Government perspective, it is difficult to say whether there is a strong inclusivity of non-public stakeholders in the governance structures. One of the interviewees mentioned that Digital Government Transformation is "pushed top down" from the central government[110] and this seems to be in line with the strong role foreseen for the SGAD. However, there seems to be mechanisms for integrating non-public stakeholders in governance and decision-making activities. For instance, in the framework of certain eGovernment bodies such as the Commission for ICT Strategy which is an inter-ministerial body comprised of senior officials representing all ministries and the Central Administration, the possibility to include private stakeholders is left open although it is not clear to what extent this possibility is exploited in reality[111]. Furthermore, one of the interviewees suggested that the debate around the PSI Directive[112] enables greater stakeholder participation at least concerning open data topics[113]. Nonetheless, based on the data available, it could be argued that the inclusion of non-public stakeholders is bigger on SDI governance bodies rather than eGovernment related structures.

[100] Directive 2003/98/EC of the European Parliament and of the Council of 17 November 2003 on the re-use of public sector information, https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32003L0098

[101] Interview 3, Spain.

[102] INSPIRE Country Report, Spain, 2016, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/ES

[103] INSPIRE Country Report, Spain, 2016, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/ES

[104] INSPIRE Country Report, Spain, 2016, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/ES

[105] http://www.idee.es/web/quest/reuniones

[106] Interview 1 and 3, Spain.

[107] « Formed from a combination of the words information and intermediary, an infomediary is a company/website/platform that gathers and organizes large amounts of data and acts as an intermediary between those who want the information and those who supply the information". See definition on Webopedia, https://www.webopedia.com/TERM/I/infomediary.html

[108] Interview 3, Spain.

[109] Interview 3, Spain.

[110] Interview 1, Spain.

[111] Boletin Oficial Del Estado, Real Decreto 806/2014, de 19 de septiembre, sobre organización e instrumentos operativos de las tecnologías de la información y las comunicaciones en la Administración General del Estado y sus Organismos Públicos, 26/09/2014

[112] Directive 2003/98/EC of the European Parliament and of the Council of 17 November 2003 on the re-use of public sector information, https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32003L0098

[113] Interview 3, Spain.

— **In Belgium**, at the national level, the INSPIRE Coordination Committee was established in 2010, and consists of representatives – one GIS expert and 1 environmental expert - from the federal level and the three regions. Other members of the Coordination Committee, which is the only national SDI consultative body at the national level, are the national contact point, the Belgian representatives of the INSPIRE Committee, the secretary, and members of MIG-P and MIG-T. The INSPIRE Coordinating Committee is responsible for the coordination between the Federal State and the regions in order to achieve effective implementation of the INSPIRE Directive in Belgium and to build up the Belgian SDI. The cooperation agreement of April 2010, in which the establishment of the INSPIRE Coordination Committee is laid down, also foresees in the creation of the INSPIRE platform, a discussion platform for all those interested in INSPIRE and exchanges on geographic data. Furthermore, the president of the platform participates in the INSPIRE Coordination Committee. Particular SDI governance and decision making structures exist in each of the three regions and at the federal level. From a Digital Government Transformation, the governance of the Flemish SDI is an interesting example, since it is fully integrated in the governance of the Flemish IT and information policy. While originally Flanders had separate governance structures in place for IT and SDI policies, since 2016 there is only one integrated Flemish Steering Committee for Information and ICT-policy.

To summarise, the evidence from these four countries confirms the findings highlighted in our general analysis and notably the existence of different approaches for governing SDI and Digital Government Transformation and bringing them together. The experience of Spain, Poland, Belgium and the Netherlands also confirms that governance approaches change over time (see the case of Poland in particular) and that participatory approaches in one community (e.g. SDI in Spain) could possibly help opening up participation of external stakeholders in the other. Finally, the in-depth analysis of these four countries highlights the importance of taking into account the structure of the country (see the case of Belgium) and its history to understand how decisions on SDI and Digital Government Transformation are taken.

2.2 Strategy

Main messages:

— Strategy indicators look at the existence of an overarching reflection and framework for understanding the role of SDI in Government Digital Transformation. They allow for instance to examine to what extent the rapprochement of SDI and Digital Government Transformation communities is a conscious choice driven by a strategy or rather a more "natural" phenomenon which is due to the need of using SDIs more and more in the context of data driven public policies and services.

— In a significant number of countries, we could identify specific SDI strategies making the link with digital transformation. However, countries have approached this question in different ways: while some developed ad hoc strategies for SDI and digital transformation others included the aspect of SDI in their eGovernment strategic documents or other programming documents (i.e. the Operational Programme for Structural Funds[114] in Poland). Furthermore, some countries also chose to treat SDI as a purely technical matter and did not develop a strategy supporting its deployment. There are also some situations in which, based only on the evidence available through desk research, it is difficult to say which of these approaches was chosen and whether the fact of not having a strategy is accidental or conscious.

— In general, the recognition of SDI in Digital Government Transformation documents is found to be widespread and easy to identify. In many cases, the reference is made to the role and importance of spatial data or geo-spatial information rather than to SDI directly. It is important to note here that only a very limited number of countries (2-3) does not mention at all geo-spatial data in eGovernment documents at the national level.

— Although one could imagine these approaches plotted on a continuum going from "no strategy" to a "full dedicated strategy", this linear understanding would not be correct. In fact, the integration of SDI aspects in existing Digital Government Transformation strategies for instance cannot be considered better or worse than having a dedicated SDI strategy linking this with digital transformation. On the opposite, the diversity of strategic possibilities corresponds to the specific characteristics, trajectories

[114] For a definition of Operational Programmes see https://ec.europa.eu/regional_policy/en/policy/what/glossary/o/operational-programme

and needs of the countries and the effectiveness of one or another strategy cannot be easily generalised.

— Finally, it emerged from the data collection that countries also have different approaches in terms of training and human capacity building and these reflect largely the strategic approaches discussed above. The vast majority of countries acknowledges the importance of digital skills and has put in place wide trainings programmes that might also include aspects related to SDIs. Some countries however go even farther as they have a full-fledged and specific training and skills strategy on SDIs. There are also a few good examples of countries working to ensure there is enough "human capacity" to use the SDI in an effective and efficient manner through the design of study programs for university students and vocational training for current professionals.

Through developing and testing different strategy indicators, we aim at identifying to what extent countries have developed a strategic vision and a well-grounded reflection on the role and potential of SDI in Digital Transformation. In particular, our analysis focuses on two key dimensions, which are captured by two different indicators:

— A strategy exists on the role of spatial data and the SDI in Digital Transformation.

— A strategic approach exists on skills and training related to innovative geospatial solutions.

Gathering data on these strategic aspects allows checking whether the rapprochement of SDI and eGovernment communities also explored in the previous section of this report happens ad hoc or results from a clear national vision that integrates these two elements. Furthermore, strategic indicators provide insights on the extent to which countries follow a comprehensive approach also in terms of training and capacity building of national public administration or rather rely on more punctual training activities. Overall, strategic indicators are useful to understand how all aspects related to the domains of INSPIRE and Digital Transformation come together and whether countries have developed a vision and plan for their future, leveraging the opportunities provided by SDI development.

2.2.1 Analysis of the 29 countries in scope

2.2.1.1 Existence of a strategy on the role of spatial data and SDI in Digital Transformation

For a significant number of countries in scope (more precisely eleven) we were able to identify strategies or programming documents concerning the role of spatial data and SDI in the framework of digital government transformation[115]. However, these documents take very different forms. **Some countries have developed specific documents and strategies that focus on SDI only and make the link to digital transformation**:

— In **Croatia**, there are two documents which lay down the strategy of the country towards SDI and notably: the National Spatial Data Infrastructure 2020 (NSDI Strategy) and the Strategic Plan for the period 2017-2020 (Strategic Plan)[116]. The vision behind these documents is for everybody *to be able to find, understand, and use spatial data*[117] and the mission for NSDI stakeholders is to ""establish an infrastructure that provides spatial data to public institutions, business entities, organisations and citizens through standardized network services"[118]. Based on the information available, it seems that these documents establish a clear role for Croatian SDI in the digital transformation. However, due to language reasons, the contents of these documents could not be examined more in-depth.

— **Czech Republic** adopted in 2012 the Strategy of Spatial Information Infrastructure Development up to 2020 (GeoInfoStrategy) which lays down "the strategic framework for the spatial information field as the

[115] It must be mentioned here that not all strategic documents could be obtained through desk research. For instance, a Draft National Geospatial Strategy was completed by Ordnance Survey Ireland (Osi) at the end of 2016, but the document could not be found online and therefore it is difficult to say whether it focuses on SDI implementation only or it makes a link with digital transformation overall.

[116] http://www.nipp.hr/default.aspx?id=1826

[117] http://www.nipp.hr/default.aspx?id=1824

[118] http://www.nipp.hr/default.aspx?id=1824

integral component of Czech eGovernment and develops the main principles of eGovernment"[119]. The strategy describes the vision, objectives and milestones of the government up to 2020 for Czech Republic to become "a knowledge-based society efficiently using spatial information"[120].

— **Germany** also has a specific strategy on SDI and geo-spatial information, firstly adopted in 2015, the National Geoinformation Strategy, Version 1.0[121]. This strategy was jointly adopted by Federal Government, Laender and Municipalities and it aims at coordinating the efforts of all players involved in the development and provision of SDI[122]. Starting point of the strategy is that geo-information is a key resource for a digital society, and the basis for future-oriented decision-making and strategic planning. It is also essential for the implementation of Germany's Digital Agenda. The National Geoinformation Strategy is seen as a contribution to the National E-Government Strategy and promotes cooperation in the domains of ICT and e-government between governments at different levels.

— In **Sweden**, the National GeoData Strategy defines the goals for the 2016-2020 period and links them to the societal challenges that the country is facing in terms of innovation and growth, digitization of public administration, urban planning, climate adaptation and defence and civil contingencies[123].

— In **Portugal**, the main strategic document is the SNIG2020 vision, which is based on a number of principles and a strong articulation with the eGovernment agenda of the country[124].

— In **Belgium,** there is no overall – national - digital strategy in this domain but at the regional level, some strategies have been developed focusing on the role of SDI for Digital Government transformation. Most recently, the geospatial strategy for the Walloon Region 2017-2019 highlighted the relevance and importance of geospatial data for government and society in general. Awareness raising on the relevant of geodata to various decision-making processes is one of the key objectives mentioned in the strategic plan. Another objective is to ensure strategic coherence and promote synergies with other relevant policies and sector, including the ICT and e-government[125].

— **The Netherlands** was among the first European countries with a geo-information strategy focusing on the role of geodata and SDI in eGovernment and Digital Transformation. The GIDEON policy document, which described the implementation approach and strategy for the development of the national spatial data infrastructure between 2008 and 2011, stressed the need to give geo-information a prominent place within e-services and e-government[126]. The 2014 policy document 'Partners in GEO', which presents a shared vision of both the private, academic and public sector on the geo-information infrastructure in the Netherlands, focuses on the transformative effects of geo-information on key sectors such as health care, spatial planning and transport, energy, construction and water[127].

Other countries decided to include aspects related to SDI and INSPIRE in their eGovernment or digital transformation overall strategies:

[119] See : The Strategy of the Development of the National Infrastructure for Spatial Information in the Czech Republic up to 2020 (GeoInfoStrategy), Eva Kubátová, Ministry of the Interior of the Czech Republic, The 8th INSPIRE Conference 2014, Aalborg, Denmark, 19th June 2014, http://inspire.ec.europa.eu/events/conferences/inspire_2014/pdfs/19.06_2_14.00_Eva_Kubatova.pdf

[120] See : The Strategy of the Development of the National Infrastructure for Spatial Information in the Czech Republic up to 2020 (GeoInfoStrategy), Eva Kubátová, Ministry of the Interior of the Czech Republic, The 8th INSPIRE Conference 2014, Aalborg, Denmark, 19th June 2014, http://inspire.ec.europa.eu/events/conferences/inspire_2014/pdfs/19.06_2_14.00_Eva_Kubatova.pdf

[121] See : Nationale Geoinformations-Strategie Die Welt mit Geoinformationen im Jahr 2025, GDI-DE,

[122] https://www.geoportal.de/EN/GDI-DE/Strategies/strategies_artikel.html?lang=en

[123] See : The Swedish National Geodata Strategy, Well developed collaboration for open and usable geodata via services, 2016-2020, Lantmäteriet, https://geodata.se/globalassets/dokumentarkiv/styrning-och-uppfoljning/geodatastrategin/national_geodata_strategy_2016-2020.pdf

[124] See : SNIG 2020: a participated vision for the Portuguese National Spatial Data Infrastructure Directorate-General for the Territory, Inspire Conference 2015, http://snig.dgterritorio.pt/Inspire/documentos/GWF_Inspire2015/SNIG-INSPIRE_GWF_PPatricio.pdf

[125] Plan stratégique géomatique pour la Wallonie, http://geoportail.wallonie.be/PSGW

[126] See: Netherlands Ministry of Housing, Spatial Planning and the Environment (2008) GIDEON—key geo-information facility for the Netherlands. Approach and implementation strategy (2008–2011).

[127] See: Partners in GEO: Shared vision of government, private sector and scientific community on the future of the geo-information sector, http://geosamen.nl/wp-content/uploads/2014/11/GeoSamen-UK.pdf

— In **Austria** for instance, "since 2001 the common public eGovernment/digitization strategies have framed and supported the development of the national infrastructure for geospatial information[128]".

— Similarly, in **Estonia**, the questions related to availability of public sector spatial data and the need to foster their reuse by public and private actors" are integrated in the Digital Agenda 2020 for Estonia[129].

— The **Norwegian** eGovernment strategy clearly refers to Norway Digital and to the question of spatial data for government transformation[130].

— In **Italy**, the newly published thee-year plan for public authorities (Piano Triennale delle PA[131]) illustrates the importance of the SDI and of the "Repertorio Nazionale dei dati territoriali" – RNDT in the digital transformation of the countries and especially from a "base registries" perspective. The document indicates a number of priority actions concerning SDI and states that the RNDT is an "indispensable tool" from a digital government perspective[132].

— In **Poland**, according to the interviewees, the Operational Programme Digital Poland 2014-2020 and the National Integrated Informatisation Programme 2020 (PZIP) can be considered as the strategic framework for the SDI development and all projects carried out by the ministry in charge of INSPIRE fit these overall strategies[133].

— Finally, in **Slovakia**, the Strategy of INSPIRE Implementation in Slovakia until 2021 mentions the need to better coordinate with eGovernment at the strategic level[134] but did not clearly define at that time a role for spatial data. Since then, many strategic initiatives took place and in particular the development of four strategic documents on digital transformation (including aspects linked to geospatial data) which foresee specific actions for the government[135]. One of the action consists in the preparation of funding for projects on 1) trainings/skills improvement on INSPIRE/geospatial data and 2) support for IT geospatial infrastructures. These two funding schemes link the strategy of the government to specific financing tools showing that there is a willingness to go further. The timeline for these actions and strategic steps is 2019-2022 and these schemes also involve the use of EU funding.

For a number of countries, the situation in terms of overall strategy is less clear: in many cases there are some programming documents (most frequently eGovernment strategies) also referring to spatial data. However, the level of reference and integration of SDI into these documents is much more limited. As an example, in Lithuania, the single strategic document, the "Program for the Development of the Information Society for 2014-2020, The Digital Agenda of the Republic of Lithuania'" acknowledges the added value of spatial data and SDI for the overall digital transformation[136]. The document does not provide additional indications on what the role of SDI in digital transformation is and the Program refers to the objective of developing electronic services and ICT products for transport and spatial data processing[137]. Similarly, in France, Cédric Villani's report on Artificial Intelligence does not cover extensively the aspect of

[128] INSPIRE National Country Report 2016, Austria, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/AT

[129] See : Ministry of Economic Affairs and Communications, Digital Agenda 2020 for Estonia, https://www.mkm.ee/sites/default/files/digital_agenda_2020_estonia_engf.pdf

[130] INSPIRE National Country Report 2016, Norway, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/NO

[131] See: Agenzia per l'Italia Digitale, Piano Triennale per l'Informatica nella Pubblica Amministrazione 2019 – 2021, 2019, https://www.agid.gov.it/sites/default/files/repository_files/piano_triennale_per_linformatica_nella_pubblica_amministrazione_2019_-_2021_allegati20190327.pdf

[132] See: Agenzia per l'Italia Digitale, Piano Triennale per l'Informatica nella Pubblica Amministrazione 2019 – 2021, 2019, https://www.agid.gov.it/sites/default/files/repository_files/piano_triennale_per_linformatica_nella_pubblica_amministrazione_2019_-_2021_allegati20190327.pdf

[133] Interview 4, Poland.

[134] http://inspire.gov.sk/koordinacia/rove-sk/strategia-implementacie and INSPIRE National Country Report 2016, Slovakia, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/SK

[135] Interview 1, Slovakia.

[136] See : Resolution no 244 on approval of information society development programme for 2014- 2020 'digital agenda for the republic of Lithuania' 12 march 2014, 12 March 2014, https://e-seimas.lrs.lt/rs/legalact/TAD/033ccec007c411e687e0fbad81d55a7c/format/ISO_PDF/

[137] See : Resolution no 244 on approval of information society development programme for 2014- 2020 'digital agenda for the republic of Lithuania' 12 march 2014, 12 March 2014, https://e-seimas.lrs.lt/rs/legalact/TAD/033ccec007c411e687e0fbad81d55a7c/format/ISO_PDF/

geo-spatial data itself but highlights its importance by mentioning a number of AI-based applications which could build on them and especially in terms of environmental protection and predictive policing[138]. This lack of further specific details exists for many other countries such as Luxembourg, Latvia, and Cyprus.

The data collection also highlighted the existence of another category of countries in which this link between strategic development and SDI and digital transformation seems to be missing and/or is not considered as necessary. This is the case in Bulgaria and Romania where the main strategic documents focus on INSPIRE implementation and SDI only and do not look at the aspect of SDI and Digital Transformation together[139].

To summarise, countries have approached the question of strategic direction on the role of SDI for Digital Transformation in three different ways:

a) by developing specific strategies focused on SDI and integrating the viewpoint of eGovernment,

b) by including the aspects related to SDI in their eGovernment and digital transformation strategies or

c) by treating the aspects of SDI as technical matter linked or not with the overarching strategic level.

Although these three macro categories do not include all possible nuances and exceptions and especially the cases in which the situation is unclear, they are still representative of a majority of countries.

2.2.1.2 Existence of a strategy on skills and training

The second strategic indicator concerns the existence of a skills and training strategy on geospatial matter. We could identify clearly a few countries having developed strategies of such kind and notably Portugal, Slovakia, Spain, Finland, Poland and Croatia. In Portugal, the empowerment of GI community (through awareness raising activities, trainings etc.) is one of the main pillars in the SNIG2020 Vision[140]. This document foresees various capacity-building activities although there was limited availability of details on them for us. **In Slovakia**, the lack of skills amongst public officials and other stakeholders is recognised as one of the country's major challenges in the 2016 INSPIRE Report[141] and it is for this reason that **the government established a number of activities (based on project's proposals) in terms of trainings and soft skills development**[142]. These projects are one of the strategic initiatives for the future and, interestingly enough, they are open to public as well as non-public stakeholders given the need for Slovakia to widen the knowledge base of geo-spatial data in all sectors of society[143]. In Finland, the Position for spatial data – Finnish national spatial data strategy 2016 refers in its section IV to research and training in the spatial data sector to support the use of spatial data and the development of the SDI[144]. In the past, skill-improving trainings have also been organised. The case of Poland and Spain is further discussed in the following section.

It is also worth mentioning here that Croatia seems to be quite active in terms of capacity building. The Croatian NSDI Strategy mentions the issue of training and capacity building as necessary to ensure there is enough "human capacity" to use the SDI in an effective and efficient manner. **Competencies should be developed through the design of study programs for university students and vocational training for current professionals**. By 2020, courses on SDI provided by five different faculties and there should be nine vocational courses on SDI. Interesting to notice is that **within the SDI governance structure a working group has been established on Capacity Building**. Objectives of this working group are to

[138] See : Cédric Villani, Donner un sens à l'intelligence artificielle, pour une stratégie nationale et européenne, 2018, https://www.aiforhumanity.fr/pdfs/9782111457089_Rapport_Villani_accessible.pdf

[139] See : Lyubka Pashova & Temenoujka Bandrova (2017) A brief overview of current status of European spatial data infrastructures – relevant developments and perspectives for Bulgaria, Geo-spatial Information Science, 20:2, 97-108, https://www.researchgate.net/publication/317957393_A_brief_overview_of_current_status_of_European_spatial_data_infrastructures_-_relevant_developments_and_perspectives_for_Bulgaria [accessed Dec 12 2018].

[140] See : SNIG 2020: a participated vision for the Portuguese National Spatial Data Infrastructure Directorate-General for the Territory, Inspire Conference 2015, http://snig.dgterritorio.pt/Inspire/documentos/GWF_Inspire2015/SNIG-INSPIRE_GWF_PPatricio.pdf

[141] INSPIRE National Country Report 2016, Slovakia, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/SK

[142] Interview 1, Slovakia.

[143] Interview 1, Slovakia.

[144] See: Finnish national spatial data strategy 2016, Position for spatial data, 2014, file:///C:/Users/mabarbero/Downloads/Finnish_Spatial_Data_Strategy_2016_EN%20(1).pdf

identify skills and knowledge gaps, present best practice guidelines and work on NSDI specific curricula for geo-information science courses at different educational levels[145].

Besides these three clearly identifiable cases, other countries training and awareness raising initiatives exist but seem less focused on geo-spatial skills and/or are less far-reaching:

- In 2016, the **Czech government** approved an updated Action Plan on the Development of Digital Market. This Action Plan includes five priorities, one of which is eSkills. In this context, the document sets out a road map of actions for fostering digital skills in the country but it does not explicitly refer to geospatial solutions.
- In **France**, the importance of training is acknowledged in all strategic documents and there is a new Grande Ecole (la Grande Ecole du Numérique) which is supposed to play a pivotal role in training public and private sector workers[146]. Amongst the curricula there are some linked to geo-spatial data. However, according to one of our interviewees, there is "no strategy on training" and there is no need to have one as training are market driven[147].
- In **Lithuania**, no indication of an existing strategy on skills and training has been found, but the "development of training centre in the field of geoinformatics, aerial photography, remote sensing and scientific research together with applications and engineering is also planned as important future activities of GIS Centras[148]".
- In **Malta**, there seems to be some ongoing activities on capacity building, skills and training as part of the activities and strategy. For instance, the country organised a two-day training on the harmonisation process of spatial data in 2016[149]. However, no HRM plan for training and skills-development on new innovative ICT/geospatial solutions has been found in place.
- In **Norway**, there is a strategy (the Norwegian Strategy for Skills Policy 2017-2021) on the development of skills, "exploiting opportunities arising from global competition and technological development[150]" across the Norwegian society but no concrete reference to innovative geospatial solutions has been traced.
- In **Italy,** the question of training of public officials is one of the key action point for the Piano Triennale delle PA[151]. In this respect, Formez (which is the governmental IT training agency) offers some trainings that are directly related to SDI (e.g. the role of geospatial data in Structural Funds management, value of open geo-spatial data for territorial development etc.)[152]. However, there is no overarching strategy in place yet.

Finally, there are countries in which such initiative do not exist currently for various reasons. In Luxembourg for instance, before putting emphasis on skills and trainings, the government is running actions aimed at increasing awareness among public stakeholders and accompanying them in making their data available to the public[153]. In Slovenia, the government translated first all the INSPIRE material and is now preparing an educational programme based on this.

To conclude, for the large majority of countries the question e-skills is framed by national strategies which go beyond geo-spatial data only and address more broadly competences that are needed in the framework of government digital transformation. Nonetheless, there are some countries which have a full-fledged and specific strategy on geospatial training and skills and which are developing university courses and vocational trainings specifically in this domain (as it is the case in France and Croatia for instance).

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[145] INSPIRE National Country Report 2016, Croatia, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/HR

[146] https://www.grandeecolenumerique.fr/

[147] Interview 2, France.

[148] http://www.gis-centras.lt/en/

[149] https://mita.gov.mt/en/ict-features/Pages/2016/MITA-hosts-a-two-day-training-on-the-harmonisation-process-of-spatial-data.aspx

[150] See : Norwegian Strategy for Skills Policy 2017 – 2021, https://www.regjeringen.no/en/dokumenter/norwegian-strategy-for-skills-policy-2017---2021/id2527271/

[151] https://pianotriennale-ict.italia.it/

[152] http://www.formez.it/

[153] INSPIRE National Country Report 2016, Luxembourg, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/LU

2.2.2 In-depth analysis of Spain, Poland, the Netherlands and Belgium

As already emerged in the context of the governance indicators examined above, the in-depth assessment of four countries comforts the results obtained by the overarching analysis of the 29 countries in scope and Spain, Poland, Belgium and the Netherlands can help exemplifying some of the findings highlighted in the previous section.

2.2.2.1 Existence of a strategy on the role of spatial data and SDI in Digital Transformation

Concerning the first strategy criterion, the existence of an overall vision on the role of SDI in Digital Government Transformation, these four countries look very diverse:

- **In Spain, there is no overarching strategy or vision**, as also confirmed by all interviewees. One of the interviewees also mentioned that this lack of strategic plan on how SDI can help Spanish digital government transformation is a clear weakness and regretted that this topic does not even seem to be on the table at the moment[154]. For another interviewee the lack of a clear strategy seems to be linked to the governance structure of the SDI (which is less top down than in the eGovernment domain) and the absence of a clear legal framework which would allow to mobilise additional resources[155]. It was noted however that some bodies (e.g. the national geographic institute) try to play a key role in developing and promoting a vision although nothing is formalised yet[156]. In general, all interviewees deplored the current situation given the fact that the infrastructure is in place and there is a good dynamic in terms of usage, which could be fostered through more strategic efforts[157]. Despite this lack of overall strategic planning, the aspects related to SDI are not entirely neglected in the Spanish digital government documents. On the opposite, in the Digital transformation Plan of the General administration of the state and its Government Agencies - the strategy TIC, ***strategic goal 4*** concerns "the Smart corporate management of knowledge, data and information" and particularly refers to the fact that "*all this information opens up new perspectives and enables the development of innovative services based on emerging technologies, such as the processing of large volumes of information, data mining, predictive analytics, and others"*[158].
- Although not explicitly mentioned in this strategic goal, the development of innovative services based on existing information is of course relevant in the context of SDI and geo-spatial data. Furthermore, in ***line with action 8*** of the same document goes in the same direction by establishing that public authorities need to rely on data analysis systems for decision-making[159]. More importantly, this line of action mentions the need to "*develop tools and standards to use location-based information in compliance with European regulations*"[160]. Hence, the strategy TIC makes a clear and important link between SDI and Digital Government Transformation, as also underlined by one of the interviewees[161]. Finally, the Third National Action Plan of Spain for the Open Government Partnership[162] refers to SDI relevant datasets in one commitment (commitment 4.3 - Improvement of the quality of real estate data through the coordination of the cadastre and the land registry).
- In Belgium, there is no overall – national - digital strategy or SDI strategy, but at the regional level several strategies have been developed focusing on the role of SDI for Digital Government transformation. Most recently, the Walloon government released its Geospatial Strategy for the Walloon Region 2017-2019[163] together with its Geomatics Operational Plan for Wallonia[164]. The Strategy and

[154] Interview 1, Spain.

[155] Interview 3, Spain.

[156] Interview 1 and 3, Spain.

[157] Interview 1, 2 and 3, Spain.

[158] https://administracionelectronica.gob.es/pae_Home/en/pae_Estrategias/Estrategia-TIC-AGE.html?idioma=en#.XIzC0ChKhGM

[159] https://administracionelectronica.gob.es/pae_Home/en/pae_Estrategias/Estrategia-TIC-AGE.html?idioma=en#.XIzC0ChKhG

[160] https://administracionelectronica.gob.es/pae_Home/en/pae_Estrategias/Estrategia-TIC-AGE.html?idioma=en#.XIzC0ChKhG

[161] Interview 3, Spain.

[162] Third National Action Plan of Spain for the Open Government Partnership, June 2017, http://transparencia.gob.es/transparencia/dam/jcr:cfc2ac4b-a5bb-4fc2-857d-4fbf61864122/2017_07_26_SPA-ENG_III_Plan_OGP_vf-1.pdf

[163] http://geoportail.wallonie.be/PSGW

[164] http://geoportail.wallonie.be/POGW

Operational Plan not only take into consideration and are in alignment with key policies and legislation in the GI and SDI domain, such as the INSPIRE Directive, the PSI Directive and the Walloon Geomatics Decree, but also the Digital Strategy of Wallonia (*Digital Wallonia*[165]), the plan on administrative simplification of Wallonia (*Ensemble Simplifions*[166]) and the economic redeployment program for Wallonia (*Plan Marshall 4.0*[167]). The Strategy and Operational Plan are organised around 4 thematic axes: 1. Awareness raising on geomatics; 2. Creation of a common framework for data production; 3. Organising the sharing of geodata; and 4. Developing a governance model for geomatics. The Operational Plan consists of 22 specific actions for the Walloon geo-ICT sector, which will be carried out between February 2017 and December 2019. The plan includes several actions that are dealing with the digital transformation of government, such as the contribution to administrative simplification, awareness raising and support to decision makers on the use and added value of spatial data, and awareness raising among citizens and society on spatial data and how they could be used.

— Another example of a strategic approach on SDI in the context of Digital Government Transformation is the 'Flanders Radically Digital' programme of the Flemish Government[168]. In March 2015, a vision document was released in which the programme was introduced and presented[169]. By 2020, Flanders Radically Digital, aimed to achieve the following three ambitions: 1. As many digitally performed government transactions as possible; 2. A far-reaching simplification and digitalisation of government processes; and 3. Interaction with target groups via a single virtual front office. Spatial data and the Flemish SDI were recognized as key elements of the digital policy of Flanders. For a long time, the Flemish digital policy was based on a clear distinction between geographic information and e-government. A new integrated IT policy was launched, in which 'information' was central. The simplification of the existing governance structures and cooperation in the domains of IT and geospatial was also proposed. At the federal level, the action plan *Digital Belgium*[170] was introduced by the Minister of Digital Agenda and Telecom and the '*Digital Minds for Belgium*', a group of approximately leading digital-world professionals. The key objective proposed in the action plan was to achieve growth and create jobs through digital innovation over the next years. Also the Digital Belgium programme has three ambitions to be achieved by 2020: Belgium to be among the European top three in digital terms, to generate 1000 new start-ups, and to create 50 000 jobs in the whole economy. Although the action plan does not addresses spatial data and the SDI in particular, many of the priorities and actions included in the plan are extremely relevant to the development and implementation of the federal SDI.

— *In Poland*, thanks in particular to the previous governance approach which foresaw the SDI being managed by the Ministry of Digital Affairs, there has been a strong involvement of SDI stakeholders in the development of the national strategic documents and especially the Operational Programme Digital Poland 2014-2020[171] and the National Integrated Informatisation Programme 2020 (PZIP)[172]. This is clearly visible while reading the documents. Moreover, according to the interviewees, "the Operational Programme Digital Poland 2014-2020 can be regarded as a strategy for the deployment and development of SDI in the country"[173]. Furthermore, according to the SDI stakeholders "the goal was and is to give special value to spatial information within the strategic documents"[174]. In the Operational Programme Digital Poland, the presentation and provision of spatial data is mentioned as a priority multiple times and as a key area for e-services at the national level[175]. Furthermore, the Specific objective 2: high availability and quality of public e-services of the Operational Programme highlights the

[165] https://www.digitalwallonia.be/fr

[166] http://www.ensemblesimplifions.be/

[167] http://planmarshall.wallonie.be/

[168] https://overheid.vlaanderen.be/informatie-vlaanderen/en/flanders-radically-digital

[169] https://overheid.vlaanderen.be/sites/default/files/Conceptnota%20Vlaanderen%20Radicaal%20digitaal.pdf

[170] http://digitalbelgium.be/

[171] https://www.funduszeeuropejskie.gov.pl/en/site/learn-more-about-european-funds/look-through-the-documents/operational-programme-digital-poland-for-2014-2020/

[172] https://joinup.ec.europa.eu/news/pl-national-integrated-i

[173] Interview 1, Poland.

[174] Interview 1, Poland.

[175] https://www.funduszeeuropejskie.gov.pl/en/site/learn-more-about-european-funds/look-through-the-documents/operational-programme-digital-poland-for-2014-2020/

importance of supporting "*public entities in creating and developing modern e-services with a particular focus on services with a high level of e-maturity, security and integration, i.a. on the common platform of public administration e-services*". In this context, priority is given, amongst others, to the domains of spatial and statistical data[176] and support is made available for professional preparation of public sector information for its re-use, through for instance APIs[177]. All these references and lines of actions show how important SDI is in the context of the broader Digital Government Transformation and how well the inputs from the SDI community were integrated in the overall strategic documents of the country.

— Finally, in the Netherlands, different strategies have shaped, since 2008, the development of SDI also in the broader context of Digital Government Transformation. A key document in this respect was the 2008 GIDEON Strategy[178], in which the strategy and implementation approach for the SDI between 2008 and 2011 was defined. At that time, the development of the SDI was positioned in the radical modernization exercise the Dutch government was involved in. Optimum utilization of geo-information and combining multiple sources of data in an intelligent manner should "substantially improve the services, enforcement, policy preparation and other processes with the government". Among the seven implementation strategies to build a key geo-information facility for the Netherlands were "to give geo-information an appropriately prominent place within e-services", "to encourage the use of geo-information in numerous government policy and implementation chains, such as safety, the sustainable living environment, mobility, and area development" and "to create a favorable climate for adding economic value to available public authority geo-information". In 2014, the Dutch government, private sector and the scientific community presented a joint vision on the future of the location-based information sector in the 'Partners in Geo' vision document[179]. By 2020, Netherlands should have reliable, accessible, up-to-date and multi-scale location-based information services. As a result, "the possibilities for using location-based information in the daily lives, in the governmental services and in the businesses of the private sector would be changed immensely". The Partners in Geo vision strongly focuses on the importance of geographic data to address key societal challenges and the need for improved cooperation between government, the private sector and the academic sector. A discussion was provided of the transformative effects of geo-information on key sectors such as health care, spatial planning and transport, energy, construction and water. The development of the national SDI – to a certain extent - follows the key principles and approach as defined in the Partners in Geo vision. Developments related to Digital Government and Digital Transformation are also recognised as important drivers. This for instance applies to NL DIGIbeter, the Agenda Digital Government[180], which is the most recent policy document on digital government in the Netherlands. Moreover, the further development of the national SDI can also be linked to the Rutte III coalition agreement 'Confidence in the future' of October 2017. This agreement not announces the further digitization of the Dutch public administration, but also contains several statements on – or closely related to – geo-information, such as the creation of a database for spatial data that should facilitate the release of information[181]. Geonovum made a detailed investigation of the coalition agreement, and formulated a set of actions related to the use of geo-information to address the challenges mentioned in the coalition agreements.

As the analysis above suggests, the different approaches for strategic planning of the countries reflect those found at the more general level and consist in:

— No or limited overarching strategy but reference to SDI in programming and strategic documents linked to Digital Government Transformation (i.e. Spain).

— No or limited strategy at the national level but strategic exercises carried out at the regional level (i.e. Belgium).

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176 https://www.funduszeeuropejskie.gov.pl/en/site/learn-more-about-european-funds/look-through-the-documents/operational-programme-digital-poland-for-2014-2020/

177 https://www.funduszeeuropejskie.gov.pl/en/site/learn-more-about-european-funds/look-through-the-documents/operational-programme-digital-poland-for-2014-2020/

178 https://www.geonovum.nl/sites/default/files/GIDEON2008-2011_Engels.pdf

179 https://geosamen.nl/wp-content/uploads/2014/11/GeoSamen-UK-1.pdf

180 https://www.digitaleoverheid.nl/wp-content/uploads/sites/8/2018/07/nl-digibeter-agenda-digitale-overheid.pdf

181 https://www.geonovum.nl/uploads/documents/Vertrouwen%20in%20de%20toekomst%20-%20uiteraard%20met%20geo-informatie%21.pdf

— Strong integration of SDI aspects in Digital Government Transformation programming document and prioritisation of SDI in this context (i.e. Poland).

— Specific SDI strategies and action plans linking this topic to the broader Digital Government Transformation (the Netherlands).

Although one could imagine these approaches plotted on a continuum going from "no strategy" to a "full dedicated strategy", understanding these different approaches in such a liner way would not be correct. In fact, the integration of SDI aspects in Digital Government Transformation strategies cannot be considered better or worse than having a dedicated SDI strategy linking this with digital transformation. On the opposite, the diversity of strategic possibility corresponds to the specific characteristics, trajectories and needs of the countries and the effectiveness of one or another strategy cannot be easily generalised.

2.2.2.2 Existence of a strategy on skills and training

This diversity across countries is also reflected in the second strategic indicator concerning the existence of a strategic approach for training and capacity building. The table below summarises the findings concerning this indicator across the four countries analysed in-depth.

Table 6 - Training approaches of Poland, Spain, Belgium and the Netherlands

	Poland	Spain	Belgium	The Netherlands
Existence of a training strategy	The Operational Programme Digital Poland 2014-2020[182] sets a vision in terms of training and capacity building also with respect to spatial literacy: "*training measures are necessary to increase the level and skills of using spatial data and spatial data services in Poland as a necessary element to improve the effectiveness of implementation of the tasks of administration, including tasks related to investment and construction process* ".	No formalised digital skill plan including SDI could be found.	Development of HR plan at the National Geographic Institute (NGI), using the 'Tasks' and 'Actors' vocabularies of the INSPIRE in Practice platform. 'Digital Skills and Jobs' as one of the five priorities in the Digital Belgium Strategy. Knowledge transfer and awareness raising also recognised in several regional strategies	In the 'Partners in GEO' vision it is recognized that "structural and significant investment in training people to use location-based information in the Netherlands" is needed. In addition, there is a clear need "to invest in exchanging, coordinating and embedding knowledge within the triple helix if we are to fulfil this vision".
Type of training activities carried out and frequency	Large scale trainings were organised in 2011-2012 and divided in Expert training (which involved 240 participants, 130 hours of classes for everyone, 6 sessions, ¾ of time computer classes) and Base trainings (4700 participants, 30 hours of classes for everyone, 2 sessions, 2/3 of time computer classes and more than 20 locations)[183]. A new training activity, called "POWER" is currently being implemented. This initiative, which is smaller scale compared to the pilots run in 2011-2012, aims at educating public sector officials in terms of SDI[184].	Different type of training activities are carried out: Big conferences for more general awareness raising Development of online trainings provided through the national geographic institute website[185] Specific training sessions for regional and local officials which provide some basic technical information on the SDI	Different types of training and awareness raising activities are organised: Regular workshops, seminars and trainings organised at the different levels, on SDI/INSPIRE implementation but also other aspects related to SDI and digital transformation Annual big conference organised at the federal/national level, but also in some of the regions	Several relevant initiatives and actions: For online training, a reference is made to the Geospatial Knowledge Base (GKB) Training Platform of the EC, several online WIKIs are available and webinars are organised regularly Several big conferences for the broader geo-community Regular training and knowledge sessions and events on particular topics
Target of the training activities	Public officials	General public (through big conferences and online trainings) and regional and local officials through specific training sessions.	Training of mainly public officials, awareness raising targeted also at private and academic sector.	Knowledge transfer to and awareness raising of public, private and academic stakeholders

Source: Deloitte and KU Leuven, 2019

[182] https://www.funduszeeuropejskie.gov.pl/en/site/learn-more-about-european-funds/look-through-the-documents/operational-programme-digital-poland-for-2014-2020/

[183] Ewa Surma, Marcin Grudzien, Implementing INSPIRE in Poland, Webinar on INSPIRE implementation in Poland and the Netherlands, 11 February 2015

[184] Interview 1, Poland.

[185] http://www.ign.es/web/ign/portal/recursos-educativos

As shown in the table, Poland represents a best practice in terms of development of a strategy of training and carrying out wide capacity building initiatives within the public sector. However, the approach of the other countries is also very interesting and for instance the fact that Spain targets both public sector and the general public through its training activities. Once more, the experience of these four countries provide additional examples of the general trends identified and confirm the diversity of perspectives in this area.

2.3 Legal Framework

Main messages:

- The interactions and integration between SDI and Digital Government Transformation do not happen in a policy and legislative vacuum, quite the opposite. On top of dedicated strategies (discussed in the previous section), countries (and the European Union) have developed and implemented legislative and policy measures providing a framework for the SDI and Digital Government Transformation activities. This framework consists of course of the INSPIRE Directive but can also include aspects related to national rules, for instance on the compulsory reuse of the spatial data infrastructure for the development of new public services or on the alignment with open data policies (in terms of standards, licenses etc.). While the use of SDI and the requirement to share spatial data amongst the public administration is of course a consequence of the INSPIRE Directive and its implementing legislation, this analysis focuses more on the additional legal measures taken by the twenty-nine countries in scope.
- In a few countries in fact, the discussion around base registries and implementation of the once-only-principle led to developing additional measures (on top of the INSPIRE Directive) concerning the use of the SDI by the public sector and in the context of the development of new public services. However, this remains rather the exception and most countries have opted for additional non-binding and non-legislative mechanisms and incentives for further pushing public administrations to use the SDI, as the case of Spain illustrates very well. Nonetheless, it could be expected that, due to further work on the application of only-once-principles also defined in the INSPIRE Directive, countries might move towards imposing stricter rules on the use of the SDI to the public sector in the future.
- Most countries have been successful in aligning the development and implementation of the SDI with the national open data agenda and enhancing the interaction between both. This is also confirmed by analysis of the European Data Portal and the high scores European countries obtain in terms of solidity, coordination and alignment of data policies[186]. In many European countries, spatial data were among the first types of government data to be opened, and still represent a large portion of the open data. Recent initiatives focus on stimulating and supporting businesses and other innovators in using open geospatial data, in order to maximize the benefits of open geodata to society.

Legal framework indicators concern those aspects which constitute the policy or legal background surrounding SDI and Digital Government Transformation. Countries in fact can decide to establish binding rules reinforcing the use of the SDI at the national (and/or regional and local) level and they can align to different extents SDI policies and strategies with other related initiatives (such as the open data agenda). These two aspects, obligation to use the SDI and to share spatial data within the context of the public sector and alignment with the national open data strategy, represent the focus of the indicators concerning the legal framework which are defined as follows:

- The use of SDI for eGovernment services is mandated/defined by law.
- A well-defined government-wide policy on open data is in place and also applies to geospatial data.

Although they belong to the same category, the two abovementioned indicators are very different from each other for two main reasons:

- The first concerns hard law and binding rules imposing something on stakeholders while the second relates to softer policy instruments governing open data.
- The first is much more future looking than the second considering that, as it will be further explained below, the existence of an additional legal mandate for the compulsory use of SDI (on top of the obligations deriving from the INSPIRE Directive[187]) does not seem to be the norm yet. However, other soft incentives for the use of SDI exist and the alignment of SDI and Open Data policies is quite frequent across countries.

The following sections develop on these two aspects and look at all countries in scope before digging into the analysis of Spain, Poland, Belgium and the Netherlands.

[186] https://www.europeandataportal.eu/en/dashboard#2018

[187] I.e. the obligation of use SDIs for the development of digital services

2.3.1 Analysis of the 29 countries in scope

2.3.1.1 The use of SDI for eGovernment services is mandated/defined by law

While in most European countries the legal framework on SDI mainly consists of national legislation transposing the INSPIRE Directive, some countries have developed additional legislation on other aspects and components of the SDI. This legal framework can cover aspects such as the composition and tasks of coordinating bodies, governance, and the obligations of different data providers or particular rules on access and re-use conditions. Also legislation on public sector information and/or open data can be considered as part of the legal framework that is relevant to the SDI, as it affects the conditions for access and re-use of geospatial data, on top of the sharing requirements of the INSPIRE Directive.

In some countries, the legal framework also contains legislation on so-called base registries (or key registries), i.e. trusted, authentic sources of basic information on items such as persons, companies or vehicles, but also on locations, buildings and roads or unique identifiers. These base registries, and the 'basic data' in these registries, are key components of Digital Government Transformation, since they are enabling the Only-One Principle[188]. Public administrations can re-use the information in these registries, and do not have to ask citizens or business to provide this information again or collect the information themselves. Moreover, the quality and accuracy of the data is ensured, and the registries are recognised as the most valid source of information. Some European States have implemented a system of base registries that also involves a mandatory reuse of the SDI for public administrations:

- Around 2000, **the Netherlands** started with the preparation and development of its system of base registries, which currently includes 10 base registries. The 2004 Legislative note on base registries provided the first exploration for legislation on base registries providing data on persons, companies, buildings, real estate, addresses and geographic maps. Each of these base registries are compliant to the 12 agreed common principles and is arranged by law. Among the spatial key registries are the Registry of Addresses and Buildings (BAG), the Cadastre (BRK), the Topography Registry (BRT), the Registry Large Scale Topography (BGT), and the Registry of the Subsurface (BRO). Besides these base registries, the Netherlands also has several other spatial data registries that are arrange by law, such as the Registry for Spatial Plans and the Cables and Pipelines Registry[189].
- **In Flanders (Belgium),** the 2009 Decree on the Spatial Data Infrastructure Flanders introduced the concept of Geographical Base Registries. The Decree states that the use of these base registries, of which the quality in terms of accuracy, completeness and up -to-dateness will be guaranteed, is mandatory for all public tasks. In 2011, the Central Reference Address File (CRAB) became the first Geographical Base Registry in Flanders. In 2016, also the Large-scale reference database (GRB) was recognized as a base registry. Both data sets are used in several key decision making and service delivery processes in Flanders[190].
- In 2011, **Denmark** launched its Basic Data Program, with the aim of ensuring the re-use and avoiding the duplication of key data about individuals, businesses, real properties and geography[191]. The Basic Data Program is about the establishment of a common basic data infrastructure to ensure that data are made accessible and easy to use by the public and the private sectors, and that all data conform to the same technical requirements. The basic data need to be as correct, complete and up-to-date date as possible, and also, as far as possible, freely available to businesses and the public. All public authorities must use the basic data. *'Open and efficient access to geographic data'* was one of the seven key priorities of the Basic Data Programme, and geographic data sets were under the scope of the programme. Among the geodata considered as basic data sets, and thus freely available since the beginning of 2013, are the land register, the geographical boundaries (the National Administrative

[188] See : Vassilios Peristeras, "The importance of Base Registries in the implementation of the "onceonly" principle", November 2015, https://ec.europa.eu/isa2/sites/isa/files/presentations/base-registries-vp.pdf

[189] See: INSPIRE in the Netherlands, National Implementation Webinars, https://ies-svn.jrc.ec.europa.eu/attachments/download/930/Netherlands_INSPIRE_implementation_20150211.pdf

[190] See: Geographical Base Registries for Flanders, INSPIRE Conference 2015, Lisbon, Portugal, http://inspire.ec.europa.eu/events/conferences/inspire_2015/pdfs/Ziggy_Vanlishout.pdf

[191] See: Good basic data for everyone – A driver for growth and efficiency, The eGovernment Strategy 2011-2015, https://uk.fm.dk/~/media/publikationer/imported/2012/gode-grunddata-til-alle/basicdata_uk_web_2012.-d-.10.-d-.08.ashx?la=da

Geographical Classification), Denmark's elevation model, the national geographical names, and the so-called Map Data.

— With act no. 111/2009 Coll., a system of base registers was established in the **Czech Republic**. The system of the base registers consists of four registers: the Register of Inhabitants, the Register of Legal entities, the Register of Rights and Responsibilities and the Registrer of Territorial Identification, Addresses and Real Estates Property. The Base Register of Territorial Identification, Addresses and Real Estates (RUIAN) contains data on administrative units, buildings, addresses, streets and public spaces, geographic names and election districts, as open data. The Czech Office for Surveying, Mapping and Cadastre is administrator of RUIAN, while editing of the data is done mainly by municipalities, building authorities, and the local cadastral offices[192]. RUIAN is the only reference source for data about addresses in the Czech Republic, which means all other information systems of public authorities use the address data of RUIAN. In 2016, the original act was replaced by a new Act no. 192/2016 Coll, which affected all base registers, and aimed to better reflect more recent needs to the eGovernment infrastructure.

It is especially through these systems of base registries, and associated legislation mandating the use of the data in these registries, that some European countries have reinforced and complemented a legal framework for mandating the use of SDI data and services by public services. It should however be noticed that only a small number of European countries are mandating the use of SDI data through this type of legislation. . In this respect, this indicator can be considered as quite future oriented as the implementation of the only-once-principle might push for the establishment of rules concerning reuse of national data infrastructures. Currently, many countries prefer relying on soft mechanisms and persuasion to increase take up of SDI amongst public authorities and the case of Spain, further described below, represents one of the best examples in this domain.

2.3.1.2 A well-defined government-wide policy on open data is in place and also applies to geospatial data.

In the past twenty years, open data initiatives have been launched in various European countries, supported by open data strategies, action plans, legislation and other policy instruments at the national and European level. Since, **in most cases, spatial data also fall under the scope of these initiatives, the implementation of these open data agendas became an important driving force in the further development and implementation of national SDIs**. In many countries, spatial data were among the first types of government data to be opened, and still represent a large portion of the open data as well as one of the most valuable categories of data for reuse[193].

In all countries, efforts have been made to align national open data policies and SDI policies and enhance the interaction between and these have been generally successful, as also shown by the results of the Open Data Maturity index on Open Data policy alignment and coordination[194]. These efforts can concern the adoption of common standards or licenses coving both open data and SDI or the development of common guidelines for all public authorities. However, the magnitude of these efforts and the extent to which this alignment take place can vary across countries. Amongst the countries in which the strongest alignment took place one could list:

— The **United Kingdom**: already in the very first stages of the development of national open data agenda, spatial data was recognised as a key type of government data that should be opened in order to promote transparent and effective government but also social and economic innovation. The Power of Information Task Force which was established in 2008 to investigate and develop UK's open data agenda, recommended to open the country's mapping and address data for use in new products and services[195]. Most recently, the need to open geospatial data and support businesses and other innovators

[192] See: Implementation of INSPIRE in the Czech Republic, National Implementation Webinars, https://ies-svn.jrc.ec.europa.eu/attachments/download/1460/CzechRepublic_INSPIRE_implementation_20160211.pdf

[193] See : Deloitte, Study to support the review of Directive 2003/98/EC on the re-use of public sector information, 2018, https://publications.europa.eu/en/publication-detail/-/publication/45328d2e-4834-11e8-be1d-01aa75ed71a1/language-en

[194] https://www.europeandataportal.eu/en/dashboard#2018

[195] See: Power of Information Task Force Report, https://powerofinformation.wordpress.com/2009/03/04/final-report

to use these data is expressed in both the 2017 Government Transformation Strategy and the UK Digital Strategy[196].

- **Sweden**: Open geodata is one of the four main goals for the period 2016-2020 stated in the Swedish National Geodata Strategy (2016-2020)[197]. According to the strategy, "in order to achieve maximum benefit to society from public geodata, user financing must be replaced by other forms of funding that facilitates the broad use and dissemination of this data within society". The strategy also proposes several examples of actions data providers could take to achieve this goal. These include promoting of collective financing of the SDI, clarifying which data could not be made available because of reasons of personal or national security, environmental protection or integrity protection, identifying other barriers to open data, modernizing legislation and monitoring the status of openness of open data in Sweden.
- **Italy**: the Piano Triennale per le Pubbliche Amministrazioni 2019-2021[198] provides a common framework and strategy to activities related to both the SDI and Open Data policies. In particular, this document brings together, under its heading 5 – Data, the SDI (linked to INSPIRE implementation) and the open data agenda. The document not only foresees as an immediate action the adoption of the standard Geo-DCAT-AP_IT across all geo-spatial datasets of the country but also indicates that the valorisation of data and data infrastructure (including SDI) is a priority for the Italian government[199].
- **Luxembourg:** in which the development of the national open data portal strongly followed the approach and principles of the national geoportal and therefore there is a strong dependency of the first from the latter, which results in great alignment.

In other countries the alignment between SDI and Open Data policies took the form of smaller scale initiatives such as the development of recommended (but not compulsory) common licenses as it is the case in Norway[200] and Germany[201] and the work on geo-spatial open data standards in Spain (see also next section). However, there are no countries in which some form of alignment did not take place and, for this reason, it can be argued that the SDI and Open Data policy frameworks are generally and sufficiently aligned in Europe.

2.3.2 In-depth analysis of Spain, Poland, the Netherlands and Belgium

When looking at Spain, Poland, the Netherlands and Belgium in particular, the team could identify further examples of the trends and findings illustrated in the previous sections.

2.3.2.1 The use of SDI for eGovernment services is mandated/defined by law

Concerning the first indicator on the legal framework, meaning the existence of a legal mandate for the reuse of SDI, **Netherlands has established binding rules at the national level and related to the question of base registries**, similarly to other countries listed above[202]. In 2000, the Netherlands started with the preparation and development of a national system of base registries, which currently includes 10 base registries. The 2004 Legislative note on base registries provided the first exploration for legislation on base registries providing data on persons, companies, buildings, real estate, addresses and geographic maps. Each of these base registries is compliant to the 12 agreed common principles and each is defined by law.

[196] See: Government Transformation Strategy 2017 to 2020, https://www.gov.uk/government/publications/government-transformation-strategy-2017-to-2020; and UK Digital Strategy, https://www.gov.uk/government/publications/uk-digital-strategy

[197] See: The Swedish National Geodata Strategy, Well developed collaboration for open and usable geodata via services, 2016-2020, Lantmäteriet, https://geodata.se/globalassets/dokumentarkiv/styrning-och-uppfoljning/geodatastrategin/national_geodata_strategy_2016-2020.pdf

[198] See: Agenzia per l'Italia Digitale, Piano Triennale per l'Informatica nella Pubblica Amministrazione 2019 – 2021, 2019, https://www.agid.gov.it/sites/default/files/repository_files/piano_triennale_per_linformatica_nella_pubblica_amministrazione_2019_-_2021_allegati20190327.pdf

[199] See: Agenzia per l'Italia Digitale, Piano Triennale per l'Informatica nella Pubblica Amministrazione 2019 – 2021, 2019, https://www.agid.gov.it/sites/default/files/repository_files/piano_triennale_per_linformatica_nella_pubblica_amministrazione_2019_-_2021_allegati20190327.pdf

[200] INSPIRE Country Report, Norway, 2016, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/NO

[201] See : Open Data Maturity in Europe, 2018 Report, Capgemini 2018, https://www.europeandataportal.eu/sites/default/files/edp_landscaping_insight_report_n4_2018.pdf

[202] Interviews1 and 2, the Netherlands.

One of these principles is that the use of basic registrations is compulsory for the entire government. This means that the data designated as authentic can be used in the work processes of government without further investigation, and it is not permitted to collect data that is already present within a basic registration. Among the spatial key registries are the Registry of Addresses and Buildings (BAG), the Cadastre (BRK), the Topography Registry (BRT), the Registry Large Scale Topography (BGT), and the Registry of the Subsurface (BRO). Besides these base registries, the Netherlands also has several other spatial data registries that are arranged by law, such as the Registry for Spatial Plans and the Cables and Pipelines Registry.

In Belgium, within the three regions and at the federal level, the legal framework mainly consists of legislation transposing the INSPIRE Directive. Only the Flemish SDI is characterized by a more comprehensive and robust legal framework, covering various aspects of the SDI. The SDI Decree of February 2009[203] goes beyond the transposition of the INSPIRE Directive into Flemish legislation, but also regulates the creation and objectives of the SDI in Flanders, the content of the SDI, the obligations of the participants relating to the SDI, the access and use of SDI, and SDI funding. The decree also covers the recognition of geographic data sources as authentic sources of data. While the composition of the steering committee, the GDI council, and access and use conditions were arranged via separate decisions, in 2016 a new decree was issued on the establishment of the Flemish Information and ICT Policy Steering Body. In addition to these decrees and decisions, specific legislation exists on various – authentic – datasets and types of geographic information, such as the 2004 Decree on the Large-scale Reference Database (GRB), the 2009 and 2012 Decrees on the Central Reference Address Dataset (CRAB), the 2008 and 2014 Decrees on the Cable and Pipeline information portal (KLIP) and the 2014 Decree on the Generic information platform public domain. These decrees all deal with the development, management, maintenance and obligatory use of specific data or information. The GRB and CRAB both are geographical base registries for Flanders, i.e. authoritative (geographical) data sources. These base registries have an important social relevance and are being used within relevant business processes of the government. Base registries are part of a semantic coherent system of objects and relations and describe the (real world) lifecycle of objects. All base registries are modelled according to the common 'Modelling rules for basic registers'. Registers only contain core information, and there is an obligation to report errors and use them for public tasks.

Spain and Poland on the other hand have a less "regulatory" approach to SDI and they rely on persuasion, soft push and displaying of benefits to convince public authorities to reuse this infrastructure (besides the binding rules established by the INSPIRE Directive). In Spain, SDI stakeholders and especially the National Geographic Institute have adopted a "soft" approach for the promotion of the usage of SDI, which has nonetheless proven effective. As one of the interviewees put it, the National Geographic Institute is taking a "step-by-step approach for convincing colleagues from all public authorities to use the SDI in their daily activities and this approach is based on the quality of the SDI rather than on the obligation to use it"[204]. This means proving the added value of the infrastructure in various domains: for instance, almost all public authorities now rely on map viewer based on the SDI rather than on Google Maps[205]. As underlined by the interviews this soft approach is producing good results and the progresses compared to five years ago are already significant[206]. "Although the public authorities are not formally obliged to use the SDI they use it nonetheless"[207]. In general, interviewees were quite optimistic about the take up of the infrastructure amongst public officials and they all explained that there is a good awareness on the existence of SDI services[208]. The approach based on persuasion and highlighting the added value of the SDI thus seems to replace well a formal legal framework for the use of SDI in eGovernment services.

In Poland, although there is no legal obligation for public sector services to use the infrastructure, **the Operational Programme Digital Poland strongly pushes for the development of SDI-based eGovernment services**. In particular, this comes as a consequence of the diagnosis on which the operational programme is based: in fact, the Council Recommendation on the National Reform Programme

[203] http://www.ejustice.just.fgov.be/mopdf/2009/04/28_2.pdf#Page25

[204] Interview 1, Spain.

[205] Interview 1, Spain.

[206] Interview 1, Spain.

[207] Interview 2, Spain.

[208] Interview 1, 2 and 3, Spain.

2013 of Poland and delivering a Council opinion on the Convergence Programme of Poland, 2012-2016[209] indicates that the country needs to increase the availability of eServices towards citizens and businesses[210]. The Operational Programme then makes it clear that particular attention must be paid to:

- "horizontal" functions,
- key areas of public e-services,
- improvement of access to public sector information and the possibility to reuse it,
- digitisation of internal administrative processes for improvement of external customer service"[211].

In this context, the document clearly refers to the need of making the SDI more accessible to public authorities and especially in terms to key datasets and services that can be reused for building eServices accessible to citizens and businesses (e.g. Cadastre, infrastructural networks etc.)[212]. Furthermore, make full use of the SDI is coherent with INSPIRE Directive implementation, the overall national strategy and also with the objective of making Polish public administration working more efficiently. Therefore, in the absence of a legislative framework, there are strong alternative mechanisms to foster SDI reuse.

As the analysis of these countries suggests, additional legislation concerning the use of SDI do not exist everywhere in Europe. However, there are other methods which are currently used to foster SDI take up and these can take different forms going from a showcase and benefits-based approach (i.e. Spain) to more strategic pushed (i.e. Poland). In the future, based on the need to progress further in the implementation of Digital Government Transformation and better leverage SDIs for applying the once-only-principles laid down by the INSPIRE Directive and reiterated in the Tallinn Declaration[213], we expect that additional countries will legislate in the domain of base registries. However, today this process is only at its start.

2.3.2.2 A well-defined government-wide policy on open data is in place and also applies to geospatial data.

Contrarily to the first indicator discussed above and as mentioned in the previous section, open data policies are being developed since the early 2000s and all countries in scope of the assignment have been active in this domain. Concerning our four shortlisted countries, there is a general strong alignment between SDI and Open Data Policies although with some differences amongst countries:

- **In the Netherlands**, the development of the national SDI is strongly in line and linked with the national open data agenda[214]. Already in 2011 the Ministry of Infrastructure and Environment, the ministry in charge of the development of the SDI, adopted an open data policy for the entire ministry, and announced that by 2015 all data of the ministry and its departments had to be made open. The ministry responsible for open data and access to public sector information, however, was 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, followed by a national open data agenda. Together with the Ministry of Economic Affairs, both ministries were involved in the Open Geodata Breakthrough project, which was launched in 2013 with the aim to address different – technological, organisational, legal and financial – barriers to the re-use of geodata[215]. **The Open Data Breakthrough Team brought together representatives from these three ministries with representatives of the private sector and academia. The Open Data Breakthrough project investigated the barriers to the reuse of geodata, organised several innovation meetings on bridging open data supply and**

[209] Recommendation for a COUNCIL RECOMMENDATION on Poland's 2013 national reform programme and delivering a Council opinion on Poland's convergence programme for 2012-2016, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52013DC0371

[210] https://www.funduszeeuropejskie.gov.pl/en/site/learn-more-about-european-funds/look-through-the-documents/operational-programme-digital-poland-for-2014-2020/

[211] https://www.funduszeeuropejskie.gov.pl/en/site/learn-more-about-european-funds/look-through-the-documents/operational-programme-digital-poland-for-2014-2020/

[212] https://www.funduszeeuropejskie.gov.pl/en/site/learn-more-about-european-funds/look-through-the-documents/operational-programme-digital-poland-for-2014-2020/

[213] Tallinn Declaration on eGovernment at the ministerial meeting during Estonian Presidency of the Council of the EU on 6 October 2017, p. 2, https://ec.europa.eu/newsroom/document.cfm?doc_id=47559

[214] Interview 1, the Netherlands.

[215] See: Open doorbraakproject Geodata 2013-2016, https://www.geobusiness.nl/startpagina-open-geodata

reuse, and funded the development of the Geodatastore, a service that provides a simple way for governments to publish their open data on the web. The release of the national elevation dataset as open data in March 2014 is often seen as one of the main outcomes of the Breakthrough project. Another important development in the Dutch SDI was the introduction of the 'Creative Commons, unless' principle in 2014 for datasets under the themes of INSPIRE. **From that moment, Governments had to apply one of the Creative Commons licenses when making their data available, unless they wanted to impose specific conditions the Creative Commons framework does not cover.** Many data providers use Creative Commons Zero, while the Public Domain Mark is especially used by the provinces. **In case data providers want to impose specific conditions, they have to make use of the GeoGedeeld framework.** This framework is built on a set number of standard conditions, allowing each data owner to specify which of the conditions for use were applicable to his/her data or services.

— **In Belgium** and especially in Flanders there is also a **high level of alignment between the open data policy of the government and the SDI policy**. Open data is currently seen as the 'default policy' within the Flemish administration. The first step towards a Flemish open data policy was taken in 2011, with the approval of the memorandum on open data[216]. The memorandum contained a number of strategic guidelines on open data in Flanders, with the aim of bringing Flanders at the same level as the leading countries in open data. An important development was the **creation of a license framework consisting of several standard licences for the provision of open data by entities in Flanders**. Flemish public administrations now can chose among three standard licenses for publishing data as open data[217]: a creative commons zero declaration, a model license for free re-use and a model license for re-use for a fee. **If a public administration wants to deviate from these model licenses, approval of the Flemish Information and ICT policy steering body is needed**. The latest development with regard to open data Flanders is the **adoption of the Open Data Charter in May 2018**[218]. The open data charter contains 20 general principles with regard to open data and is a clear declaration of intent from all Flemish departments and agencies, provincial and local authorities to take further steps with regard to the realization of open data. **'Open by default' and 'comply or explain' are the first principles**. Open data is the standard, and if data is not open, an explanation should be given why this is the case. Almost all spatial datasets in the Flemish SDI currently are available as open data. **At the federal level**, the Deputy Prime Minister and Minister of the Digital Agenda and Telecoms in July 2015 announced the **adoption of the open data strategy for Belgium** in order to strengthen the digital ecosystem and the evolution towards leaner, more efficient and modern administration. **Open data is included as a key element in the Digital Belgium strategy under the priority of 'Digital Government'**. It is stated that: *"Public data belonging to the federal government must by definition be accessible, with a few exceptions based on privacy and security. Transparent access to data means a better democratic process. That is why we will ensure that this data is accessible in a user-friendly manner using a single open data portal."* Several providers of spatial data at the federal level make their data available as open data. In the Brussels Capital Region, leading organisations and data providers such as the CIBG and Brussels Mobility already in 2014 decided to share their geodata under a regional open data license. Becoming an 'Open Region' is one of the four challenges in *Smartcity.brussels*, the smart city strategy for the Brussels-Capital Region, developed by the CIBG[219].

— **In Poland**, the only legal and policy regime that interviewees mentioned in relation to open data and from the SDI perspective is the national transposition of the Public Sector Information (PSI) Directive[220]. On top of this, **spatial data owners need to coordinate with the open data portal (opendata.gov.pl)** as many geo-spatial datasets are also included in the open data portal's collection. However, this is a "loose and fruitful collaboration" which is not based on a mandatory license[221].

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[216] https://overheid.vlaanderen.be/sites/bz.vlaanderen.be/files/VR_2011_2309_DOC_0959-1_BIS_Beleid_met_betrekking_tot_open_data.pdf

[217] https://overheid.vlaanderen.be/informatie-vlaanderen/ontdek-onze-producten-en-diensten/voorwaarden-voor-het-hergebruik-van

[218] https://smart.flanders.be/open-data-charter/

[219] https://cibg.brussels/nl/het-cibg/een-strategie-smart-brussels

[220] Directive 2003/98/EC of the European Parliament and of the Council of 17 November 2003 on the re-use of public sector information, https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32003L0098

[221] Interview 1, Poland.

— Finally, it is interesting to note that **Spain** is an open data champion in Europe, and a "trend setter" according to the classification of the European Data Portal, which considers four main aspects related to open data and notably policies, portals, impact and quality[222]. Furthermore, as proven by one of the presentations delivered at the INSPIRE Conference 2018, there is a high level of awareness in Spain concerning the need not only to provide data for free and with an appropriate license but also to "lower all barriers for reuse"[223]. This demonstrates that **Spain has gone quite far in open data thinking already**. Nonetheless, the interviewees seem to suggest that there is no "government wide policy" on open data as defined in our indicator[224]. Interviewees referred of course to the Spanish transposition of the Public Sector Information (PSI) Directive[225] but explained that no other programming document provides an overarching open data vision for the country. This may contradicts the score that Spain obtains with respect to the presence of an open data policy framework in the European Data Portal ranking[226] but no further information on how the country obtained this score could be found and therefore it could suggest that soft measures were enough in that case[227]. Based on the information provided by the interviewees, although there seems not to be an obligation to do so, **in Spain most organisations publish their data in the data.gob.es portal as the government is pushing the different data providers to link to this website**[228]. One of the interviewee also mentioned that "the geographic information committee of the Spanish standardisation body (UNE) has elaborated a standard for open geographic data in 2018"[229]. **This standard is called UNE 148001:2018 – Open Geographical Data and it has been defined by the UNE working group on geographic information**. According to this standard, Open Geographic Information must be: available, documented, under an open license and in an open format[230]. This is considered by one of the interviewee as a big step forward in terms of open data policy and SDI[231]. However, as one of the interviewee regretted, no generic standards for open data is available at the national level[232]. Furthermore, there is no overall license policy for open data: according to one of the interviewees, the government promotes the use of Creative Common license (CC BY 4.0) but there is no formal obligation to use it and not everybody follows this instruction[233]. According to another interviewee however, the government does not promote the use of Creative Common license but simply the use of a standard license. Based on these contradicting information it can be argued that no formal policy on license exists and is applicable to spatial data or that, at least, there is no obligation for different data providers to follow central government's instructions.

To conclude, alignment between SDI and Open Data policies is present in all countries as open data initiatives have been around for a couple of decades and geo-spatial information are particularly important in the context public open data as also highlighted by the recent revision of the Public Sector Information Directive[234]. However, this alignment can be more or less strong and especially when it comes to license and standards. Furthermore, looking at open data policies from the SDI perspective highlights some possibilities for improvements and some challenges that might still exist in ensuring coherence between these domains.

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[222] https://www.europeandataportal.eu/sites/default/files/country-factsheet_spain_2018.pdf

[223] Antonio F. Rodriguez, "All you need is Data. The Spanish new standard for Open GeoData", INSPIRE Conference 2018, https://inspire.ec.europa.eu/conference2018

[224] Interview 1, Poland.

[225] Directive 2003/98/EC of the European Parliament and of the Council of 17 November 2003 on the re-use of public sector information, https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32003L0098

[226] https://www.europeandataportal.eu/en/dashboard#tab-map

[227] This point needs to be further investigated for the final report.

[228] Interview 3, Spain.

[229] Interview 1, Spain.

[230] Antonio F. Rodriguez, "All you need is Data. The Spanish new standard for Open GeoData", INSPIRE Conference 2018, https://inspire.ec.europa.eu/conference2018

[231] Interview 1, Spain.

[232] Interview 1, Spain.

[233] Interview 2, Spain.

[234] https://ec.europa.eu/digital-single-market/en/proposal-revision-public-sector-information-psi-directive

In this respect, the situation of Spain seems to deserve some further analysis as the contradictions in the data could not be entirely clarified in this study.

3 Analysis of technical infrastructure

The indicators on the technical infrastructure aimed to assess the degree to which SDI/INSPIRE development and implementation in European countries goes beyond the traditional components of an SDI. The aim is to explore to what extent additional components have been added to the SDI, to further improve the access to and use of geospatial data. Also the alignment with and integration of more general ICT and e-Government infrastructure developments is investigated, as well as approaches for monitoring of and experimenting with new and emerging technologies.

It should be noticed that the development and implementation of SDI/INSPIRE in Europe already led to the development of coherent and standardized technical infrastructures in all European countries, with high levels of semantic and technical interoperability. The impact of these infrastructures and their contribution to the Digital Transformation of Government should not be underestimated. A huge amount of geospatial data is made available, easily accessible and reusable, and can be used to support service delivery and decision making in the public sector. Both at national and at the European level, the development of SDI/INSPIRE can be considered as one of the major data interoperability initiatives.

In this chapter, however, the focus is not on the impact already achieved by SDI/INSPIRE, but on efforts to develop additional components on top of the traditional implementations of SDI/INSPIRE. Indicators on the technical infrastructure cover three important aspects:

- **Extended infrastructure:** these indicators cover the development of additional components beyond the components as required by INSPIRE. Specific attention is given to the development of API's on top of INSPIRE/SDI.
- **Interoperability:** these indicators focus on joint efforts to improve the interoperability of data, integrate data collection flows or establish links between different platforms, portals and catalogues
- **Innovation:** deals with how countries are dealing with generic ICT solutions, such as solutions designed under the ISA/ISA^2 programme, and new technological developments. The indicators cover the extent to which these solutions and new developments are investigated, tested and incorporated in the SDI/INSPIRE.

In this chapter, we describe in detail each of these three indicators and provide an analysis of the situation in the 29 countries in scope, followed by a more detailed analysis of the situation and developments in Belgium, Poland, the Netherlands and Spain.

3.1 Extended infrastructure

Main messages

- In addition to the mandatory web services as required by INSPIRE, most European countries also developed and implemented other types of web services, all based on a Service Oriented Architecture, which is also the basis for many e-Government infrastructures. Examples of such services are web-processing services, gazetteer services, sensor web enablement services and invoking services. In some countries, after an initial phase in which the focus has been on developing as many services as possible, the strategy switched to developing less services but of a better quality. New and innovative approaches for publishing spatial data on the web are also being explored in various countries. This is part of an overall trend towards a making spatial data accessible and usable for a broader range of user groups, also including developers and non-expert users. In this context, platforms are seen as a way of delivering geospatial data to users through different channels and in different formats. Communication and exchange of knowledge and experiences between data providers, users and other stakeholders is also supported by these platforms.
- There is a clear trend towards the set-up of registries as additional components to extend and support the functioning of SDIs. These registries relate to generic elements such as code lists, thematic vocabularies etc., but also to the univocal definition of specific thematic registers such as addresses, buildings, etc. Some countries try to systematically use registries, sometimes even mandated by law (see analysis of the institutional setting), while others are still in their initial stage. In some countries, registries are in place for the entire government information infrastructure, which clearly shows the role and position of the SDI in this broader information infrastructure.

— One of the key elements for an improved disclosure and uptake of SDI components for the Digital Transformation of Governments are APIs, which allow developers to deploy new applications more easily. These API's are more and more widespread and have nowadays become part of the national SDIs in many cases. To streamline API-related activities across different organisations (and sectors), several countries worked on the development of a national API strategy, in which also standards for APIs are investigated.

Following the publish-find-bind principle, the technical infrastructure of SDIs traditionally consists of different services making it possible to *discover, view and download* spatial data. With the development of other types of services, on top of those mentioned above, but also of other SDI components, data providers aim to further improve the access to and uptake of geospatial data.

Two different indicators have been defined to explore and keep track of the extent to which European countries have extended their SDI with additional components:

— The SDI goes beyond what a traditional SDI or INSPIRE requires by developing additional components in the infrastructure

— Application Programming Interfaces (PI's) have been developed on top of INSPIRE/SDI

While the first indicator aims to investigate the development and implementation of additional components – beyond traditional SDIs – in general, a separate indicator was defined to investigate the development of application programming interfaces (APIs) on top of the SDI. Enabling access to spatial data via such APIs makes it easier for programmers and developers to reuse and integrate data in their own applications and environments.

3.1.1 Analysis of the 29 countries in scope

3.1.1.1 The SDI goes beyond what a traditional SDI or INSPIRE requires by developing additional components in the infrastructure

Most SDI developments in the different Member States still strongly focus on the mandatory network services to discover, view and download geospatial data. However, **in recent years several Member States started developing and setting up other types of services, as additional components of the infrastructure**. Examples of these are:

— Web Processing Services,

— Gazetteer Services,

— Sensor Web Enablement Services (mostly Sensor Observation Services), and

— Invoke Services for invoking other services to support working processes.

Overall, the development of these 'additional' services still is in an initial stage, and relatively little of these services are fully operational. Nonetheless, **examples of such additional services, often in combination with the establishment of specific platforms supporting the delivery and access to these services can be found in several Member States**. **Lithuania**, for example, has developed a geoportal that goes beyond the traditional 'publish-find-bind' paradigm, but offers a series of services for various domains: a tourism data management tool for tourism centres; maps and tools for education; maps and tools for government; etc.[235]. New projects are planned or ongoing such as a National Spatial Data Cloud, e-services for surveyors and for planners, and e-services to assess land characteristics. Other interesting developments and practices can be seen in the Netherlands, Spain and Belgium. They are detailed in section 3.1.2.

Another component that is increasingly considered as a valuable asset and added to the NSDIs are registries. Often, registries related to or relevant to the SDI are part of a national government-wide system of registries. Registers are fundamental for reaching data interoperability and foster data harmonization efforts and they also serve as cross-border and cross-domain components of the different NSDI. Some registries are supporting SDI implementation (e.g. the ARE3NA Re3gistry and related services

[235] https://www.slideshare.net/geoportalas/inspiring-capabilities-of-usinglithuanian-spatial-data-portal

with the application schema, the feature catalogues, code lists for metadata, etc.) or are a component of the data infrastructure itself. A growing number of countries have now engaged in the usage and set-up of registers as part of their infrastructure.

- The **German** SDI, the GDI-DE, has since its initiation developed many registries in support of its infrastructure. Some of the more generic registers are used such as the Organisationen-Register; Namensraum-Register. But GDI-DE also developed their own registries such as: Codelisten-Register; INSPIRE-Monitoring-Register; also Schema-Register and CRS-Register (a register of Coordinate Reference Systems for the whole of Europe)
- **Latvia** has a National Register of Information Systems[236], a structured set of information technologies and databases, which provides the initiation, creation, compilation, accumulation, processing, use and destruction of information necessary for the performance of state functions. It provides an opportunity for any interested party to obtain information on the national information systems. The State Information Systems Register Manager is the Ministry of Environmental Protection and Regional Development.
- The **Austrian** INSPIRE Registry has been set-up for testing a federated system of registers in support of INSPIRE. The Austrian INSPIRE Register can be seen as a national extension of the given INSPIRE vocabulary. It is based on the ARE3NA Re3gistry software. An example of a thematic vocabulary is the Lithological Classification of Austria[237]. The vocabulary consists of a description of lithologies of consolidated and unconsolidated rocks, which are classified according to their modal composition or grain size. The classification follows International community standards (IUGS).

3.1.1.2 API's have been developed on top of INSPIRE/SDI

Application Programming Interfaces (APIs) are a set of routine interfaces, communication protocols and tools to design and develop applications, usually on top of existing components of an information infrastructure. **In the context of SDIs, APIs are considered as a key mechanism to integrate and use the spatial data and web services within applications and they are often conceived as building blocks to be used by developers**.

In recent years, several European countries have developed an approach to APIs and offered them to the geospatial and ICT community, as part of their SDI or INSPIRE developments. APIs are also seen as a mechanism to make spatial data more usable, since access through applications is easier for most (end) users and developers that are less familiar with spatial web services.

- **France** was one of the first countries that developed APIs and added them to the geoportal of the National Geographic Institute. In this way, other organisations, such as local authorities, could integrate maps in their own website without additional developments. The APIs were offered together with a set of good documentation to make their usage very straightforward. Furthermore, Frances has developed a national API catalogue (api.gouv.fr) where all national and regional APIs available are listed and referenced (including several SDI relevant APIs i.e. the API Géo, API Carto API Lppk4Géoportail, Base d'addresse nationale[238]). This constitutes a further step for facilitating reuse of SDI by developers and communicating about available interfaces and datasets.
- In **Sweden**, Lantmäteriet (the National mapping Agency) provides several API's and has developed a dedicated API portal[239]. The portal is meant to help implementers and users to better organise the access to the spatial data services. The API portal is available for both the production environment and the verification environment (testing and validation) for geodata. Users of the portal log on to the respective environments of the API Portal to manage services and privileges for that particular environment. As a logged user, you can see and manage the services, create authorization keys, access groups and also see usage statistics.
- Ordnance Survey **Ireland** has developed several API's to better disclose some of the datasets. For example, it provides an API based on an ESRI RESTful service to access data regarding OSi National

[236] https://www.visr.eps.gov.lv/visr/

[237] http://resource.geolba.ac.at/lithology/0

[238] https://api.gouv.fr/

[239] https://www.lantmateriet.se/en/maps-and-geographic-information/Geodatatjanster/api-portalen/

Statistical Boundaries and other datasets. The data can easily be visualized and downloaded for integration within applications.

— **Germany** has been working for a long time on the full SDI/INSPIRE implementation chain, including the testing, validation and monitoring of their infrastructure. As part of these developments, the GDI-DE Testsuite was developed which now includes also an API allowing spatial data providers to integrate the testing and validation into their workflows in an automated way[240].

— In **Croatia**, the Environmental Agency has several examples of publishing open data through APIs, such as air quality.

3.1.2 In-depth analysis of Spain, Poland, the Netherlands and Belgium

3.1.2.1 The SDI goes beyond what a traditional SDI or INSPIRE requires by developing additional components in the infrastructure

In all four countries examined efforts haves been made to develop additional components on top of the traditional SDI components.

Especially in the Netherlands, these efforts are very visible and well advanced. Several initiatives to develop new and innovative SDI components are put together under the main theme of '*SDI.Next*'[241]. The central aim of 'SDI.Next ' is to make spatial data accessible and usable for a broader range of user groups, including non-expert users[242]. This should enable a better use of spatial data for addressing key societal challenges (e.g. energy, climate, mobility, housing,) requiring a more data-driven approach. The Netherlands is also exploring the relevance of platforms in the context of SDIs, as a multichannel approach to the delivery of geospatial data. Reusability of data becomes central in these platforms, which should provide a fit-for-purpose solution to different user groups[243].

Several data sets in the Dutch SDI are already made available as linked data via (REST) API's and SPARQL via PDOK ('Publieke Dienstverlening Op de Kaart' – Public Service on a Map), the Dutch central platform for offering access to geographic information in the Netherlands[244]. Among these data sets are the Registry of Addresses and Buildings (BAG), the Cadastre (BRK), and the Topography Registry (BRT), while various other data sets are planned to be released as linked data soon. Experimenting with various other new components and technologies is being prepared. An experiment is planned on setting up APIs compliant with WFS 3.0, while experimenting will be done on the release of INSPIRE sensor data via the SensorThingsAPI. A vector tiling implementation is also foreseen for the Dutch spatial planning data[245]. Finally, the Netherlands also established two registries as part of the process of INSPIRE implementation[246]. The INSPIRE-namespace register contains a list of registered namespaces by the Dutch INSPIRE data providers. The so-called 'aanmerkingsregister' is a list of spatial data sets that are considered as INSPIRE data. For each data set, the register also contains information on the responsible data provider and the status of publication. The register allows to track the process of INSPIRE implementation in the Netherlands. Moreover, the register also contains a direct link to the metadata on each data set in the National Georegister.

The technical infrastructure of the SDI in Spain also goes well beyond what is requested by INSPIRE and considered as "basic" from an SDI perspective[247]. Spain has developed a considerable amount of web services as part of their SDI infrastructure. This is a development that has been going on for many years now. In the national geoportal[248], many of those services are documented and can be accessed and integrated in applications. Besides the 45 discovery services, more than 2000 view services are available as well as 432

[240] https://wiki.gdi-de.org/display/test/Testsuite-API+nutzen

[241] https://www.geonovum.nl/themas/sdinext-een-data-infrastructuur-waarop-je-kan-bouwen

[242] Interview 3, the Netherlands.

[243] See Whitepaper Geo-Standaarden (2017): https://geonovum.github.io/whitepaper-standaarden/

[244] https://www.pdok.nl/next

[245] Interview 3, the Netherlands.

[246] https://wiki.geonovum.nl/index.php?title=Aanmerking_en_Namespaces

[247] Interviews 1, 2 and 3.

[248] https://www.idee.es/

download services, but also 8 processing and 1 transformation service. Several tools and applications are available as well. A big part of these more than 2000 web-services are not compulsory under INSPIRE[249]. Recently the strategy for Spain moved from making available as many services as possible to have fewer services but of a better quality[250]. For this reason, "the amount of services is decreasing over time but their relevance is increasing[251]". As an example, the National Geographic Institute is coordinating a co-funding initiative aimed at capturing, processing and publishing ortho-photos, LiDAR data and land and use cover databases to be provided as a service at the national level[252]. This new service (of better quality) will replace some of those currently existing. Despite the ambition of going beyond what a traditional SDI and INSPIRE requires, this also requires additional financial resources, which are however not always easily available.

The Belgian case is also very interesting. Coherently with the regional differences in terms of pace of SDI implementation and extent to which different 'regular' SDI components have been implemented, **differences can also be found in the extent to which the SDI has been extended beyond the components required by the INSPIRE Directive.** At the national level, the federal government is developing technical platforms to host and offer different services through its Directorate-General Digital Transformation[253]. The architecture is based on SaaS (Software as a Service), IaaS (Infrastructure as a Service) and PaaS (Platform as a Service). Some practical services such as a service to secure access to data resources are already available. While they are not yet implemented within products of the National Mapping Agency (NGI-BE) there is discussion ongoing to work in that direction.

In Poland, there are a number of past and ongoing developments and activities which go beyond what is strictly required by INSPIRE[254]. In recent years, the country has been looking in particular at methods for making SDI more re-usable and re-used by the wider public. Amongst these methods, APIs play an important role together with google search integrated services[255]. According to the Polish interviewees, APIs, services and applications are needed to lower entry threshold of users"[256]. As per other countries, such as Spain, the priority is therefore not the development of many services anymore but rather the establishment of a few which really respond to users' needs. In this domain, according to the latest figures from the national geoportal of 2018, Poland currently disposes of 96 view services (75 WMS, 21 WMTS), 63 download services (22 WFS, 6 WCS, 35 ATOM) and around 50 other services[257] (e.g. a metadata validation service, API service, dictionary service, OpenLS service). This corresponds to around 32 terabytes of data[258] and this amount increases year after year (for instance, it was 30 terabytes in 2016)[259].

3.1.2.2 API's have been developed on top of INSPIRE/SDI

With regard to the availability of APIs in Belgium, it can be observed that the regions have the most extensive experience in setting up APIs. The Geoviewer API of the Walloon Government allows developers to easily create a personalized interactive map on the web, with tools for zooming, measuring, drawing, displaying backgrounds and geographic data, legend, scale, etc[260]. The Geoviewer API serves as a basis for the development of WalOnMap, the interactive map of the Geoportal of Wallonia but also for other applications

[249] INSPIRE Country Report, Spain, 2016, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/ES

[250] Interview 1.

[251] Interview 1.

[252] Interview 1.

[253] The Belgian federal geo - platform INSPIRE and environmental approaches, INSPIRE Conference 2018, NGI Belgium & IRCEL-CELINE, https://inspire.ec.europa.eu/conference2018/psessions

[254] Interview number 1.

[255] Interview number 1.

[256] CAPAP, A way of making spatial information more popular, INSPIRE Conference 2018, Office of Geodesy and Cartography, https://inspire.ec.europa.eu/conference2018/psessions

[257] CAPAP, A way of making spatial information more popular, INSPIRE Conference 2018, Office of Geodesy and Cartography, https://inspire.ec.europa.eu/conference2018/psessions

[258] CAPAP, A way of making spatial information more popular, INSPIRE Conference 2018, Office of Geodesy and Cartography, https://inspire.ec.europa.eu/conference2018/psessions

[259] Marcin Grudzien, INSPIRE 2016 Conference, INSPIRE Framework for eGovernment, Head Office of Geodesy and Cartography, 30 September 2016

[260] http://geoportail.wallonie.be/API-geoviewer

developed by the Walloon Public Service and many other organisations make use of the Geoviewer API. Examples of these are the flood maps of the Walllon Region[261] and *Cadasports*[262], the map of sports facilities in the Walloon Region. The Flemish administration also offers a wide range of APIs, for various purposes[263]. Examples include an API to integrate the use of information on events in public space (GIPOD), another to facilitate to embed information on the underground in applications (KLIP), over an API that allows securisation of geospatial data and services (Geosecure), up to an API that supports the image processing chain. Moreover, the Flemish Region also developed a more explicit API strategy[264]. In the Brussels Capital Region, several APIs have been developed and made available as part of the Brussels Smart City initiative[265]. These include – among others - an API on the popular Fix My Street application, a points-of-interest API and a GeoLocalization API. At the federal level, the National Geographic Institute is still exploring the possibility of developing and using APIs to support other federal organisations in the development of applications.

In Poland, several APIs are already in place, and further upgrades and improvements of the APIs are foreseen. A key example is the API available through the geoportal (geoportal.gov.pl). To facilitate users' uptake of data and services and especially in the domain of map viewers, the Polish geo-portal offers an API allowing users to easily embed maps on their html website page and allowing them to exploit some additional functionalities such as finding an address point, zooming in to specific coordinates and adding text information to a map view[266]. Another interesting API has been developed by the Office for Geodesy and Cartography, also based on the data from the business registers. The API shows the location of over 10.000 public authorities in Poland[267]. Both examples show that there is a growing and long-lasting interest in Poland in exploring the potential of APIs as a way to increase take up and lower barriers to reuse. Nonetheless, it is difficult to elaborate further on this topic also due to the fact that APIs are not all gathered on the same platform and, for instance, APIs that could have been developed at the regional level could not be easily found.

In the Netherlands, the initiative was taken in 2017 by Geonovum, the Office Forum for Standardisation, the Chamber of Commerce, and the Cadaster to establish a 'Knowledge Platform on APIs' ('Kennisplatform APIs 'in Dutch)[268]. Aim of this initiative is to support the Dutch government in decision making on the development and use of APIs for the release of government data. Several working groups focusing on particular aspects of APIs, such as strategy, architecture, authorization and authentication, were established. The Knowledge Platform also worked on the preparation of a Dutch API Strategy, whose draft was released in February 2019[269], and a competition was organised to award the best API implementation in the Netherlands. Aim of the strategy is develop a coordinated approach on APIs in the Netherlands and standardize where necessary. The strategy consists of a non-technological and a technological part. The non-technological part of the strategy is about communication and policy on APIs and how to respond to users' needs. The technological part deals with API design rules, security and API-based architectures.

Spain is making some considerable efforts in terms of APIs and the need to invest in this domain was already highlighted as crucial in the INSPIRE country report back in 2016[270]. This is because one of the top priorities for the country is to bridge the gap between geo-spatial information and IT developers and to make everything as user friendly as possible[271]. In fact, IT developers often find it difficult to work with geo-information technologies: for this reason, the country is working on APIs and user-friendly services and platforms. One example in this domain are the map viewer services which have been made more user-centric and available through APIs as to ensure that developers find it as easy as Google Maps to integrate them in

[261] http://geoportail.wallonie.be/catalogue/9c55d236-8d98-4964-a581-a8421fe08efa.html

[262] http://www.cadasports.be/CADSPORT/accueil/

[263] https://overheid.vlaanderen.be/Webdiensten-Ons-API-aanbod

[264] See https://overheid.vlaanderen.be/nieuws/api-strategie-zet-standaardisatie-centraal

[265] https://api.brussels/store/

[266] https://www.geoportal.gov.pl/en/usluga-api

[267] Marcin Grudzien, INSPIRE 2016 Conference, INSPIRE Framework for eGovernment, Head Office of Geodesy and Cartography, 30 September 2016

[268] https://www.geonovum.nl/themas/kennisplatform-apis

[269] https://docs.geostandaarden.nl/api/API-Strategie/

[270] INSPIRE Country Report, Spain, 2016, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/ES

[271] Interview 1.

their apps. Similarly, in order to work on user experience, the Spanish Cadastre made its cartographic viewer mobile friendly[272]. Furthermore, and to help developers even further, Spain is working on building a platform where all available government/public APIs are listed. In fact, currently the National Geographic Institute disposes of a platform where it publishes all its APIs. However, other administrations and local/regional authorities also have their specific APIs and these are not all available through the National Geographic Institute platform yet. For the future, one of the priorities is to coordinate with regions and local authorities and provide IT developers with one entry point/platform where they can find all available APIs and make their choice[273]. Although there are several positive developments in terms of APIs, it must also be mentioned here that some important INSPIRE data provider such as the Cadastre do not have an API policy and vision yet[274]. In order to allow to focus resources where really needed and to help users even further, it will important to coordinate decisions about which APIs are necessary in the context of INSPIRE and Digital Government Transformation.

3.2 Interoperability

Main messages:

- Semantic interoperability is essential for any well-functioning SDI and also for digital government applications. Most of the efforts on data harmonisation and the streamlining of data and information workflows are concentrated within particular thematic domains. The INSPIRE Regulation on interoperability addresses semantic interoperability across thematic domains (feature catalogue) and it proves to be innovative in adopting object oriented data model. In this respect, although not yet fully implemented, this regulation demonstrates its value in terms of innovation digital transformation of public administration. Cross-regional and cross-border initiatives in these domains are quite frequent and a signal that countries work together on a bilateral and multilateral basis around these topics.
- Linking different geo-catalogues and open data catalogues is a relatively recent phenomena which is often steered by the SDI community that wants to see their spatial data resources as part of the broader (open) government data movement (based on the alignment with the open data policies also discussed in the analysis of the institutional setting). Hence, the exchange of metadata between portals, as well as the automatic harvesting of geoportals is getting more and more attention. A particularly interesting development is the shift towards more platform-based approaches, focusing not only on the provision of data but also higher levels of interactivity and communication between stakeholders.

Interoperability is key to good functioning of an SDI, and the uptake of SDI data, services and components in e-government applications. Interoperability is defined as the ability of computer systems or software to exchange and make use of information. While semantic interoperability should guarantee that data content is understood by all in the same way, technical interoperability is about guaranteeing that system components can interoperate.

Both are relevant in the development and implementation of SDI/INSPIRE, but also in understanding and strengthening the role of SDI in the Digital Transformation of Government. Two different indicators have been defined to investigate how countries are dealing with the aspect of SDI interoperability in the wider context of Digital Transformation:

- Joint efforts have been made to improve the interoperability of core thematic data and/or integrate different data collection flows.
- There are different platforms, portals and catalogues operational that link to each other and exchange information and other components for stimulating the reuse and uptake of geospatial data.

The first indicator focuses on the aspect of semantic interoperability, and aims to measure the extent to which countries have been active in improving the interoperability of various data sets. The second indicator deals with the existence of various platforms, portals and catalogues for making data and services accessible

[272] Interview 3.

[273] Interview 1.

[274] Interview 3.

and promoting the reusing of geospatial data. A key aspect here is the extent to which these various portals and platforms are linked to each other.

3.2.1 Analysis of the 29 countries in scope

3.2.1.1 Joint efforts have been made to improve the interoperability of reference/core thematic data and/or integrate different data collection flows.

Efforts to harmonize data collecting and maintenance practices mainly take place within particular thematic communities, sometimes also across borders (e.g. transport, soil and geology). There are relatively few countries in which joint – cross-sectoral – efforts took place to improve the interoperability of different data sets and/or integrate different data collection flows. However, some interesting examples could be seen.

- In **Germany**, many initiatives can be found to enhance data interoperability across borders and sectors. First, there is the National Geodata Base (NGDB), which is a commonly agreed basic stock of data from the existent overall offer of geodata in Germany. It consists of a collection of transparent and quality secured geodata, which are required for the execution of statutory tasks, for the support of modern administrative action or for economic development and for research. Second, many companies, universities and public sector bodies are active in data interoperability and the harmonization of spatial and non-spatial data (e.g. wetransform, BKG). At research, but also at operational level, efforts are made to define an INSPIRE ontology – see Interlinking Heterogeneous Spatial Data Using an INSPIRE Ontology (Homburg and Würriehausen, 2016). A study on the complexity and potential simplification of INSPIRE has been initiated as well.
- Another relevant initiative in this context is the Basic Data Programme in **Denmark,** which was initiated under the Danish 'Joint Government eGovernment Strategy 2011- 2015'. From the beginning of this initiative, effort was done to ensure that the interfaces, standards and data models for all basic data were coordinated with each other, in order to make it possible to link these data.
- Two other interesting examples can be found in Portugal and Sweden. In **Portugal,** thematic clusters have been set-up – mirroring the European approach - to promote and tackle the challenge of (cross-)thematic spatial dataset harmonisation. In **Sweden**, effort has been done to develop a common national map service in order to support the coordinated development towards combinable data.

3.2.1.2 There are different platforms, portals and catalogues operational that link to each other and exchange information and other components for stimulating the reuse and uptake of geospatial data.

The web is full of portals, of all kinds and shapes. This is not different for the geospatial community and for SDI/INSPIRE in particular. Although it is legally not mandatory to develop a geoportal for INSPIRE, many countries have primarily invested in the development of such portals, which often resulted in many different – national, sub-national, thematic – geoportals within one country. This development occurred in parallel with the development of – open – data portals and of so-called one-stop-shops, i.e. single entrance points for citizens and businesses for interacting with their Government(s). In reality, many of these portals and platforms contain – at least partially- the same or very similar data and information. Some countries have implemented a logic and streamlined the approach to the various portals within their country, with data portals that are referring to each other and the underlying catalogues that are being harvested to exchange metadata records. In this way, geospatial resources also become discoverable and accessible via the general – open – data portal. In several countries however, the portals are only loosely coupled.

- The **German** SDI is since its inception based on a federated system. The Geodatenkatalog.de harvests more than 20 catalogues of the federal government (including thematic) and Länder. In turn, the federal geo-catalogue is harvested by the European geoportal. Moreover, the federal geo-catalogue is also harvested by the National Open Data Portal and then further by the European Open Data Portal. Testing is also performed using GeoDCAT-AP schema using a CSW based implementation and tested with data from the geoportal from Rheinland-Pfalz. In general, many efforts take place in Germany to link catalogues and portals to each other. Several private companies are active in this field and involved in the pilots initiated by the Federal or Regional Governments.

— In **Austria,** many portals (geo and open) exist, especially at the level of the Länder and in some specific fields. Some efforts are under way to better integrate them (e.g. GEOLAND). Austria is also looking into how data flows can be better integrated and streamlined. To this end they started a project called 'Promotion of best practices for national environmental information systems and tools for data harvesting at EU level'. The challenge set by DG ENV (who initiated the project) is to retrieve information based on all the environmental data distributed in different locations and systems and to find a way to collect the data in an efficient manner. In addition the legal obligation to report and monitor throughout the full environmental domain is showing a scattered landscape of different environmental management information systems targeted at the specific requirements in the regulatory framework. The aim of the project is hence to define, identify and present best practices of EU and national environmental information management systems and portals that contribute to active dissemination in the EU and its Member States and explore and develop and test tools to use such publically available data through data harvesting and mining.

— While most European countries decided to develop their national open data portal and their geoportal separately, the **United Kingdom** decided already in 2010 to deliver all geo-portal facilities through the national data portal data.gov.uk, providing a one-stop shop for all government data. As a result, the scope of data.gov.uk was broadened to also include non-open government data. To support the discovery of and access to spatial datasets, also some additional geospatial tools had to be implemented. Ordnance Survey, Cabinet Office and the Department for Environment Food & Rural Affairs collaborated to implement the map-based tools allowing users to search and preview spatial datasets on data.gov.uk. While individual data providers were responsible for creating and maintaining metadata for their geospatial datasets, these metadata are harvested from these publishers by data.gov.uk. The harvested metadata can be searched and previewed on data.gov.uk, and are published to the EU via a discovery service.

3.2.2 In-depth analysis of Spain, Poland, the Netherlands and Belgium

3.2.2.1 Joint efforts have been made to improve the interoperability of reference/core thematic data and/or integrate different data collection flows.

When comparing the efforts done in the four countries investigated on improving the interoperability of different data, it is clear that **the Netherlands is probably one of the most active in the harmonization and integration of data from different sources.** This is especially visible in the creation of several key authentic datasets in which data from different sources and providers are integrated into one authentic dataset. Furthermore, when implementing the INSPIRE Directive, the Netherlands decided to integrate several datasets into one product covering the entire territory. Currently, some key initiatives on improving the interoperability of data, not only geospatial data but also administrative data, are being carried out[275]. For instance, in order to better align the many different information models that exist in the Netherlands, Geonovum, Kadaster and VNG Realisatie took the initiative to develop a Metamodel for Information Modelling (MIM)[276]. Bringing together their knowledge of and experience in information modelling (in both spatial data and administrative data), the three organisations developed a common base line for the development of information models. The Metamodel contains clear rules on the definition of data specifications – in general terms, and not only for geospatial data - but also provides the flexibility of different levels of modelling. The model can be used for the development of information models, implementations based on the model and better understanding the meaning and definition of information objects. Recently, the so-called DiS-GEO initiative[277] ('Doorontwikkeling in Samenhang' with can be translated as 'Continous, Coherent Development') was launched, with the aim of further developing and improving the system of spatial key registries. The existing registries were developed independently of each other, and therefore do not form a coherent whole, which has implications for the management, funding, quality management and use of the registries. Moreover, the usage of the registries has increased enormously in the past years, and further development of the registries is needed to deal with new and additional user needs.

An important element in the Dutch DiS-GEO initiative is the development of a coherent registry of objects. In

[275] Interview 3, the Netherlands.

[276] https://www.geonovum.nl/geo-standaarden/metamodel-informatiemodellering-mim

[277] https://www.digitaleoverheid.nl/nieuws/doorontwikkeling-van-basisregistraties-in-samenhang-dis-geo/

the current system of registries, data on the same objects are scattered over various registries, each with their own content, maintenance processes and ICT-systems. A coherent registry of objects is a centrally-organised, uniform registry with all key data on objects in physical reality. This includes objects that are visible in the terrain, such as buildings, roads, water, railway lines and trees, but also some (administrative) objects such as residences, municipal boundaries and public spaces.

In Belgium, there is close collaboration and coordination between the different levels and regions in the harmonization of data across different data providers. As part of the INSPIRE implementation process, the observation was made that coordination across data providers was needed for 24 of the 34 themes of INSPIRE. In several cases, additional effort was carried out beyond the implementation of INSPIRE, to rethink existing geodata production chains and even to set up national authoritative registers for reference data. The "Belgian Streets and Addresses" (abbreviated as "BeSt Address") project was launched to create an authentic source of addresses in Belgium, which will be based on the three regional address registers[278]. A common address definition and data model were developed, and a cooperation agreement was concluded between the federal state and the three regions on the creation of the regional registers and the access to and mandatory use of the data in these registers. Furthermore, the development of authentic sources of building data and administrative units is ongoing in separate working groups, as well as the transformation of hydrographic data from the different regions/levels into one seamless and INSPIRE compliant data set. This should lead to the development of a Belgian methodology that could also be applied to other cross-border data sets. Also within each of the regions, additional efforts is made on the harmonization of data across data providers. The Flemish administration is working actively on the release of geodata following the principles of the Flemish URI standard. This domain fits within the objective of the Flemish government to focus on an unambiguous standard for the exchange of information. All identifiers of information resources that are available through the data.vlaanderen.be domain in the form of a URI should be persistent and semantically unambiguous. In addition to a few datasets, Data.Vlaanderen.be also offers access to the standards, information models, tools and documentation that enable users to get started with data. The first dataset that is released on this domain are the addresses from the address register (CRAB).

In Poland, harmonization mainly takes place within single organisations and/or thematic domains, and data providers are considered to be responsible for making their own data interoperable. Important to mention are the creation of key reference datasets such as the Georeferenced Database of Topographic Objects (GBDOT) and the National Register of Administrative Borders and Addresses (TERYT), harmonization efforts across administrative levels, e.g. between the central and local level on spatial zoning plans, and cross-border harmonization initiatives, e.g. with Czech Republic, Slovakia, Germany and other European countries.

In Spain, various types of harmonization projects and activities took place in the past years, which resulted in a set of harmonized reference datasets. CartoCiudad is the official cartographic database of the Spanish cities and villages with their streets and roads networks topologically structured. The database is the result of the harmonization and integration of official geospatial data produced by different public authorities: the Cadastre, providing blocks, building numbers and street axis, the Statistical Office, providing official street names and wards, the Post Office, providing post codes and the National Geographic Institute, providing the transport network from the Spanish 1:25.000 scale, boundaries and orthophotographies. Harmonization efforts also focused on geographical names, with the harmonization of the Basic Gazetteer for Spain and the Concise Gazetteer for Spain, which both are developed by IGN in cooperation with the Autonomous Communities that have their own gazetteer and the Registry of Local Bodies of the Ministry of Regional Policy. Additionally, SIOSE, the Land-Use Information System for Spain, is the result of harmonization efforts between several central governments, including the Ministries of Development, Agriculture, Food and Environment, Economy and Competitiveness, Finance and Public Administration and Defence, and the autonomous communities. Furthermore, within several autonomous communities harmonization initiatives took place, between different departments and/or with the local authorities in the region. Finally, it is also important to mention that Spain is very involved in cross-border projects and initiatives dealing with harmonization of data, with Portugal, France but also other European countries.

[278] Interview 2, Belgium

3.2.2.2 *There are different platforms, portals and catalogues operational that link to each other and exchange information and other components for stimulating the reuse and uptake of geospatial data.*

The second indicator on interoperability looked at the existence of different portals and platforms, and the extent to which these portals and platforms were linked to each other. Some innovative approaches but also key differences between the four investigated countries could be seen.

The most striking observation on **Belgium** is the absence of a national geoportal – and data catalogue providing access to geospatial data of data providers of the different regions and administrative levels. Although the idea to develop an overarching national geoportal exists for many years and was even encompassed in the cooperation agreement among the three regions and the federal level, such a geoportal is still not in place. Each level/region has its own portal, providing access to mainly or even solely data from organisations within their own region or administrative level. Harvesting of data mainly happens between the geoportals and open data portals, while some of these portals provide access to metadata and/or data of the other regions/levels. For instance, via *Geopunt*, the Flemish geoportal, users also can discover and get access to some data from federal entities, such as the National Geographic Institute, the Belgian statistical office and the Federal Public Service Economy. The *Flemish Open Data Portal* harvests data from Geopunt but also from various municipalities in Flanders. The *Belgian biodiversity data* portal is one of the very few thematic data portals providing access to data from organisations in the different regions and levels. The portal currently contains more than 100 biodiversity related data from various federal, Flemish and Walloon public authorities and other organisations. **Harvesting data from the federal geoportal, the data portals of several federal organisations, the regionals portals, and several local portals, the *Belgian data portal data.gov.be* currently contains the largest offer of – spatial – data in Belgium.** It should be mentioned that consultation and coordination between the different levels/regions currently takes place on solutions for exchanging metadata between the different (geo)portals in order to make spatial data sources discoverable via the various portals[279].

The **Netherlands** has several georegisters and data portals in place. The *National Georegistry* (NGR)[280] is the national catalogue of spatial data in the Netherlands. The NGR contains all spatial data sets and services. Most of these data sets can be downloaded, while services allow to view data or use them in your own application. *PDOK*[281] *('Publieke Dienstverlening Op de Kaart' – Public Service on a Map)* is the central facility for the provision of geodata of national importance. These include up-to-date and reliable data for both the public and private sector[282]. All data on PDOK are open data, and thus freely accessible to anyone. **PDOK also can be seen as an approach to implement a more platform-oriented approach to the provision and use of geospatial data. One element of this approach is the creation of the Geoforum[283] that aims to establish an active geo-community exchanging views and knowledge on various geo-related topics.** The provision of data through different channels and in different formats also is a key element in the creation of such a platform. *Data.overheid.nl,* the Dutch open data portal, provides an overview of all available data sets within the Dutch government. The portal contains a register with information on and links to data sets of Dutch public organisations. The National Georegistry currently contains 6731 resources (6117 data sets, 587 services and 21 series). PDOK provides access to around 157 different data sets and 415 services. Data.overheid.nl currently contains information on approximately 11500 different datasets. Data.overheid.nl harvests metadata from the National Georegistry. This means that all datasets in the National Georegistry that are recognized as open data are included in the registry of data.overheid.nl.

Already in 2004 **Spain** started with the development of a national geoportal, (http://www.idee.es), which now provides access to around 5300 geospatial datasets, 4000 services and 1000 series. The geoportal harvests data from 30 other catalogues of national government organisations, such as the National Geographic Institute, the Ministry of Agriculture and Fisheries, Food and Environment, the Ministry of Economy, Industry and Competitiveness and the Ministry of Energy, Tourism and Digital Agenda, and of the autonomous regions,

[279] Interview 2, Belgium.

[280] nationaalgeoregister.nl/

[281] https://www.pdok.nl/

[282] Interview 2, the Netherlands.

[283] https://geoforum.nl/

which all have their own portal(s). The National Geographical Information Center (CNIG) is responsible for the creation and maintenance of the national geoportal. **The CNIG developed a methodology for the verification of the practical interoperability of geoportals, analysing aspects of interoperability, accessibility, usability, multilingualism, use of standards, etc., and has conducted several studies on the geoportals in Spain**. In one of these studies, 110 different websites in Spain were identified through which official geospatial data could be downloaded. This list of portals, i.e. geoportals and data portals of public authorities at central, regional and local level, is made available on the national geoportal, and is one of the most visited pages of the portal. Spain has a separate Official Catalogue for INSPIRE dataset & services (CODSI), which contains all the datasets under the scope of INSPIRE and all INSPIRE compliant services. CODSI current contains 245 services and 222 datasets. In its 2016 Action Plan on INSPIRE Implementation, Spain defined the list of spatial datasets under INSPIRE at national level, thereby taking into account all data custodians that provide data sets or services that can contribute to the infrastructure of INSPIRE. Between 2010 and 2016, the list of reported datasets decreased from more than 5000 datasets to less than 300 datasets. It should also be noticed that Spain has much more OGC compliant services, but many of these are not INSPIRE compliant. CODSI is used for feeding the INSPIRE Geoportal. The national open data portal of Spain (datos.gob.es) not only harvests the data from the IDEE catalogue, but also contains a viewer that uses one of the WMS of IGN.

The national geoportal of **Poland** (http://www.geoportal.gov.pl) is developed and maintained by the Head Office of Geodesy and Cartography and is the central access point to spatial data and services in Poland. In the 2013-2015 INSPIRE Country Report, it was stated that the national geoportal made available around 200 different spatial data services. The official national discover service sharing metadata for data sets and services, is part of the geoportal. **The national geoportal harvests metadata from the catalogues of many different government departments and agencies, and third parties**. Several of these organisations have their own geoportal. Examples are the Geostatistician portal, the portal of the Central Geological Database, the portal on environmental monitoring facilities, and several regional portals. The national geoportal also contains separate applications for browsing, searching and viewing specific – related – datasets and services, such as the National Geoportal map, the INSPIRE geoportal and the 3D Geoportal. There also are various integrated WMS services in the Geoportal, on building registration data, utilities data and local spatial development plans. The national open data portal contains some geospatial datasets and services, but especially links to the different geoportals.

3.3 Innovation

Main messages:

- Relatively few countries systematically use and integrate generic ICT solutions as developed in the ISA^2 programme. However, some examples on the application and use of the core vocabularies (persons, business, location and public service) and other ICT reusable solutions (e.g. AAA-mechanisms) could be identified.
- All countries consider innovation and technological monitoring as crucial, and especially in the context of Digital Government Transformation, and some initiatives could already be found in these areas. Several countries systematically follow the most important developments in order to test and apply them in the geospatial and SDI context, through testbeds, pilot projects or research projects. Some countries strongly collaborate with universities and private partners to stay ahead of the latest developments while others rely on peer learning and analysis of best practices from other countries.
- Countries also rely on Small and Medium Enterprises (SMEs) to cultivate innovative approaches through the development of new digital systems, components, services, tools, trainings etc.

Innovation indicators deal with the process of investigating, experimenting with and implementing new solutions and developments in the SDI. Although SDIs and INSPIRE clearly have their own specific features and requirements, there are also several parallels between SDI developments and more general ICT developments. ICT developments that are extremely relevant to the SDI domain include service-oriented architectures, semantic web, interoperability, data security and many more. On the other hand, also the geospatial domain itself is continuously evolving, with new and emerging trends and solutions for collecting, processing, sharing and using geospatial data.

The innovation indicators aim to grasp how countries are dealing with developments and solutions that are relatively new to the SDI domain. With regard to more generic ICT solutions, we especially want to verify to which degree generic ICT solutions offered by e.g. the ISA² programme are applied in the context of SDI developments. Looking also at other – potentially – relevant solutions, we want to investigate the approaches adopted in countries for discovering, testing and implementing new technologies and solutions. Two different indicators capture these two key dimensions:

- Generic ICT solutions, such as those designed by the ISA/ISA² programme, are (re-)used in the SDI.
- A procedure is in place to discover, explore and incorporate new technological features or emerging technologies.

3.3.1 Analysis of the 29 countries in scope

3.3.1.1 Generic ICT solutions, such as those designed by the ISA/ISA² programme, are (re-)used in the SDI.

SDI developments to a certain extent should go hand-in-hand with general ICT developments. When looking at the current developments at international, EC and Member State level, we see that both communities are increasingly coming together. At international level, this is for instance clearly visible in joint efforts of standardisation bodies, such as OGC and W3C[284]. At the European level, this trend is testified by the inclusion of 'geospatial' in the ISA and ISA² programme.

Some European countries are also reusing certain generic ICT solutions designed under the ISA and ISA² programmes in the context of their SDI. **Austria**, for instance, worked on the development of a common infrastructure for implementing Authentication, Authorization and Accounting (AAA) solutions, thereby taking advantage of related developments under ISA. These implementations have been tested and applied also in the context of their SDI development and implemented in various geospatial communities (e.g. 8 federal states, the Environmental Agency, the National Statistical Institute). **Spain, Belgium and Poland** are also reusing some of the ISA generic solutions, as further developed in the next sections.

3.3.1.2 A procedure is in place to discover, explore and incorporate new technological features or emerging technologies.

New technological developments are a key consideration in developing, maintaining and exploiting SDIs and INSPIRE in particular. **Several interesting practices and approaches can be seen throughout Europe of Member States that have been closely monitoring and experimenting with relevant new and emerging technologies. Among these technologies are new methods for processing huge amounts of data, big geospatial data analytics; the implementation of 3D geodata models and their integration with BIM (Building Information Modelling); the application of blockchain technology to automate processes and transactions; or new ways of publishing, searching and linking spatial data with other data on the web**. Some countries are systematically investigating and experimenting with new developments, other countries rather focus on particular developments. In many cases, this happens in close collaboration with academia, industry and SMEs in particular. Although several good examples can be found, it still is not a common practice in all Member States to (pro-)actively follow and test new developments.

- In **Sweden**, Lantmateriet is pioneering in the adoption of blockchaining. Lantmäteriet started testing Blockchain technology already in 2016. In July 2017, a pilot project was launched on the use of Blockchain to register land and properties in Sweden, in partnership with the Swedish Blockchain startup ChromaWay, the telecom company Telia Co. AB and the consulting firm Kairos Future[285]. These two years of testing and collaborating with other stakeholders helped in revealing and understanding the technical and legal challenges associated with the implementation of Blockchain in public administration. The Swedish SDI systematically collaborates with Academia and Industry to test new solutions. Other examples include work on Linked Data, 3D Geodata applications and many others.

[284] See for example: http://www.opengeospatial.org/pressroom/pressreleases/2358

[285] https://cointelegraph.com/news/swedish-government-land-registry-soon-to-conduct-first-blockchain-property-transaction

— **Portugal** is a good example of how new technologies are discovered and tested in the context of (European) projects. An example is the CROSS-NATURE project[286], which is a cross-border research project and aims to development a common Digital Service Infrastructure (DSI), combining alphanumerical and spatial information. It provides free and open access to biodiversity data and is oriented towards Alien Invasive Species (AIS) control and biodiversity protection. CROSS-NATURE is applying a Linked Open Data (LOD) approach, allowing to identify new data of interest and add value to this information, as well as to improve access to new sources of knowledge, keeping them in the future. The CROSS-NATURE project is co-financed by the European Union, through the CEF – Connecting Europe Facility. There is also the Transversal Working Group (TFRT-TR), a Technology strand group, consisting of entities from the INSPIRE RPF Core, which represent the diversity of technological solutions available on the market.

— In **Germany** new technologies and their application in the context of SDI/INSPIRE are explicitly mentioned in the SDI Strategy. Germany has also seen many testbeds and pilots to implement new technological developments. These take often place in collaboration with universities and private companies. Germany is very active in the field of 3D geodata (CityGML), data cubes and coverages, secure access, data transformation etc.

— The **Czech Republic** has for a long time experimented with the link between the geospatial world and the e-Government world. CENIA, the Environmental Agency, has worked for several years on e-Environmental solutions to support environmental policies based on SDI and INSPIRE solutions. Moreover, the country has supported new developments bringing closer together geoportals and open data portals by using new techniques and standards such as GeoDCAT-AP, which is currently supported by the Czech INSPIRE portal.

— In **Slovenia**, the University of Ljubljana, together with the National Mapping Agency and some private sector partners joined forces with other European partners to set-up a Center of Excellence on 3D geodata[287]. The aim is to develop Research & Development projects to test and implement new 3D geodata solutions for various applications and to build the necessary knowledge in this field.

3.3.2 In-depth analysis of Spain, Poland, the Netherlands and Belgium

3.3.2.1 Generic ICT solutions, such as those designed by the ISA/ISA² programme, are (re-)used in the SDI.

In all four countries, relatively little of the generic ICT solutions developed under the ISA/ISA² programme currently are being used as part of the national SDI. In **Belgium**, it is especially in the Flemish region that efforts are made to apply and implement various re-usable components of ISA, mainly in the context of the OSLO initiative: Open Standards for Local Administrations[288]. The OSLO specifications are the result of a public-private partnership initiated by V-ICT-OR, the Flemish Organisation for ICT in Local Government, and funded by Flemish ICT service providers (e.g. BCT, CEVI, Remmicom and Schaubroeck) and public administrations (e.g. CORVE, Digipolis). The initiative implemented the ***EU ISA Core Vocabularies***[289] (person, business, location and public service) and worked on creating their own additional vocabularies. OSLO and V-ICT-OR are also looking into other aspects of generic ICT components such as secure access mechanisms, Semantic Web solutions and even Augmented Reality. There is a systematic collaboration between the geospatial and e-Government community to this respect. In **Spain**, some more generic ICT solutions already are being reused, such as the *re3gistry software* that was developed under the ELISE action[290]. The added value of developing such generic solutions under the ISA and ISA² programme is recognised, and additional tools and services could be helpful to release the burden and work pending on Member States[291]. **Poland** has also an interest in the reuse of solutions developed under ISA and ISA². The country has taken up since the beginning the re3gistry software developed under the ELISE action[292] and the *INSPIRE validator*[293]. The latter

[286] http://www.dgterritorio.pt/a_dgt/investigacao/projetos/atividades_de_i_d_em_curso/cross_nature/

[287] https://slice3d.si/

[288] https://joinup.ec.europa.eu/nl/collection/oslo-open-standards-local-administrations-flanders

[289] https://ec.europa.eu/isa2/solutions/core-vocabularies_en

[290] https://ec.europa.eu/isa2/solutions/re3gistry_en

[291] Interview 1, 2 and 3, Spain.

[292] https://ec.europa.eu/isa2/solutions/re3gistry_en

is installed and in use for internal purposes only. In the **Netherlands**, only very recently attention was given to the (re-)use of more common or generic ICT components in the Dutch SDI. This especially applied to both *secure access mechanisms* and core vocabularies, which currently are being investigated.

3.3.2.2 A procedure is in place to discover, explore and incorporate new technological features or emerging technologies.

Amongst the four shortlisted countries, the Netherlands has the longest and strongest tradition of experimenting with and testing new technologies in the geospatial domain. An important mechanism to do this is the organisation of pilot projects on particular topics or technologies that are considered to be relevant to the future development of the SDI. Already in 2010, a pilot project on 3D Geo-information was launched, with the aim of promoting and stimulating the development of 3D applications[294]. The pilot was an initiative of several stakeholders in the Dutch SDI, such as Geonovum, the Kadaster, the Ministry of Infrastructure and Environment and the National Geodetic Commission (NCG). The main results of the pilot were the development of a 3D standard for the Netherlands and the integration of this standard into the data model of the large-scale topographic base registry. In 2011, the 3D pilot received the OGC 3D award. While the pilot project ended in 2012, the work on 3D geo-information continued, including through the establishment of a 3D interest group. In 2012, a new pilot project was launched, on the topic of linked open data, following a similar approach as the 3D pilot[295]. Launched by a small group of government organisations, there was a strong involvement of public, private and academic partners in the pilot, also including partners from outside the 'geo' domain. The objectives of the pilot were to raise awareness on linked open data, explore whether linked data could be useful for the publication of government data, gain insight in relevant technologies, knowledge and technologies, and experiment with linking official government data with other data on the web. The pilot resulted in an integrated approach to 'linked open data' for the Netherlands and the publication of linked data on two particular 'use cases': data on monuments and data on houses. A third pilot project was extremely relevant to the role of SDI in Digital Transformation. Via the pilot '"Testbed: spatial data on the web" private companies and other SDI stakeholders were encouraged to explore and develop solutions that aim to bridge between geo- and INSPIRE standards and web standards that are more common to the web community for searching and accessing data[296].

In Belgium, there are again clear differences in the extent to which the different regions/levels are dealing with the innovation of their SDI, and the – potential – adoption of new technological developments. The Flemish administration clearly is the most active in identifying, experimenting with and implementing new and emerging developments. Recently, the Flemish administration has identified four main technological trends for the digital government in 2025. These trends include blockchain, artificial intelligence (AI), smart cities and the integration of earth observation data in the SDI[297]. For each of these trends, a specific approach has been developed on exploring and testing the application of these trends in the SDI. One approach to explore, test and implement these new and innovative technologies, is through the involvement in European research and innovation projects, under programmes such as H2020 and Erasmus+. For instance, the agency Information Flanders is involved in several H2020 projects. The POLIVISU project[298] aims to enhance public involvement and support in urban policy making, by equipping decision makers with various skills and tools - from open (geo) data processing to advanced visualisations - to use big data for collaborative policy experimentation. OpenTransportNet[299] addressed the complex challenges associated with mobility in European cities and looked at how open data can contribute to this. OpenTransportNet aimed at cities to get started with open geo data and to create accessible and visually attractive maps. This resulted in open data hubs that help cities and businesses to tackle transport-related challenges. The CORONA project[300] aims at ensuring the availability of reliable, harmonised air quality data from Ireland, Norway and Belgium (Flanders) on the European Data Portal. The project, which is a good example of a cross-border approach, will

[293] http://inspire-sandbox.jrc.ec.europa.eu/validator/

[294] https://www.geonovum.nl/geo-standaarden/3d-omgevingsinformatie

[295] https://www.geonovum.nl/over-geonovum/actueel/vervolg-pilot-linked-open-data-van-start

[296] https://www.geonovum.nl/themas/testbed-geo4web

[297] https://overheid.vlaanderen.be/informatie-vlaanderen

[298] https://www.polivisu.eu

[299] http://opentransportnet.eu/

[300] https://project-corona.eu/

provide a methodology for all EU/EEA Member States to publish air quality data in an interoperable and standardised manner and build quality assurance tools to streamline the assimilation of raw data for publication as open data. At the federal level, the research project FLEXPUB[301], in which the National Geographic Institute collaborates with two universities aims to develop a global federal strategy for the implementation of flexible geographical public e-services and establish a federal blueprint for enabling flexibility and innovation in the public sector also beyond the field of geographical e-services. On a more operational – technological level – the NGI is increasingly collaborating with the Directorate-General Digital Transformation, which is more active in monitoring and experimenting with new technological developments[302].

Poland always has been active in identifying and learning from best practices emerging in other countries and contexts[303]. This applies to the reuse of generic ICT solutions but also to the exploration and testing of new and emerging technologies. There is no structure approach or process implemented to do this, it has rather seen as the responsibility of individual SDI experts. Attending and actively participating in international conferences and other events in Europe (and worldwide) is seen as a key way to learn more about promising pilots, technologies and developments which are occurring in other Member States and countries[304]. In this respect, the innovation process is driven more by individuals and benchmarking with other countries rather than structured approaches and methods for fostering innovation. An interesting example of how Poland is integrating innovation and new technologies in the SDI is represented by the 3D building model that was recently published on the geo-spatial portal and which currently covers more the whole Poland[305].

In Spain, similarly to Poland, there is also no 'formal' procedure in place to discover and experiment with new developments and technologies, as this is rather seen as a continuous process and the country has a priority to innovate and experiment with the SDI[306]. The pressure for innovation often comes from the users whom request new features and services regularly. For instance, one of the most recent request was the possibility of downloading only changes with respect to previous download or specific data[307]. The nature of the requests and needs coming from users keep innovation in SDI high on the agenda. Although there is no formal process or "innovation/technology watch" the National Geographic Institute has an explicit mandate to innovate with respect to the SDI. To do so, it relies on collaboration and projects with universities, such as the University of Zaragoza, with whom they develop innovative and experimental projects (e.g. on GeoPackage). This public-university collaboration works very well and is sometimes complemented by the involvement of private sector and companies[308].

[301] See https://flexpub.wixsite.com/home

[302] https://bosa.belgium.be/en/activities/dg-digital-transformation

[303] Interview 1, Poland.

[304] Interview 1, Poland.

[305] http://mapy.geoportal.gov.pl/imap/?gpmap=imap3d&locale=en

[306] Interview 1, 2 and 3, Spain.

[307] Interview 2, Spain.

[308] Interview 1, Spain.

4 Analysis of impacts

Impact indicators aim at capturing elements of effectiveness, efficiency and relevance, pushing towards digitalisation of public sector and society. Impact indicators are divided in two categories, mirroring the aspects captured in the INSPIRE country reports and notably:

— *Usage indicators*, which try to measure the success of the SDI in terms of number of users and applications and then highlight whether the SDI has been used as a basis for governments and business to move further in terms of digitalisation of products, processes and services.

— *Benefits indicators*, which look at the concrete advantages brought by INSPIRE and the development of SDI to government, citizens and businesses. Such advantages can be quantitative and qualitative and they can touch upon many different dimensions including efficiency of processes, economic gains, development of innovative products and services and increasing citizens and customers' satisfaction.

In the next sections, we describe more in details the usage and benefits indicators developed and we offer an overview of the data collected for these dimensions across the 29 countries in scope, with a special focus on Belgium, Poland, Spain and the Netherlands.

4.1 Usage

Main messages:

— Usage indicators are important to understand to what extent the SDI is used on a daily/regular basis by stakeholders (public authorities, private sector and also "indirectly" citizens) and therefore also to look at benefits in terms of impact and magnitude.

— The analysis confirmed that there is a diverse situation across countries in terms of usage of the SDI by public authorities. Some countries are already leveraging the infrastructure on a daily basis to increase efficiency and improve policy making while others experience some difficulties in doing so due to lack of skills or awareness about the possibilities of SDI. As a result, SDI potential is not fully exploited in certain countries although there is a positive trend in terms of increase of usage and the situation is improving year after year (Relevance).

— Countries using extensively SDI to develop new public sector services and applications have shown the benefits of doing so in different sectors including amongst others:

- The environmental and climate change sector
- The urban and territorial planning sector
- Housing and Cadaster
- The agricultural sector
- The maritime sector

— Besides these traditional sectors in which SDI usage by public administration is more frequent, other sectors and domains are also emerging (i.e. drones restrictions, emergence services, protection of civilians).

— Citizens are offered more and more applications and services that are SDI based and, especially in certain domains such as the Cadastre, this is the "new norm" for certain countries. In parallel, new domains of applications for SDI based services to citizens are also emerging (i.e. police, drones).

— Countries in which the SDI is more widely used by the public sector tend also to perform well in terms of private sector usage (as the analysis of Belgium, the Netherlands, Poland and Spain illustrates well). The analysis also show that there are exceptions to this general rule (i.e. Estonia, where, based on available data, private sector use of SDI seems more developed than the use by public sector).

— Finally, the use of SDI components and infrastructures for development of cross-border Digital Government Services remains limited across the EU Member States and Norway. However, this seems to be a promising indicator for the future and when looking at the role of SDI for Digital Government Transformation. Amongst the most interesting examples of cross-border usage there is the X-Road project currently carried out by Finland and Estonia.

— These findings must be taken with caution: in fact, reporting and monitoring of usage is not always done or done regularly across countries. This could translate in a skewed or biased analysis where countries collecting data on usage are considered as better than others which do not collect data or do not publish the results.

The usage of the SDI is one of the key aspects to consider in order to evaluate whether the development of such infrastructure brought relevant changes and produced considerable effects in terms of Digital Government Transformation. Logically, if the infrastructure is used only to a very limited or to limited extent, the benefits and impacts that are linked to SDI can only be minimal. Therefore, the assessment of the usage can also be seen as a pre-condition for the analysis of the benefits as well as a good basis for understanding the role of SDI in Digital Government Transformation. However, the correlation between extent of usage and magnitude of impact might not always be true: in certain situations and countries it could happen that a limited use of SDI still results in considerable impact due to specific circumstances. This link between magnitude of usage and magnitude of impacts will be analysed in the next chapter on benefits.

In order to be comprehensive and cover all possible uses of SDI, the usage indicators differentiate between three possible categories of usages and notably:

— Public administrations use consistently SDI to in decision- making and service delivery processes.

— There is a considerable take up of the SDI by private sector and other organisations (e.g. NGOs) for delivery of – new and innovative – applications, products and services.

— The country uses the SDI in the deployment of cross-border eGovernment services.

One could consider these indicators as either entirely separate or incremental. In certain countries, the usage of the infrastructure by public authorities for internal purposes might constitute the very first step that can then lead to an uptake of the SDI by businesses and finally or in parallel to the development of cross-border public services based on this infrastructure. In other countries however, the usage of the SDI by public administrations and by businesses might progress in parallel or even in the reverse order: businesses might be quicker than public administrations in starting to reuse the SDI. These possibilities were also explored in the framework of the data collection.

Finally, before embarking in the analysis, it is worth reminding here that the lack of data might hamper the quality of the findings, as the evidence available on "usage of SDI" remains limited when compared to other aspects covered by this study. It is clear that measuring SDI usage is not a priority for public administrations, nor an obligation for them and this can explain the more limited availability of data. Furthermore, public administrations understand measurement of benefits in different way compared to private sector and this also explains a different perception of the importance of measuring usage quantitatively. Nonetheless, the following sections build on the best evidence available and on a combination of INSPIRE and eGovernment related sources of information as well as interviews with key stakeholders where possible.

4.1.1 Analysis of the 29 countries in scope

4.1.1.1 Public administrations use consistently SDI in decision- making and service delivery processes

In terms of use of SDI by public authorities, there are very interesting examples of extensive use of the infrastructure in Lithuania, Luxembourg, Norway and France amongst others.

— In Lithuania, more than 100 services for national information systems make use of SDI and INSPIRE components (in terms of metadata, web services etc.) and these systems are used on a daily basis by around 3500 public sector employees[309]. The National land management system and the Land Informational System are amongst two of the public sector applications that are built on top of the SDI and are used daily by public authorities[310]. For Lithuania, the implementation of INSPIRE acted as incentive for changing the status quo and came as binding factor that was crucial in overcoming the

[309] See: National Benefits for INSPIRE Implementation, the real life use cases, Andrius Balciunas and Evaldas Rozanskas, INSPIRE conference 2016, Barcelona, http://inspire.ec.europa.eu/events/conferences/inspire_2016/page/oral

[310] See: National Benefits for INSPIRE Implementation, the real life use cases, Andrius Balciunas and Evaldas Rozanskas, INSPIRE conference 2016, Barcelona, http://inspire.ec.europa.eu/events/conferences/inspire_2016/page/oral

resistance to change of the public sector users[311]. In this country, interesting application domains are emerging:, citizens for instance can check the geographic restrictions in place for flying drones through an application which is built on top of the national SDI

— In Norway "data is used actively at the national, regional and local level"[312] and in a wide array of domains such as environmental sector, climate change adaptation, police, defence, rescue and preparedness, fisheries management, coastal zone planning, oil and gas industries, land-use planning, building projects, higher education sector, agricultural administration, transport and mineral extraction[313]. We did not find however more granular information on specific use cases.

— In Luxembourg, the use of SDI by public administrations has brought to significant improvement such as "the rising use of WMS web services by the municipality administrations within their local GIS systems, stopping a long year tradition of retrieving datasets on CD, with partially severe actuality issues[314]". This benefit can also be generalised to other public authorities in other countries. However, as mentioned in a 2018 Study on Open Data, public officials in Luxembourg seem to believe that the availability of SDI and more geospatial data in general led to a facilitation of their tasks but not yet to new ways of approaching and delivering public services[315].

— In France, the government created a number of shared services based on SDI and for policy making purposes. For instance, CARTOMER is a specific infrastructure on protected marine area which is used by different authorities (ministry for environment, authorities in charge of protected areas, municipalities etc.) for planning and decision making and which is also accessible to the general public[316]. At the regional level, initiatives such as the Observatory on the natural, agricultural, forest and urban space in Aquitaine, which aims at monitoring and improving land usage and planning, also make use of part of the French SDI[317]. Some French SDI based applications are also built to improve citizens' experience with public services. For instance, the government developed a new SDI-based application for winemakers that allows them to communicate to public authorities the land attribution for each type of vineyards so as to comply with the obligations in terms of protected denomination of origins, protected geographical indication and controlled origin denomination[318]. The French 2016 INSPIRE country report mentions four other examples of reuse of the SDI by public authorities (3 at the national and 1 at the regional level)[319] in policy making or public service delivery, some of them also open to the public as the example above. This significant take up of the infrastructure by the public sector was confirmed by one of the interviewees who also argued that there is no need to actively push for more reuse, the take up happens de facto due to increased efficiency in using the SDI[320].

— The follow up study on the impact of Open GeoData in Denmark also suggests that the country experiences widespread usage of the SDI and this trend towards more uptake of SDI across Member States and Norway is also confirmed by other studies and sources[321].

Those above are just a few examples of how countries assess and report on their use of SDI by public administrations but they can be, to some extent at least, generalizable to all Member States. Other countries

[311] See: National Benefits for INSPIRE Implementation, the real life use cases, Andrius Balciunas and Evaldas Rozanskas, INSPIRE conference 2016, Barcelona, http://inspire.ec.europa.eu/events/conferences/inspire_2016/page/oral

[312] INSPIRE National Country Report 2013-2015, Norway, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/NO

[313] INSPIRE National Country Report 2013-2015, Norway, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/NO

[314] INSPIRE National Country Report 2016, Luxembourg, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/LU

[315] See : Impacts of Open Data in Luxembourg and the Greater Region – 2018, https://download.data.public.lu/resources/study-impacts-of-open-data-in-luxembourg-and-the-greater-region-2018/20181004-093205/impacts-of-open-data-in-luxembourg-and-the-greater-region-2018.pdf

[316] http://cartographie.aires-marines.fr/

[317] INSPIRE National Country Report 2016, France, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/FR

[318] Interview 2, France.

[319] In particular, see the API Carto project (https://apicarto.ign.fr/), the GeoBretagne platform (https://cms.geobretagne.fr/), la passerelle INSPIRE vers le portail Open data national and the ELF project (http://www.elfproject.eu/) , INSPIRE National Country Report 2016, France, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/FR

[320] Interview 2, France.

[321] See : The impact of open geographical data – Follow up study, March 17th, 2017, PWC, https://sdfe.dk/media/2917052/20170317-the-impact-of-the-open-geographical-data-management-summary-version-13-pwc-qrvkvdr.pdf

(e.g. Malta, the Netherlands and Latvia) also mention various cases of use of SDI by public authorities and especially in the domain of environmental policies and climate change (see for instance in the case of Malta), sometimes without describing in details the magnitude of the usage and the use cases or by offering high level statistics only (e.g. Portugal and Sweden). Furthermore, there are certain domains in which the public sector develops more frequently SDI based services, also to interact with citizens.

One of these domains is the Cadaster:

- The Italian Cadastre allows Private Chartered Surveyors to register constructions of new real estate units, changes to those and divisions or constructions of land parcels through an IT system called SISTER .
- In Estonia, "applications for planning and permit requests in Tallinn, Estonia are placed via a mobile enabled web portal, creating a transparent, real time process saving time and money.
- In France and Spain, citizens and businesses can also ask for planning permits through SDI based applications.
- In Sweden, SDI based applications are used for citizens' services not only in terms of smart buildings but also smart environment.

The cases of Belgium and the Netherlands, which are also very interesting from a usage perspective, are further discussed in Section 4.1.2.

The majority of the countries in scope of this analysis offer limited information and/or mention some obstacles in the usage of the infrastructure by public authorities. In Hungary for instance, shared SDI is not yet seen as common practice and public administrations do not have the possibility to automatically access each other's data, which hampers data usage overall[322]. The 2016 INSPIRE Country report of Estonia mentions that the use of SDI within the public administration is limited by the lack of technical skills of public officials and that using spatial data for decision making requires a level of IT skills which "is not present at the moment"[323] (information from 2016).

To conclude on the usage of SDI by public administrations for policy making or provision of public services, the situation across Member States and Norway is quite diverse. While for some countries there seems to be limited use of SDI amongst public sector and/or barriers for the take up (in terms of licenses, lack of skills and knowledge) a nourished group of countries was able to leverage the SDI to become more efficient and to improve public decision-making. The factors influencing the belonging of a country in one or another category can be sought in the contextual indicators and the institutional set up in terms of strategy, governance and infrastructure. This indicator also helps highlighting that in a number of cases the SDI is already "indirectly" used by citizens in their interactions with government and there are some services (e.g. cadaster management systems) that are more widespread than others in this respect although there are examples coming from different policy areas (environment, agriculture etc.). However, developing SDI based services is "the new normal" only in some sectors and there is a large marge of improvements in others. This remains an "innovative approach" which is not yet automatically integrated in the way public authorities conceive and develop public services to citizens across all sectors. Nonetheless, there is a growing interest and take up of SDI within the public sector and public authorities use this infrastructure more and more in development of citizens' services.

4.1.1.2 There is a considerable take up of the SDI by private sector and other organisations (e.g. NGOs) for delivery of – new and innovative – applications, products and services

The analysis of the second usage indicator (use of SDI by private actors and other organisations) shows that, generally speaking, those countries in which there is a strong public sector use of the infrastructure also see a considerable private/non-governmental sector usage that might indicate that these two aspects are linked. This is at least the case for Denmark, France, Lithuania, the Netherlands and Luxembourg.

- **In Denmark**, according to the 2017 study on the impact of open geographical data, the geospatial information in general and **the SDI in particular had a great significance in terms of development of new innovative services and products**[324]. This study presents a few examples of

[322] INSPIRE National Country Report 2016, Hungary, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/HU

[323] INSPIRE National Country Report 2016, Estonia, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/EE

[324] See : The impact of open geographical data – Follow up study, March 17th, 2017, PWC, https://sdfe.dk/media/2917052/20170317-the-impact-of-the-open-geographical-data-management-summary-version-13-pwc-qrvkvdr.pdf

companies using the SDI such as Scalgo[325], which is a national flood risk platform, or Bisbase, which connects geospatial and business data to create a product that is sold to banks for relevant business analysis[326].

— **In Luxembourg**, on top of a flood monitoring application similar to Scalgo and developed by Google, **the 2018 study on Open Data lists many other examples of business use of SDI and address data in particular**: amongst the known users of SDI there are banks, insurances and consulting firms[327] and the SDI counts around 15.000 single accesses per day[328].

— **In France**, although there are no comprehensive statistics on "private/non-governmental" sector usage available, the development of the api.gouv platform[329] and of the API géo[330] constituted important steps towards an increase in the usage of public data infrastructure, including SDI. This was acknowledged during the expert's interview and it is also confirmed by the statistics of the API Géo webpage: during the first week of May alone, the platform knew 7 123 229 unique searches[331].

— **In Lithuania** businesses have shown a growing interest in using the SDI and the percentage of business users went from 12% in 2013 to 38% in 2016[332]. The report also mentions interesting applications which were developed building on the SDI and in particular the application developed by the Lithuanian National Credit Union[333].

— The case of the Netherlands, which is particularly interesting in this respect, will be further discussed in the next section.

There are many other examples of reuse of the SDI by businesses and these can be found also for countries where the public sector use is more limited.

— **In Estonia, companies like Datel provide geospatial services to governments based on the country's SDI.** The most well-known applications developed by Datel are the Urban Planning and Permitting System (see also usage by citizens below) and the geoinfosystem for public authorities[334].

— **In Belgium, there have been some efforts in terms of business users' identification and follow up** and the example of KLIP, which is an application for building works and visualising underground cables, is considered as a very interesting use of the Flanders SDI[335] (see also the following section).

To conclude on business and non-governmental usage of SDI, countries seem to have two different approaches for analysing the usage of their SDI infrastructure:

— Monitoring and provision of basic statistics on number of access to services, number of downloads etc. (e.g. Luxembourg, France);

— Analysis and promotion of companies' case studies (e.g. Flanders, Estonia).

A combination of both is needed however to fully grasp the extent to which the SDI is used by private businesses and other organisations, and, in this respect, there are very few examples of "integrated reporting/monitoring" which hampers the quality of the data available for this report.

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[325] https://scalgo.com/

[326] See : The impact of open geographical data – Follow up study, March 17th, 2017, PWC, https://sdfe.dk/media/2917052/20170317-the-impact-of-the-open-geographical-data-management-summary-version-13-pwc-qrvkvdr.pdf

[327] See : Impacts of Open Data in Luxembourg and the Greater Region – 2018, https://download.data.public.lu/resources/study-impacts-of-open-data-in-luxembourg-and-the-greater-region-2018/20181004-093205/impacts-of-open-data-in-luxembourg-and-the-greater-region-2018.pdf

[328] INSPIRE National Country Report 2016, Luxembourg, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/LU

[329] https://api.gouv.fr/

[330] https://api.gouv.fr/api/api-geo.html

[331] Information retrieved on the 16th of May, source: https://api.gouv.fr/api/api-geo.html

[332] INSPIRE National Country Report 2016, Lithuania, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/LT

[333] See: National Benefits for INSPIRE Implementation, the real life use cases, Andrius Balciunas and Evaldas Rozanskas, INSPIRE conference 2016, Barcelona, http://inspire.ec.europa.eu/events/conferences/inspire_2016/page/oral

[334] See : Estonia ICT Cluster, https://e-estonia.com/wp-content/uploads/1pager-2017-web-002.pdf

[335] https://overheid.vlaanderen.be/informatie-vlaanderen/producten-diensten/kabel-en-leidinginformatieportaal-klip

4.1.1.3 The country uses the SDI in the deployment of cross-border eGovernment services

This indicator aims to cover the level of usage of SDI in the deployment of cross-border eGovernment services and applications. For this indicator specifically, the information and evidence gathered during the data collection activity has been most limited. Based on the information we found, only two countries that have deployed and operationalised cross-border eGovernment services using SDI components.

The example, X-Road[336], a joint project between Estonia and Finland, and can be perhaps considered as a best practice on how progress in this respect could be achieved. X-Road is an: *"Open source data exchange layer solution that enables organisations to exchange information over the Internet. X-Road is a centrally managed distributed data exchange layer between information systems that provides a standardized and secure way to produce and consume services. X-Road ensures confidentiality, integrity and interoperability between data exchange parties."*[337]

X-Road in principle brings together the Estonian data exchange layer X-tee[338] and the Suomi.fi Data Exchange Layer service of Finland[339]. As part of the X-Road technology, Finland and Estonia jointly also set up an institute, the Nordic Institute for Interoperability Solutions (NIIS).[340] **NIIS and X-Road undertake among others activities the development of cross-border eGovernment services that are using SDI/INSPIRE components**.

Unfortunately, no other example of such cross-border provision of eGovernment services could be identified at this stage. There is a very high number of cross-border projects concerning SDI and many of them also involve the development of platforms or visualisation tools for instance. In this respect and in terms of cross-border initiatives for the harmonisation of data and services, there are some very interesting examples of extensive use of the infrastructure coming from certain geographical areas in Europe such as the:

- The Nordic and Baltic states,
- The Central European and Balkan countries or,
- The southern EU Member States.

Next to geographically-clustered initiatives, there are also project-endorsed synergies such as the European Location Framework (ELF)[341] or the Opel ELS projects, led by EuroGeographics[342], the umbrella organisation of Europe's National Mapping, Cadastral and Land Registration Authorities.[343]

Nonetheless, we took the stand here to interpret this indicator quite strictly and only include examples of eGovernment services in the scope of the analysis. If one follows a strict interpretation of this indicator, it emerges that only a small number of countries have already embarked in developing SDI based e-government services cross border, although this seems a very promising direction for the future.

4.1.2 In-depth analysis of Spain, Poland, the Netherlands and Belgium

In the cases of Spain, Poland, the Netherlands and Belgium, there have been significant investments and focus on the usage of SDI by public sector but also by private and non-governmental actors.

In Spain, In terms of usage within the public sector, all interviewees were very positive especially concerning the progresses made since five years ago. As one of the interviewee clearly stated: "year after year the SDI is more and more used"[344] and this is confirmed by the data provided in the INSPIRE Country Report 2016 and

[336] See: 'X-Road – the data exchange layer', https://www.niis.org/data-exchange-layer-x-road/

[337] See: 'X-Road – the data exchange layer', https://www.niis.org/data-exchange-layer-x-road/

[338] See: 'Introduction of X-tee', https://www.ria.ee/en/state-information-system/x-tee/introduction-x-tee.html

[339] See: 'General information on the web service', https://www.suomi.fi/instructions-and-support/general-information-on-the-web-service and 'Legislation', https://www.suomi.fi/instructions-and-support/general-information-on-the-web-service/legislation

[340] See : https://www.niis.org/

[341] See: 'European Location Framework', http://www.elfproject.eu/

[342] See: 'EuroGeographics', https://eurogeographics.org/

[343] In 2016, ELF moved into a transition phase and started transferring the responsibility for the future of ELF to EuroGeographics. See: http://www.elfproject.eu/content/overview

[344] Interview 1, Spain.

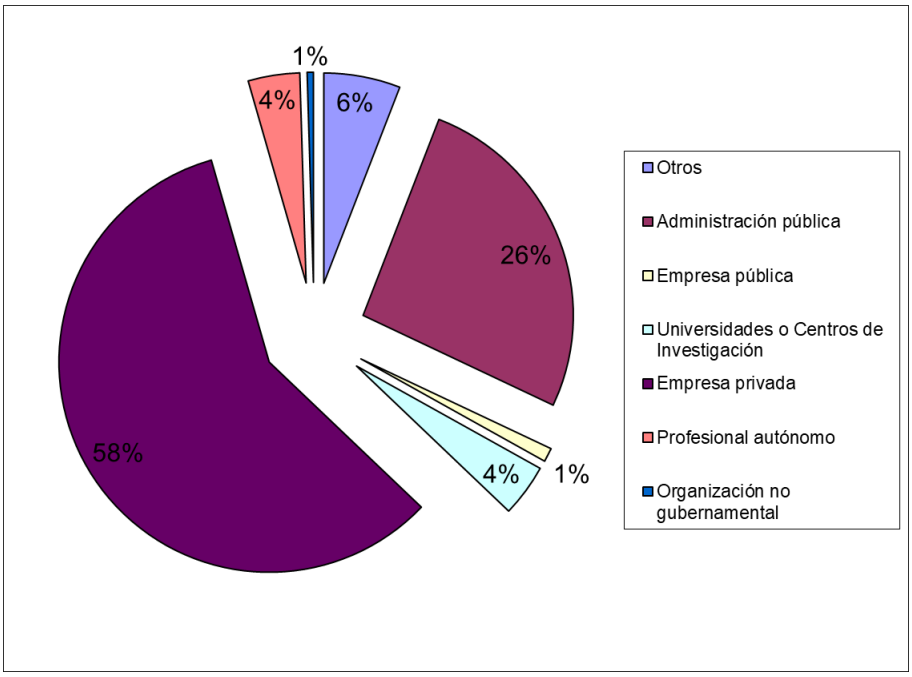
INSPIRE country fiches on the accesses and downloads from the different platforms and data catalogues at the national and regional level[345]. In this respect, see for instance the trend in the number of Cadastre online service unique users over time and break down of types of Cadastre users shown below.

Figure 2 – Increase in the number of users of the Cadastre services

	2011	2012	2013	2014	2015
Usuarios distintos	4.406	13.201	23.501	28.130	33.767
Usuarios año	4.406	8.795	10.393	11.220	11.428

Source: Spanish Cadastre, internal document

Figure 3 – Break down of types of Cadastre services and data users



Source: Spanish Cadastre, internal document

As shown in the picture, around 26% of users of Cadastre data and services come from the public sector itself. A very good example in this respect is the take up of map viewer services: **today almost all ministries use web-services and produce web-services built on the SDI and this was surely not the case a few years back**[346]. Another illustration of this increased take up comes from the Cadastre, which today provides datasets on flooding to thousands of municipalities in Spain[347]. Concerning the usage by private sector in Spain, data also seem to suggest an increase in the take up and especially for certain categories of data and services although private sector users already constituted a big majority in the case of certain services (as 58% the Cadastre, see picture above). For instance, as one of the interviewees mentioned, the usage of SDI based information for **the development of cycling and hiking apps for rural area has significantly increased over time due to the higher quality of the SDI compared to Google Maps**[348]. Furthermore, already back in 2016 the INSPIRE country report highlighted the increase in the unique accesses to the portal as proxy for increased use amongst private sector[349]. In this context, it is important to mention that in Spain there is a very important infomediary sector with more than 660 companies identified in the latest analysis[350] and that a very strong majority of them works with geo-spatial

[345] INSPIRE Country Report, Spain, 2016, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/ES

[346] Interview 1, Spain.

[347] Interview 3, Spain.

[348] Interview 1, Spain.

[349] INSPIRE Country Report, Spain, 2016, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/ES

information for a total turnover of 25% of 1.7 billion euro[351]. Finally, one of the interviewee suggested an increase in access and downloads from outside Spain[352], which were already around 20% of the total according to the INSPIRE Country Report 2016[353].

Although everybody acknowledges these progresses, there is no official data on the overall usage of the infrastructure by the public and private sector, as also highlighted by the INSPIRE Country report[354]. This is due to the fact that **no registration is needed to use the services or download the data** and therefore the data providers have limited knowledge about their users except for some figures on downloads and access to services. Recently, the National Geographic Institute developed a user survey which was advertised on the website and the institute also started doing further research on the URLs. However, according to an interviewee, a well-grounded mapping and analysis of users requires more resources than those available[355]. On the side of the Spanish Cadastre, this body has been developing yearly statistics on usage for some time and these show that 475.000 cartographies are downloaded every year[356]. Furthermore, this body has been monitoring the number of users deciding to rely on online services instead of going to the Cadastre offices (as further discussed in the section on benefits) and has also developed a user survey. However, all these **usage monitoring exercises are specific to an organisation and there is no overall monitoring of the SDI usage** that could allow to understand the breadth and speed of the take up. Data emerging from the monitoring of the different portals and services are in fact not aggregated at this stage.

Poland has also been paying particular attention to the usage of spatial data both within the public and the private sector. This is proven by the efforts made in terms of projects and initiatives aimed at increasing take up and facilitate users' life. Amongst these, a very interesting initiative called **CAPAP** deserves special attention. **Concluded in November 2018, this EU funded project focused on**: a) Increase the utilization of spatial information by citizens, entrepreneurs and public administration; b) Improve the accessibility of tools, services and data sets managed by public administration; c) Improve quality and interoperability of eServices and spatial data sets managed by public administration; d) Increase users' awareness and skills related to spatial data sets and spatial data services.[357]"

In particular, the project contributed to the development of a number of user-centric applications and tools including:

- "Applications with simple graphical user interface (GUIs)
- Applications and services with simple APIs
- Standardised but not „spatial" interfaces like
- Simple Object Access Protocol – SOAP and Representational State Transfer - REST
- Simplified data models
- Popular, non-spatial data exchange formats;
- XML, JSON, CSV, Shapefile instead GML
- Eye-catching and simple map compositions[358]"

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[350] ASEDIE, VI Infomediary Sector Report, 2018, http://www.asedie.es/assets/asedie-sector-infomediary-report-2018.pdf

[351] ASEDIE, VI Infomediary Sector Report, 2018, http://www.asedie.es/assets/asedie-sector-infomediary-report-2018.pdf

[352] Interview 1, Spain .

[353] INSPIRE Country Report, Spain, 2016, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/ES

[354] *« No existe un seguimiento sistemático del uso de los servicios espaciales de las IDE en España, entre otras razones, porque el usuario de servicios estándar es esencialmente anónimo y resulta difícil establecer contacto con él. »* INSPIRE Country Report, Spain, 2016, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/ES

[355] Interview 1, Spain.

[356] Interview 3, Spain.

[357] CAPAP, A way of making spatial information more popular, INSPIRE Conference 2018, Office of Geodesy and Cartography, https://inspire.ec.europa.eu/conference2018/psessions

[358] CAPAP, A way of making spatial information more popular, INSPIRE Conference 2018, Office of Geodesy and Cartography, https://inspire.ec.europa.eu/conference2018/psessions

Amongst the many application which came out of this initiative, the project resulted in the development of an Error Reporting application allowing to report errors of data sets, services and applications or of a Spatial Analysis application allowing to create map composition[359]. The applications developed under this project are almost all already available on the website of the initiative or they will be soon[360].

Although there is a strong focus on take up as illustrated by the project described above, similarly to what happens in Spain the data on the usage of the SDI by public authorities is not easily available. The desk research and interviews carried out at this stage do not allow to provide quantitative evidence on the extent to which public officials and public authorities rely on SDI for policy making and/or development of eGovernment services for instance. **The interviewees mentioned an ICT system called Universal Map Module (UMM) created for emergency management services. The system provides ICT services publishing spatial data and tools that supports emergency services such as police, fire brigades in their everyday activities.** Furthermore, no data or final conclusions on the effects of the CAPAP project on public sector SDI take up could be found, also due to the fact that the initiative was closed only recently.

On the other hand, usage amongst private sector is more carefully monitored and the trend is very positive. The number of unique accesses and downloads to the Geoportal are in fact constantly growing. While in 2015 the country reported over 55.000 unique user on a peak day and 27.000.000 requests[361], the interviewees mentioned that nowadays the portal reaches 30.000.000 requests per day[362]. However, the interviewees underlined that the use of transformed interoperable data remains smaller with respect to the use of data as-is, with a ratio of 1000:1[363]. As such, the interviewees argued that "INSPIRE interoperable data is not as used as other national data"[364]. Furthermore, as some data is provided as open data, the data providers do not have a full and detailed overview of services and products which are developed by businesses on top of SDI and they can only rely on statistics on accesses and requests as those provided above. To these statistics, the Ministry for Administration and Digital Affairs also added some monitoring of Google statistics but without venturing farther in the analysis of private sector usage[365].

The Head Office of Geodesy and Cartography that is in charge of INSPIRE implementations has identified some difficulties which are limiting reuse of SDI by private sector and notably:

- "IT specialists interacting with the platforms are not GIS specialists;
- There is a competition with Google, Bing and other map services providers;
- There are licenses restrictions[366]".

For these reasons and as mentioned in the previous sections, the Polish authorities are working towards a more user-friendly approach for the provision of the SDI and notably to address a larger audience which needs simpler services and good-looking platforms[367]. The provision of APIs in particular helped improving the number of users overall, as also shown in the picture below.

[359] CAPAP, A way of making spatial information more popular, INSPIRE Conference 2018, Office of Geodesy and Cartography, https://inspire.ec.europa.eu/conference2018/psessions

[360] Interview number 1.

[361] Ewa Surma, Marcin Grudzien, Implementing INSPIRE in Poland, Webinar on INSPIRE implementation in Poland and the Netherlands, 11 February 2015

[362] Interview 1, Poland.

[363] Interview 1, Poland.

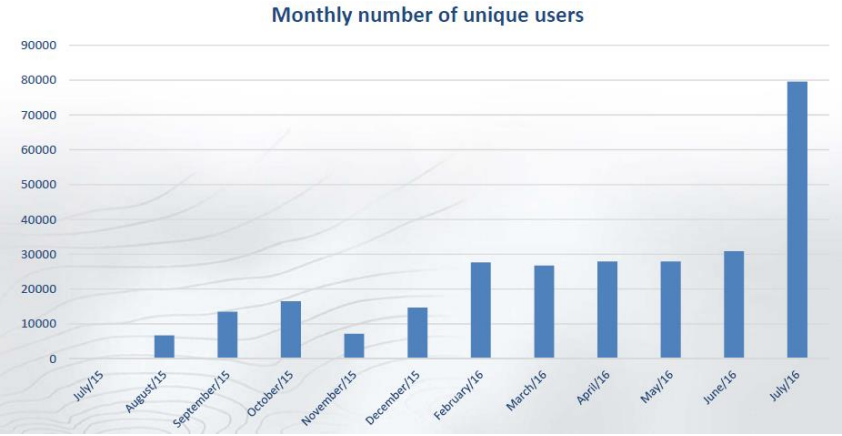
[364] Interview 1, Poland.

[365] Interview 1, Poland.

[366]Marcin Grudzien, INSPIRE 2016 Conference, INSPIRE Framework for eGovernment, Head Office of Geodesy and Cartography, 30 September 2016

[367] Marcin Grudzien, INSPIRE 2016 Conference, INSPIRE Framework for eGovernment, Head Office of Geodesy and Cartography, 30 September 2016

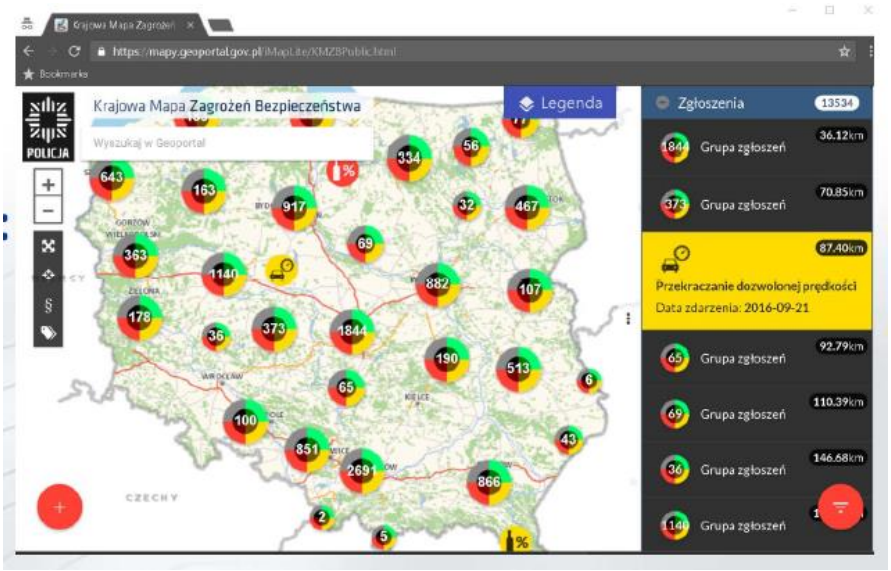
Figure 4 - Number of SDI users after APIs implementation (July 2015-July 2016)



Source: Marcin Grudzien, INSPIRE 2016 Conference, INSPIRE Framework for eGovernment, Head Office of Geodesy and Cartography, 30 September 2016

The INSPIRE Country Report 2016 mentions that the spatial data infrastructure is used not only by businesses but also by non-governmental organisations for educational and monitoring purposes[368]. For instance, KLUB GAJA is an environmental Polish NGO working on nature and animal protection and it uses the SDI to monitor developments and inform citizens about environmental issues[369]. Citizens can use eServices build on SDI and especially in the framework of Cadaster services. Indeed, parcel information is available online to citizens and businesses[370]. Similarly, the police built an SDI based application – the National Security Map - for citizens to report minor criminal offences and dangerous spots (see picture below)[371]. The number of daily entries is in between 500 and 3000 accidents reported and citizens most frequently raise issues related to parking and speed security issues as well as public drinking[372].

Figure 5 - Police crime application



Source: Marcin Grudzien, INSPIRE 2016 Conference, INSPIRE Framework for eGovernment, Head Office of Geodesy and Cartography, 30 September 2016

[368] INSPIRE Country Report 2013-2015, Poland, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/PL

[369] http://www.klubgaja.pl/app.php/ngo

[370] INSPIRE Country Report 2013-2015, Poland, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/PL

[371] Marcin Grudzien, INSPIRE 2016 Conference, INSPIRE Framework for eGovernment, Head Office of Geodesy and Cartography, 30 September 2016

[372] Marcin Grudzien, INSPIRE 2018 Conference, Improving public safety with National Security Map, September 2017

Finally, the report also highlights that "spatial development information made available using local or regional hubs may be used to strengthen public participation in planning procedures. To expand social participation, local authorities use geo-web portals providing online information to the public on ideas/applications for planning documents"[373].

In **the Netherlands**, **the available statistics clearly show the progress concerning both the supply and use of spatial data**[374]. Between 2015 and 2018, the number of data sets on PDOK increased from 91 to 157, and the number of – view and download – services from 257 to 415. In this period, also the availability of the services clearly improved. The number of requests on these services increased even more dramatically over these 4 years, with around 5 times as many requests in 2018 compared to 2015.

Table 7 - Progresses on the supply and use of spatial data in the Netherlands

	2015	2016	2017	2018
Data sets	91	106	126	157
View- & download services	257	304	344	415
Service requests (per year)	2,1 billion	4,4 billion	6,3 billion	10,5 billion
Service requests (average per month)	175 million	367 million	525 million	875 million
Availability	98,50%	99,29%	99,14%	99,49%

Source: PDOK Annual Report 2018.

In 2018, a consultation took place among the users of the National Georegister (NGR), the catalogue of spatial data sets in the Netherlands. 112 different users participated in this consultation, which aimed to evaluate the use, quality and added value of the NGR. The majority of the participating users were from the public sector (63%), but also users active in the private sector (28%) and citizens (10%) participated in the study. Interesting to notice is that the public sector evaluated the NGR slightly more positively than the private sector users.

Various use cases of open spatial data in the Netherlands, in many different domains (transport, housing and environment). Some interesting examples are:

- The Hooikoortsradar[375], a website that provides information regarding pollen and hay fever, such as the expected amount of pollen in the upcoming days
- HomeShow[376], a website and application for real estate agents, showing all the relevant information about the neighbourhood for a house that is for sale about the neighbourhood (e.g. facilities, shops, population statistics, etc.).
- Hier wil ik wonen ("I want to life here")[377], a mobile app that allows users to calculate how well home addresses score based on their preferences in three categories: comfort, health and safety.
- Zwemwater[378] ("Bathing water"), a website providing information on the water quality and services offered at swimming locations in the Netherlands
- Amsterdam City Dashboard[379], a website that provides information on the city of Amsterdam related to a wide range of municipal services (transport, environment, statistics, economy, culture), via dashboards, maps and other visualizations.

[373] INSPIRE Country Report 2013-2015, Poland, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/PL

[374] PDOK Annual Report 2018; Interview 3, the Netherlands

[375] https://www.hooikoortsradar.nl

[376] https://www.homeshow.eu/

[377] https://play.google.com/store/apps/details?id=eu.centric.hierwilikwonen&hl=nl

[378] http://www.zwemwater.nl/

- Homeatrix, a website providing house value calculations based on open data from various providers
- Boer & Bunder, a website with information on agricultural parcels (soil type, eligible areas, what is cultivated, cadastral information, Natura 2000 data and other information on applicable legislation).
- "Overstroom ik" ("Will I flood") is an application citizens could use to check the flood risk to their home.
- The "Salt Map" shows the roads where salt has been sprinkled.

Furthermore, GeoBusiness Nederland, the association representing companies that work with geo-information, annually investigates the state of the market in the country, based on a survey among companies active in the sector. The results of the 2018 Monitor[380], in which 41 Dutch companies participated, provides interesting insight in the state of the geo-ICT sector in the Netherlands. Almost 80% of the companies indicated that open – spatial – data was very important for the activities of the company. The Monitor also demonstrated the importance of the public sector as customer in the geo-ICT market. 54% of the participating companies stated that more than half of their revenues were from services and products provided to the public sector.

Another interesting illustration of the usage of the SDI data and services is the overview of applications based on data from the National Data Warehouse for Traffic Information (NDW)[381]. Almost 50 different applications are presented, in three main categories: applications providing traffic information, applications for traffic management and applications for traffic policy and research.

In Belgium, the various regional and federal SDIs in Belgium are strongly used by public authorities at different administrative levels and in different thematic domains. There are many examples of the public authorities using the data and services provided by the SDI in their decision making and service delivery processes, of which examples link to online applications as websites are the most visible. Especially the Flemish SDI as developed a set of applications and services on top of the SDI that are strongly used by public organisations and other stakeholders in particular domains. Several of these applications and services have been recognised by the e-government community as best practices. Some examples are provided in the table below.

The *Solar Map* (Zonnekaart in Dutch), an initiative of the Flemish Energy Agency in collaboration with VITO and Information Flanders, shows the solar potential of all rooftops in Flanders. Accurate height measurements of Flanders were used to determine the area, orientation and slope of each of the more than 2.5 million roofs in Flanders. Citizens can consult the solar map online and immediately see whether his or her roof is ideal (green), usable (yellow) or of limited or no use (orange). For every roof marked in green or yellow, the tool also immediately calculates the cost price and the repayment time based on average family consumption (electricity consumption of 3,500 kWh/year) and indicates the annual savings in energy costs and CO2 emissions.

Vlaio, the Flemish Agency for Innovation & Entrepreneurship developed the so-called *Hindrance Premium tool,* in collaboration with Information Flanders. The hindrance premium is a financial subsidy for small enterprises who face serious hindrance from roadworks. These enterprises automatically receive a letter from the Flemish administration in case they qualify for a hindrance premium. The automatic selection is based on data from the GIPOD (Generic Information Platform Public Domain), in which all public works in Flanders are registered, and the VKBO (Enriched Crossroads Bank for Enterprises). The unique combination of both databases, supplemented with the open data from GRB, CRAB and the road register, allows a geographical selection of companies that will be affected by planned works. These company can easily request the allowance via an interactive web application.

The *Care Atlas* provides an overview of various types of information related to care, welfare and health. Statistical information – e.g. about deaths, hospital admissions, population screenings – is provided at the level of the so-called care zones, a classification the Flemish government uses in the domain of health and welfare. The Care Atlas also contains information on the care facilities, such as hospital, home nursing services, centers for short stay, etc., in the form of POIs or points of interest. These POIs can be visualized on the map together with the care zones and / or care statistics.

[379] http://citydashboard.waag.org/

[380] https://www.geobusiness.nl/geobusiness-panel-monitor

[381] https://www.ndw.nu/toepassingen/nl/

An alternative way to identify and describe the usage and benefits of the Flemish SDI, is by looking at different use cases of the **GRB, the Largescale Reference Database which provides a uniform topographical reference for geo-information in Flanders**.

The GRB is used in many public sector processes in Flanders, and integrated in many applications supporting these processes. In the context of the Cables and Pipelines platform, the platform for exchanging plans of underground infrastructure between utilities companies and contractors, the GRB is used as the reference map for mapping underground cables and pipes. In the Digital Building Permit, the online application to request for a building permit, parcel and building geometry can be selected and downloaded for making a site plan. Many police services in Flanders are using the GRB as a reference background for making drawings for traffic accident registrations.

But also in the other regions and at the federal level there are interesting examples demonstrating the role and impact of SDIs in the context of Digital Transformation. In 2017, the federal project 'Cartography for Wildfires' was awarded with the national e-government award in the category of 'best collaboration'[382]. For this project, the NGI worked closely with the emergency services, ASTRID, the FPS Home Affairs, the Nature and Forest Agency and with Defense, with the aim of creating a web application providing access to an up-to-date base map and all thematic data the fire department, police, civil protection, and other ad hoc emergency service needed in case of large wildfires. Another interesting example at the **federal level, also awarded with a national e-government award, is the GeoNavoTool, a cartographic tool for tracking the movements of persons during international – summit - meetings**[383]. The most well-known application based on the SDI of the Brussels Capital Region is **the Fix My Street initiative of Brussels Mobility in collaboration with the municipalities and several Brussels partner institutions, with technical support from the BRIC. Fix My Street is an internet and mobile platform made available to the public and the authorities to report incidents in public spaces.** It helps in locating and describing problems in the public domain, and informs the public and authorities about the different stages in the process of 'fixing' the incident.

From the very beginning of the development of the Flemish SDI, **especially small and medium-sized companies have been strongly involved in the development and the implementation process**. The Flemish administration strongly relied on the knowledge and expertise of private companies for the development and implementation of **especially the technological components of the SDI**. INSPIRE led to an increase in the awareness on the value of spatial information and the need to share information across organisational boundaries, and resulted in additional services and products provided by the private sector to the administration. The impact of the SDI on the private sector in Flanders further increased when data became available as open data, which could be reused by private companies for developing new services and products. Some illustrations of this are:

- *Realo (https://www.realo.be/nl)* is a Belgian website that shows real estate properties and provides demographic information about the different places in Belgium. Value of real estate is estimated with algorithm based on open data.
- *Aircheckr* (https://aircheckr.com/products) offers air quality data at several levels of detail: real-time, forecasting and statistics. Aircheckr can easily be integrated into different applications through API and widgets.
- *Spotbooking* is a web application developed by the Flemish geo-ICT SME Geosparc (https://www.geosparc.com) that supports the process of applying for, processing and maintaining intakes of public space within a town or city.

As these examples from Spain, Poland, the Netherlands and Belgium suggest, all these countries have known very interesting developments and progresses in the use of SDI by public sector and private/non-governmental sector. Increased usage of the infrastructure by public and private sectors in these countries are evolving in parallel and according to a deliberate strategy to foster both. At the same time, as also shown in the analysis of the 29 countries, monitoring mechanisms of usage are not always very comprehensive and rely on a mix of limited statistics and specific use cases.

[382] Interview 1, Belgium.

[383] Interview 1, Belgium.

Concerning the usage indicator and notably the use of SDI for cross-border eGovernment services, not many example could be found for these four countries. Poland for instance is involved in many cross-border activities but none of them went as far as to involve the establishment of SDI based eServices yet. Similarly, Spain is involved in many different cross-border projects for instance Ideotalex (jointly with Portugal) which is supported by the European Regional Development Fund and provides a cross-border/cross-region SDI with some additional services on top[384] but does not make clear reference to SDI based services as an outcome. The analysis of Belgium and the Netherlands did not allow finding many cases yet for the use of SDI for cross-border eGovernment services, although both countries are very active in cross-border projects, mainly on knowledge exchange, setting up SDI components and data harmonisation, which may be interpreted as preliminary steps for further applications developments.

Most cases of joint processes and services are in the domain of environmental policies, such as air quality, noise pollution or Natura 2000. Interesting examples in other domains – in which both Belgium and the Netherlands are involved - are the creation of cross-border proximity maps (e.g. for statistical purposes)[385], cross-border information services on commercial sites and property[386] and cross-border crime fighting.

To conclude on the usage indicators, the analysis of these four countries support the assumption concerning **the existence of a link between increased usage within the public and private/non-governmental sector at the same time.** In fact, the countries are progressing in parallel on both fronts and example of use cases emerge both from the public and from the private sector. In terms of usage of the infrastructure for cross-border provision of eGovernment services, very interesting examples are emerging but remain rare: this could be linked to the fact that such examples do not exist yet but also to the fact that data on such examples is very scares. Nonetheless, given the increase in the usage of the infrastructure at the national level, cross-border developments should not be long in coming.

4.2 Benefits

Main messages:

- The benefits indicators look at the positive effects of SDI implementation from the perspective of all possible stakeholders concerned (public authorities, private sector and citizens). A few countries rely on Cost-Benefits Analysis (CBA) to measure and capture these effects while others privilege qualitative approaches. In general, there is limited consistent and regular monitoring/measuring of benefits, which makes quantifiable information scarce. This is also due to the fact that different public administrations do not all understand the measurement of benefits in the same way and do not always focus on quantitative evidence.
- According to the available studies and analysis, benefits for public authorities, businesses and citizens can be divided in macro-categories and analysed at a higher level, based on the examples available.
- For public authorities, the main benefits linked to SDI relate to a) Efficiency gains, b) Better, smoother and/or optimised processes (also due to more informed decisions based on data integration), c) More cooperation and exchange between stakeholders, d) More innovative services/processes and more attention and investments in innovation and e) Better policy outcomes. Countries have mostly investigated and quantified the aspect of efficiency gains while other benefits are less explored although equally important (e.g., the question of improvements to business processes due to usage of SDI).
- For citizens and business, the identified benefits mirror partially those listed for public authorities and they are notably: more efficient interaction with governments (saving time and money) and burden reduction, better access to information and participation in public life, better policy making outcomes and market growth and jobs creation. Amongst these categories of benefits, the question of efficiency and burden reduction attracts most of the attention to the point where, in certain cases, this becomes a driver for further extend SDI implementation.

[384] http://www.ideotalex.eu/OtalexC/

[385] https://inspire.ec.europa.eu/sites/default/files/presentations/1645proximity_statistics_across_borders_using_inspire.pdf

[386] www.the-locator.eu/

— Overall, the analysis showed that the availability of more geo-spatial data corresponded to an increase in production and efficiency across all categories of stakeholders and notably governments at different levels of administration and businesses. It also shows that one of the expected benefits of the SDI development, that is to say improvement in policy outcomes, is not sufficiently explored in the framework of studies concerning benefits.

The indicators on benefits constitute the second category of "impact indicators" and they aim at assessing the positive outcomes resulting from the development and usage of SDIs in terms of Digital Government Transformation and at the national and cross-border level. Benefits can be distributed across different stakeholders and notably:

— *Governments and public authorities* which might take advantage from the infrastructure and availability of data in the process of digital transformation to become more efficient (and to cut costs), to deliver improved and new services and to innovate;

— *Businesses* which can a) leverage the SDI to develop and improve their own services but also b) benefit from public data available and new and improved services delivered by public authorities;

— *Citizens, which* can also benefit from new and improved eGovernment services.

The indicators developed for assessing the benefits thus differentiate between the public sector (the governments) and the businesses, citizens and society more widely as shown below:

— The use of SDI has delivered measurable benefits to governments.

— The use of SDI has delivered measurable benefits to businesses, citizens and society more broadly.

Although the indicators above are quite high level in terms of granularity and do not look at precise categories of benefits, these emerge from the data collection. The findings on the recurrence and types of benefits identified by the different countries are reported in the following section.

4.2.1 Analysis of the 29 countries in scope

The data collection highlighted very different levels of details and quality of data in the monitoring and reporting of the benefits linked to development and usage of SDI. In fact, out of all countries in scope of the analysis, in 2015-2016 only five seem to have in place formal/recurrent monitoring mechanisms and notably Denmark, the Netherlands, Slovakia, Lithuania and Sweden. It may happen that further analysis or monitoring activities were put in place after that date that we were not able to find.

— **Denmark has good initiatives in this domain**. The country carried out a number of in-depth analysis on the impact of open-geospatial data on the economy and society over the years and these analyses also cover aspects linked to the benefits for governments, citizens and businesses. The most recent study was carried out in 2017 and constituted a follow up study from a previous research of 2013[387]. The analysis showed that the **availability of more geo-spatial data corresponded to an increase in production and efficiency across all categories of stakeholders and notably governments at different levels and businesses**[388].

— **The Netherlands** took a similar approach to the monitoring of benefits and carried out two different cost benefits analysis (CBAs) focused on INSPIRE, a first in 2009 and a follow up study in 2016 and both analysis confirmed the positive trends and benefits identified at the earlier stage. In particular, these CBAs provided a detailed assessment of four different use cases and contemplated different scenarios for implementation[389].

The approach taken in Slovakia and Lithuania also involved carrying out of CBAs while Sweden took a more original approach:

[387] See : The impact of open geographical data – Follow up study, March 17th, 2017, PWC, https://sdfe.dk/media/2917052/20170317-the-impact-of-the-open-geographical-data-management-summary-version-13-pwc-qrvkvdr.pdf

[388] See : The impact of open geographical data – Follow up study, March 17th, 2017, PWC, https://sdfe.dk/media/2917052/20170317-the-impact-of-the-open-geographical-data-management-summary-version-13-pwc-qrvkvdr.pdf

[389] INSPIRE National Country Report 2016, the Netherlands, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/NL

— In **Slovakia**, almost each ministry has a unit that takes care of analysing the benefits linked to government spending. In the context of INSPIRE, different ministries carried out CBAs exercises (under the coordination of the INSPIRE National Contact Point) and, although the results are not always publicly available, benefits were clearly listed and qualified[390].

— In **Lithuania** on the other hand, one centralised CBA on the INSPIRE Directive was carried out prior to 2016 and this led to the identification of direct economic benefits linked to increased efficiency and other indirect benefits (social, policy and others)[391]. In particular, the CBA highlighted that the implementation of INSPIRE directly led to the saving of around 20.000 working days which amounts to 1,2 million euro spared by the government. Indirectly, it brought socio-economic benefits for around 900,000 euro in 2014 and growing to 1,8 million in 2016[392]. The CBA mentions that it is impossible to quantify the impact of the INSPIRE Directive on the acceleration of take up and development of SDI[393].

— **Sweden** also made efforts in evaluating and assessing the benefits of INSPIRE in 2014 and, similarly to what happened in Slovakia and Lithuania, this seems to be a once-only exercise that was not repeated since[394]. What is interesting about the Swedish example is the fact that the country paid particular attention to the social benefits linked to SDI. In particular, the country linked the development and use of SDI to key societal challenges for Sweden, which can be solved through more geo-spatial data[395] (see box below and also the section on Strategy).

In Sweden, "based on a definition of the future societal challenges that the country is facing where geodata can contribute to the solutions, five challenges are defined: 1) Innovation and growth, 2) Digitization of public sector administration, 3) Streamlining of the urban planning process, 4) Climate adaptation and environmental threats, 5) Defence and civil contingencies"[396]. **For each of these challenges, the country defined which could be the role of SDI in finding the solutions**. For instance, with respect to the challenge related to climate adaptation and environmental threats, it was stated that the benefits of geo-spatial and SDI concern:

- "The possibility to demonstrate and explain complex courses of events based on often large and complex quantities of data produced by research;
- The possibility to carry out analysis, impact assessments and planning measures for climate adaptation, and as basis for the presentation and communication of different types of climate and environmental information;
- The possibility for citizens to obtain information and get an overview of the environmental conditions in different areas, and to participate in the social debate on environmental issues"[397].

[390] Interview number 2.

[391] INSPIRE National Country Report 2016, Lithuania, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/LT

[392] INSPIRE National Country Report 2016, Lithuania, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/LT

[393] INSPIRE National Country Report 2016, Lithuania, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/LT

[394] INSPIRE National Country Report 2016, Sweden, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/SE

[395] See : Country Report of Sweden, Swedish Spatial Data Infrastructure and the National Geodata Strategy, Submitted to United Nations Committee of Experts on Global, Geospatial Information Management, Seventh Session, New York, August 2017, Submitted by Bengt Kjellson, Director General Lantmäteriet. Prepared by Lantmäteriet (the Swedish mapping, cadastral and land registration authority), Statistics Sweden, the Swedish Maritime Administration, the Swedish Environmental Protection Agency, the Swedish Meteorological and Hydrological Institute and the Geological Survey of Sweden.

[396] See : Country Report of Sweden, Swedish Spatial Data Infrastructure and the National Geodata Strategy, Submitted to United Nations Committee of Experts on Global, Geospatial Information Management, Seventh Session, New York, August 2017, Submitted by Bengt Kjellson, Director General Lantmäteriet. Prepared by Lantmäteriet (the Swedish mapping, cadastral and land registration authority), Statistics Sweden, the Swedish Maritime Administration, the Swedish Environmental Protection Agency, the Swedish Meteorological and Hydrological Institute and the Geological Survey of Sweden.

[397] See : Country Report of Sweden, Swedish Spatial Data Infrastructure and the National Geodata Strategy, Submitted to United Nations Committee of Experts on Global, Geospatial Information Management, Seventh Session, New York, August 2017, Submitted by Bengt Kjellson, Director General Lantmäteriet. Prepared by Lantmäteriet (the Swedish mapping, cadastral and land registration authority), Statistics Sweden, the Swedish Maritime Administration, the Swedish Environmental Protection Agency, the Swedish Meteorological and Hydrological Institute and the Geological Survey of Sweden.

Finally, a number of countries have carried out analysis on their geo-spatial or open data market in the last few years (e.g. Luxembourg, Spain) but these studies did not target specifically the benefits of SDI as such and might not be fully considered as monitoring exercises in this respect. As these examples suggest, when looking at the benefits all countries rely on specific studies and, in some cases, on studies concerning not only SDI but wider data initiatives (e.g. Norway) which might also allow to see the bigger picture and capture better the impact of SDI on digital transformation overall. It is important to note that, in general, countries do not rely on yearly or regular forms of monitoring as they seem to prefer a punctual study approach to better catch a trend

Based the data available through these studies, it is possible to distinguish, at the macro level, categories of benefits which are more frequently associated with the development and usage of SDI. In the table below, we list the most mentioned categories of benefits by type of stakeholders concerned: public authorities/governments, businesses and citizens.

Table 8 – Categories of identified benefits

Benefits for public authorities/governments	*Benefits for businesses*	*Benefits for citizens*
More cooperation between public authorities Improved environmental policy making Efficiency gains (time and money savings) Optimised and improved procedures (e.g. less manual workflows, reduced errors) Reduced duplication of datasets Easiness of merging datasets Cheaper IT development and economies of scales in IT development Production efficiency Better/up-to-date data analysis and reliability Innovation and increased investments in innovative data sharing activities Reduction of burden on public officials and increased motivation of the staff Simplification of budgetary procedures for data acquisition	Better accessibility of datasets and better access to information More efficient interaction with governments Burden reduction Market efficiency Potential for innovation Better policy making outcomes	Better accessibility of datasets and better access to information More efficient interaction with governments Burden reduction Job creation Increased possibility to participate in public life Better policy making outcomes

Source: Deloitte and KUL, 2019

If the availability of bold figures on these benefits is quite limited, almost all countries have been identifying and listing relevant categories of benefits (see long list provided in the table above) which can be grouped around five macro categories, as shown in the picture below.

Figure 6 - Macro categories of benefits

Source: Deloitte and KUL, 2019

In the next sections, we dig further into the details and examples of these categories of benefits for the different stakeholders first from a general (EU29 and Norway) perspective and then leveraging the specific experience of Spain, Poland, the Netherlands and Belgium.

4.2.1.1 The use of SDI has delivered measurable benefits to governments

As the table provided in the previous section suggests, traditionally there has been as stronger focus on discussing and reporting on benefits of SDI for governments and public authorities themselves. This is probably linked to the obligation of INSPIRE reporting and to the fact that a number of countries carried out cost-benefits analysis before or after the implementation of the Directive. **Benefits for public authorities are both quantifiable and unquantifiable**. Some examples of quantifiable benefits come from:

— Denmark, where it was established that efficiency gains for municipalities, regions and national government corresponded to around 50 million DKK in 2012 (circa 6.6 million euro) and 42 million DKK (5.6 million euro) in 2016[398]. Production effects for the public sector grew from 965 million DKK (around 13 million euro) in 2012 to 1.9 billion DKK in 2016[399] (around 25 million euro) as also shown in the picture below.

[398] See : The impact of open geographical data – Follow up study, March 17th, 2017, PWC, https://sdfe.dk/media/2917052/20170317-the-impact-of-the-open-geographical-data-management-summary-version-13-pwc-qrvkvdr.pdf

[399] See : The impact of open geographical data – Follow up study, March 17th, 2017, PWC, https://sdfe.dk/media/2917052/20170317-the-impact-of-the-open-geographical-data-management-summary-version-13-pwc-qrvkvdr.pdf

Figure 7 - The value of geospatial information in Denmark (2012-2016)

DKK in millions	2012	2016
Production effect of the open geodata	**1.402**	**2,542**
Private enterprises	116	446
Government agencies	321	373
Municipalities	965	1,376
Regions		151
Independent institutions, etc.		196
Efficiency effect of the open geodata	**190**	**999**
Private enterprises	40	726
Utility companies	100	229
Government agencies	50	22
Municipalities		18
Regions		2
Independent institutions, etc.		2
Total socio-economic value of the open geodata	**1.592**	**3.541**

Source: PWC, The impact of open geographical data – Follow up study, 2016[400]

- Lithuania, where it was calculated that the INSPIRE Directive led (during the reference period) to a saving of 20.000 public officials' working days for a total benefits of 1.2 million euro.
- Slovakia, where one of the first CBAs carried out by the ministries highlighted overall benefits (both for the public and private sector) of in between 800k and 1.2 million euro over 15 years. Newest figures mentions around 6.5 million euro of benefits[401].

Both in terms of quantifiable and non-quantifiable benefits, **efficiency gains** are by far the most frequently mentioned. In Denmark, a study suggests that the government SDI initiative and the country data programme led to "efficiency gains for around 1 billion DKK per year in municipalities, regions and governments[402]". These efficiency gains related to:

- " Optimised and improved procedures
- Fewer manual workflows and recording tasks
- Reducing errors and saving time
- Saved time and money for the acquisition, input and maintenance of data,
- Cheaper development of new IT systems
- Operational savings related to data handling in existing IT systems;
- Fewer shadow and copy registers"[403]

The reduction of costs and the time savings linked to the development and take up of SDI at the national level are the most recurrent benefits identified. Countries such as Estonia, France, Lithuania, Luxembourg, Malta, Italy, the Netherlands, Slovakia, Spain and Sweden all mention this aspect and certain countries provide concrete examples of increased efficiency. In Luxembourg for instance, the usage of the SDI allowed municipalities to switch from CDs to web-services thus becoming more effective and loosing less time updating the datasets[404]. In France, the efficiency gains clearly emerged after the regional reform of 2017

[400] The impact of open geographical data – Follow up study, March 17th, 2017, PWC, https://sdfe.dk/media/2917052/20170317-the-impact-of-the-open-geographical-data-management-summary-version-13-pwc-qrvkvdr.pdf

[401] Interview 1, Slovakia.

[402] INSPIRE National Country Report 2016, Denmark, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/DK

[403] INSPIRE National Country Report 2016, Denmark, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/DK

[404] INSPIRE National Country Report 2016, Luxembourg, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/LU

when the regions of Nord-Pas-de-Calais and Picardy were merged[405]. In this occasion, the fact that both regions had harmonised datasets as per the INSPIRE Directive made the merging much easier and more effective and allowed a quick development of services[406]. In Slovakia, the country report clearly states that the SDI led to time saving internal demands and processes as well as reduction of costs for data integration and reduced time for the provision of datasets to citizens and businesses[407].

Furthermore, many countries mention the reduction of duplication of IT infrastructure and investments as one of the main results of SDI development.

In Italy for instance, investing in one single infrastructure allowed to a) avoid multiplication of IT systems, b) concentrate resources in one single infrastructure and c) establish economies of scale as a results of the investments[408]. Although efficiency gains are the most "popular" benefits of SDI implementation, the descriptions of these remain quite high level and generic as illustrated by the examples above. Only a few countries (and Denmark in particular) invested in detailing the sources of these efficiency gains and even fewer countries tried to quantify them.

For the other macro-categories of benefits identified, the evidence is more scattered. While the improvement and optimisation of business processes is mentioned a few times as one of the main benefits of SDI implementation and usage, there are few concrete examples and business cases described.

- In **Germany**, the project on 'GDI-DE operating model' aimed to examine and evaluate the benefits of spatial data to business processes at different administrative levels (e.g. building permit), in order to derive a business and operating model for the German SDI[409]. As part of the project, an economic efficiency analysis of the investment and operating costs was also carried out. However, no direct monetary benefit could be derived from this, since very little applications were available that provided measurable benefits to the public.
- In the **Netherlands**, the CBAs carried out in 2009 and 2016 explored in particular four fictional use cases for the SDI and it emerged from the analysis that these processes can be optimised not only in terms of efficiency but also in terms of results thanks to the availability of a spatial data infrastructure[410] (see next Section for further details).

For most of the other countries however, the documents available only generically mention process improvement amongst the benefits identified without providing further details. Sometimes more information can be derived, indirectly, through the description of the usage of the infrastructure or by looking at the examples of use case put forwards. For instance, in the case of **France**, the description of cross-border initiative also helps identifying possible cases for business process improvements (e.g. as in the case of merging of two regions, mentioned above)[411]. It is important to note that the question of benefit is context specific (specifically linked to the use case and the process examined) and it is not useful to generalise although they provide some insights on possible process improvements linked to SDI.

Concerning the benefits related **to better cooperation and exchange between stakeholders, new and innovative services as well as better policy outcomes**, we could not find much more than "generic" statements although supported by the literature and experts' opinions. Besides **Denmark** and a few other countries in fact, these benefits have been mentioned in the INSPIRE country reports or other documents but without a fully developed analysis and substantiation behind. In the case of **Czech Republic** for instance, it is mentioned that "standardised services, gradual data opening and modern technology creates new processing options and opens a new era of applications and services" for governments[412]. In this sense and also based on discussions with key experts, it can be argued that one of the benefits of SDIs usage is that

[405] https://www.gouvernement.fr/action/la-reforme-territoriale

[406] INSPIRE National Country Report 2016, France, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/FR

[407] INSPIRE National Country Report 2016, Slovakia, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/SK

[408] INSPIRE National Country Report 2016, Italy, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/IT

[409] INSPIRE National Country Report 2013, Germany, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/DE

[410] See : Costs-benefits analysis, INSPIRE Final report, Ecorys and Grontmij, 2009, https://www.geonovum.nl/uploads/documents/nkba_engelse_vertaling.pdf

[411] INSPIRE National Country Report 2016, France, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/FR

[412] INSPIRE National Country Report 2016, Czech Republic, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/CZ

this plays a role as innovation driver for public administrations in this "new era", also leading to more time and investments in innovation within the public sector. This is clear not only in terms of more innovative services and applications but also in terms of policies.

In this respect, **Latvia** for instance established that there is some evidence of - potential - benefits of INSPIRE data in different policy domains (such as transport, agriculture, environment, health, education)[413]. The importance of SDIs for more innovative and better policies is mentioned in other contexts but should be further emphasised by the available literature.

4.2.1.2 The use of SDI has delivered measurable benefits to businesses, citizens and society more broadly

The benefits highlighted for citizens and business also mirror, to a certain extent, the benefits identified for public authorities. However, data on the business and citizens' benefits is even scarcer and quantification is even more limited. In this context, four macro-categories of benefits came across most frequently from the data collection:

- **More efficient interaction with public administration (saving time and money) and burden reduction:** this emerged clearly as a real or at least expected benefit from the experience of several countries. While in several countries the NSDI contributed to the development of e-platforms as single entry points for citizens to interact with public administration, only few countries have monitored and measured the actual benefits of such platforms.
- In **Denmark** for instance, the follow up study on the benefits of open geospatial data highlighted this aspect but without pointing out at specific examples while **Estonia refers to more efficient citizens-government interactions in the field of prevention of land and real estate fraud cases**. **In France and in Spain, the increased efficiency in interactions and burden reduction for citizens and businesses is considered one of the pivotal benefits** of the take up of the SDI infrastructure. In France for instance, the urbanistic geo-portal (Géoportal de l'Urbanisme) which was, until now, only available by going physically to the relevant authority (town hall, other public body) will from 2020 onwards be available online thus entailing a significant time reduction for businesses and citizens. Furthermore, the example of the application developed for winemakers (see chapter 4.1 on usage) also shows how the need to reduce burden for citizens and businesses is at the core of the development of new services based on the SDI[414].
- **In Spain, benefits are quantified**: examples are the Geoportal de Hydrocarbon and the services offered by the cadastre online. For the first service, which indicates to citizens more easily which station has the lowest oil prices in their area, there are around 20 million accesses per year (which is estimated to be a 60 million euro of benefits per year). For the cadastre service, there have been over 33.000 users in the period 2013-2015. This services allowed citizens to spare 19,75 hours and 392,87 euro per search. In total, over 3 years citizens spared 55mio hours and 1.000mio euro[415]. Building on these two examples, **the Spanish INSPIRE Country Report clearly mentions that: "the more efficient interaction allows to a) reach a bigger number of citizens and b) gain a better control over the quality of the data**. Furthermore, it also increases the agility of the exchange of information[416]".
- **In Italy**, the newly established online services linked to the cadastre (see chapter 4.1 on Usage) also **list amongst their main benefits an increased efficiency in the interactions and a reduction of burden** for the parties involved[417].,
- In **Lithuania**, the evidence suggests that, thanks to the SDI, land owners have been able to view parcel data online and are hence better informed with the result that they are receiving lower fines for

[413] INSPIRE National Country Report 2016, Latvia, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/LV

[414] Interview 2, France.

[415] INSPIRE National Country Report 2016, Spain, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/ES

[416] INSPIRE National Country Report 2016, Spain, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/ES

[417] See : Italian Cadastral System, Innovative ways in management and use of the Italian Cadastral Cartography, Fifth Plenary Meeting of the European Region of the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM: Europe), Franco Maggio, June 2018

abandoned land administration although the money savings are not precisely calculated[418]. Burden reduction is also mentioned as a key benefit (e.g. in the case of Malta) but sometimes at a very generic level[419]. **However, far than being only a "benefit" of the use of the SDI in different countries, the willingness to have more efficient interaction and burden reduction seems to be a driver for the take up of the infrastructure.**

- **Better access to information/participation in public life:** this, rather unquantifiable, this benefit is mentioned in a few cases and especially by **countries such as Sweden, Slovakia, Estonia and Czech Republic**. One of the interviewee clearly mentioned that **NGOs are using (also) SDIs to keep an eye on government activities and monitor policy developments and initiatives**[420]. In the case of Slovakia, it is mentioned that the availability of the **SDI has increased "environmental awareness" amongst citizens**[421]. Furthermore, in Sweden, "the possibility for citizens to obtain information and get an overview of the environmental conditions in different areas, and to participate in the social debate on environmental" is explicitly highlighted in relation to the climate adaptation and environmental threat challenge (see previous chapter)[422]. In general however, countries which have wider (open) data strategies and plans (e.g. Norway, the United Kingdom) consider better access to information as one of direct consequences of these initiatives and they do not link this benefit only to SDI. In the case of Norway, it is stated that it is difficult to "trace back these benefits to SDI alone"[423].
- **Better policy making outcomes:** once more, this benefit is "expected" in a number of cases but there are few illustrations of how access to SDI translates in practice to better policies. **One of the examples might be the French platform "Cartomer" which concerns protected marine areas**[424]. The aggregation and harmonisation of data in one platform is expected to improve the quality of decision-making. However, this is not clearly expressed and can only be assumed at this stage. Besides general statements on the "increased availability of data for policy makers[425]" and "sounder evidence based policies" there are not many evidence of improved policy outcomes unfortunately. This is probably one of the domains suffering the most from the general lack of monitoring described in the previous section.
- **Market growth and jobs creation:** this benefit can be found in a more limited number of cases and mainly when indirect benefits are listed together with direct benefits. There are very few figures in this respect mainly coming from the countries where there has been more regular monitoring (Denmark and the Netherlands). **In Denmark for instance, the value of the geospatial market (also driven by the establishment of SDI) doubles in between 2012 and 2016** and, according to the latest study, there is a strong optimist amongst companies on the fact that this growth will continue[426]. Other countries only refer to this type of benefits from a higher level: it is the case of **Czech Republic** for instance, it is mentioned that "**new jobs will be progressively created**"[427]. The Slovakia country report mentions benefits for SMEs in terms of market growth and reuse of information but without entering into details.

To conclude, the limited availability of evidence and structured monitoring on usage of SDI has also repercussions on the availability of data for the analysis of benefits. Measuring of usage and benefits goes

[418] INSPIRE National Country Report 2016, Lithuania, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/LT

[419] INSPIRE National Country Report 2016 Malta, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/MT

[420] Interview 1, Slovakia.

[421] INSPIRE National Country Report 2016, Slovakia, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/SK

[422] See : Country Report of Sweden, Swedish Spatial Data Infrastructure and the National Geodata Strategy, Submitted to United Nations Committee of Experts on Global, Geospatial Information Management, Seventh Session, New York, August 2017, Submitted by Bengt Kjellson, Director General Lantmäteriet. Prepared by Lantmäteriet (the Swedish mapping, cadastral and land registration authority), Statistics Sweden, the Swedish Maritime Administration, the Swedish Environmental Protection Agency, the Swedish Meteorological and Hydrological Institute and the Geological Survey of Sweden.

[423] INSPIRE National Country Report 2016, Norway, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/NO

[424] INSPIRE National Country Report 2016, France, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/FR

[425] See for instance the 2016 INSPIRE Country Report of Italy, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/IT

[426] See : The impact of open geographical data – Follow up study, March 17th, 2017, PWC, https://sdfe.dk/media/2917052/20170317-the-impact-of-the-open-geographical-data-management-summary-version-13-pwc-qrvkvdr.pdf

[427] INSPIRE National Country Report 2016, Czech Republic, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/CZ

hand in hand since without data on users it is difficult to identify strong use cases and point at the main beneficiaries of SDI development. Nonetheless, the analysis of the available data suggests that, both in terms of benefits for public authorities and for citizens and businesses, the attention has been focused on efficiency related benefits although social benefits are also mentioned. Interestingly enough, the crucial aspect which drove the adoption of INSPIRE (the question of better policy making) is less explored. This could constitute a serious limitation for when the Directive will have to be evaluated and also in terms of analysis of the role of SDI in the context of government digital transformation.

4.2.2 In-depth analysis of Spain, Poland, the Netherlands and Belgium

As discussed in the previous section, benefits related to SDI in Digital Government Transformation can be mapped against five macro-categories. This also holds in the framework of the in-depth analysis of the four shortlisted countries. In **Poland**, the **country reports list many different benefits related to the SDI development** and differentiated between benefits for public administrations, for businesses and for citizens.

For public administrations themselves, the reports mentions in particular:

- *Increased exchanges and interoperability* at the European level which leads to better monitoring and policies (e.g. in the environmental domain).
- Reduced costs for data integration and improved data management leading to cost savings[428].
- Reduced time and costs for planning, analysing and preparing public interventions in many domains including urban planning and environmental protection.
- *Better intra-institutional cooperation* and increased awareness on the potential of spatial information at different levels of government[429].

In this respect, the country report also highlights that "**one of the main and perceived benefits is the awareness and potential of spatial information**. Usage of spatial information increases from one year to the next (see for instance the indicators on the use of network services, for example in the area of protected areas, from around 1,8 million to 2 million requests per day). However, there is still a lack of tangible impact on the benefits for the environment, including environmental protection"[430]. The interviewees also mentioned this lack of concreteness in the benefits identified and the need to carry out further studies and analysis to better identify and quantify benefits for the public sector[431].

In terms of benefits for citizens, it is suggested that they mainly consist in reduced costs and burden for accessing data. This applies to areas such as Cadastre but also to other domains that are less evident. For instance, "the availability of data stored in the Register of Historical Monuments in digital form reduces the costs of accessing data on historic monuments stored in analogue form. Prior to the publication of digital data on the register of monuments, access to data was available at the NIDD and from the various Regional Monuments Offices and required to cover the costs of processing customers' data, commissioning of the system enables remote access to site location data and basic internet characteristics"[432]. On top of this, the improved eGovernment services built on the SDI also represent of course a benefit for Polish citizens. From an even higher perspective, citizen's benefits from the improved efficiency and effectiveness of Polish administration, which derives from a better use of the data infrastructure.

Finally, in terms of benefits for businesses, the country identified the following:

- Interoperability between portals and services;
- Increased analytical capacity;

[428] "*The streamlining and acceleration of the spatial data acquisition process for the two INSPIRE Spatial Data Themes under Annex III to the INSPIRE Directive deserve particular attention: the statistical units and population distribution (demography), thus saving time and resources both in the public service and in the private sector*". INSPIRE Country Report 2013-2015, Poland, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/PL

[429] INSPIRE Country Report 2013-2015, Poland, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/PL

[430] INSPIRE Country Report 2013-2015, Poland, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/PL

[431] Interview 1, Poland.

[432] INSPIRE Country Report 2013-2015, Poland, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/PL

— Lowered costs of accessing and gathering data.[433]

Although these benefits were related to a specific theme and dataset (the register of historical monuments), they could be generalised to the overall SDI as they are also highlighted in other contexts. However, once more there is a lack of concrete and quantifiable examples in this respect, linked to the difficulties in monitoring usage as well.

In **Spain**, although are no doubts amongst the interviewees about the many benefits of the SDI for different stakeholders, but, due to the limited monitoring of usage, these are difficult to quantify. The interviewees highlighted in particular the following aspects:

— Overall benefits for public administrations linked to increased efficiency, reduction of costs and increased effectiveness;

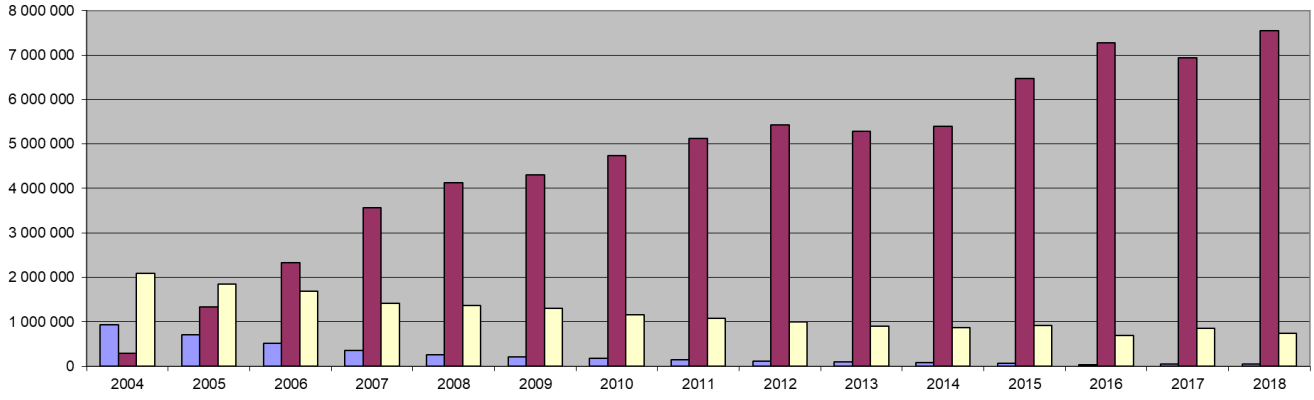
— Overall benefits for citizens due to better online services which reduce the time and money they need to invest when interacting with public authorities;

— Overall increase in data quality thanks to bigger data use and therefore data validation and feedback.

Concerning the benefits for public administrations, no specific examples reported of situations in which the usage of SDI facilitated the work of public officials were provided (a part from the Cadastre example discussed further below) but the interviewees all mentioned that they believe this is happening on the ground[434]. This feeling is confirmed by previous, although quite old, studies such as the analysis of **socio-economic benefits of SDI in Catalonia, which underlined that "the internal efficiency benefits (of SDI) account for over 500 hours per month**. Using an hourly rate of €30 for technical staff in local government, these savings exceed €2.6 million per year" and "effectiveness savings are just as large at another 500 hours per month"[435].

The example of the online Cadastre service can also serve as a more recent illustration of the benefits both for the public authorities and for the citizens. The Spanish Cadastre started providing SDI based online services (as an alternative for the services provided in the Cadastre offices) back in 2011. These services allow citizens to obtain documents directly from the portal and avoid having to go to a physical office. In the period 2013-2015 more than 33.000 users leveraged these services for a total of 2.782.000 files downloaded[436]. The figure below shows an update of the figures related to the paper certificates provided (blue bar), digital certificates provided (purple bar) and number of visits to the Cadastre offices (yellow bar) for the period 2004-2018.

Figure 8 – Trend in the number of paper certificates and digital certificates delivered by the Cadastre as well as visits to the physical offices



Source: Spanish Cadastre, internal document

[433] INSPIRE Country Report 2013-2015, Poland, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/PL

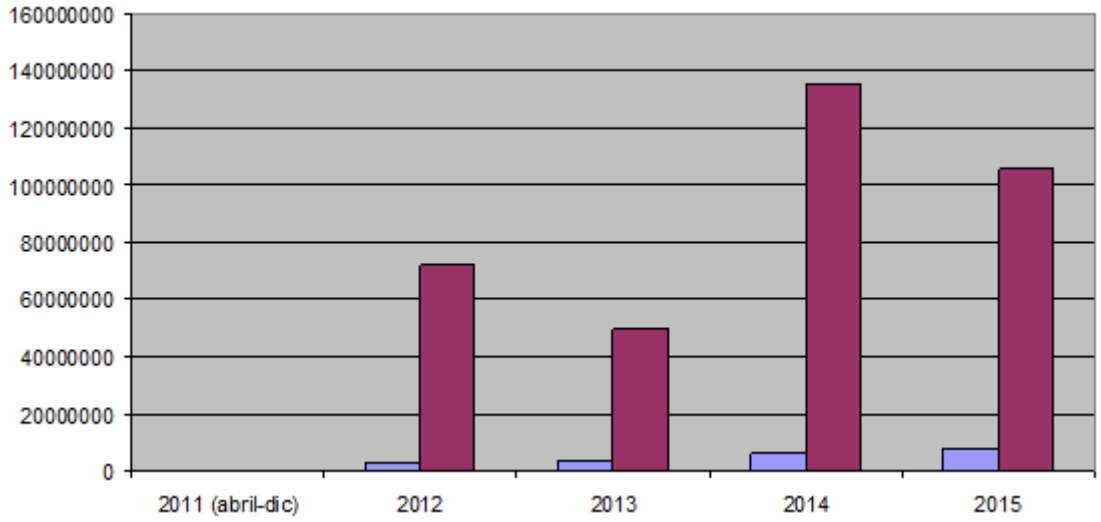
[434] Interview 1, 2 and 3, Spain.

[435] Pilar Garcia Almirall, Montse Moix Bergadà, Pau Queraltó Ros, M. Craglia, The Socio-Economic Impact of theSpatial Data Infrastructure of Catalonia, 2008

[436] INSPIRE Country Report, Spain, 2016, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/ES

Back in 2015, it was established that the reduction of paper certificates and visits to the Cadastre offices corresponded to an economic gain of 362 million euro for the Cadastre and 19,92 million of hours of work spared for a total of more than 1.000 million euro and 55 million hours spared over these three years[437]. The figure below shows the time (blue bars) and money (purple bar) saved over the period 2011-2015[438].

Figure 9 - Time and money saved by the online Cadastre services



Source: Spanish Cadastre, internal document

Furthermore, one of the interviewees highlighted that public authorities gained in terms of data quality through increased use of their data and services which trigger more feedback and reporting of issues[439].

There are also other examples of how the SDI benefits for citizens. For instance, the Ministry of Industry has developed a portal that allows citizens to find the most convenient petrol station in their area. This portal is visited around 20 million time every year and it allows citizens to spare a total of 60 million euro[440].

Other benefits for non-public stakeholders emerged indirectly from the interviews, such as the possibility for companies to build better quality hiking and cycling apps covering rural areas (see section on usage) or the possibility to create new products and services based on new SDI services (e.g. ortho-mapping of Spain). However, the interviewees themselves underlined they are in need of studies and analysis of benefits as these are very rare and very context specific[441] as also proven by the examples listed above.

In Belgium, interestingly enough, the key benefit at national level is the convergence of efforts across regions and the federal level in setting up and maintaining the different SDIs and in assuring different SDIs follow the same structure, quality and level of availability of data. This is mainly the results of the coordination and collaboration in the context of INSPIRE implementation.

Direct benefits of the SDI are mainly situated at the level of the specific regions and administrative levels, and – similar to other countries - often difficult to measure and monetize[442]. **The Brussels administration mainly reported benefits in terms increased awareness on and interest to sharing of spatial data, improvements in the quality and effectiveness of the work of public authorities and increased sharing of data**. As a particular example of how the SDI contributed to the work of public authorities, the process of public procurement is mentioned as a process in which the impact of the SDI is strong.

At the federal level, (potential) benefits are identified at three main levels: the level of the federal administration, the level of the federal users and the level of the European users. The federal SDI is seen as

[437] INSPIRE Country Report, Spain, 2016, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/ES

[438] Internal document, "Cinco años del servicio de descarga masiva y gratuita de información catastral: 2011 – 2016", 2016

[439] Interview 3, Spain.

[440] INSPIRE Country Report, Spain, 2016, https://inspire.ec.europa.eu/INSPIRE-in-your-Country/ES

[441] Interview 1 and 3, Spain.

[442] INSPIRE Report Belgium 2013-2015.

an opportunity to collectively create and share a pool of suitable datasets for users at the federal and European level.

The Flemish administration reports that considerable savings for the public authorities have been achieved since the creation of the Flemish SDI, as data were acquired jointly and shared for free. Access and use of the data for public authorities, citizens, businesses and organisations have significantly been extended and facilitated. Since the reuse of the data within GDI Flanders is encouraged, businesses can use the large number of data sets to create innovative products and services. An in-depth investigation of the Flemish geo-sector was undertaken in 2014, showing the different types of companies active in this sector, their main activities but also statistics on the number of employees and the average turnover. The study also focused on the occupational profiles in the sector, needed skills and the match between education and the needs of the job market. Little information was included on the impact of the SDI on the sector.

In addition to the impact on businesses through the increased availability of open geospatial data, businesses but also citizens benefit from the SDI through the delivery of new or improved e-services that are using SDI data and services. Examples of this are the digital building permit, the collection and provision of information related to the public domain, or the improved access and exchange of cable and pipeline information between parties involved in earthworks.

Finally, the Netherlands constitutes a very interesting example from the perspective of benefits also due to its bigger focus on benefits reporting. In fact, the country has developed several estimates and measured the benefits and costs of INSPIRE. 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[443]. The analysis was based on the information supplied by various relevant parties (both data providers and users) from a number of (theoretical) use cases. A follow up study was done in 2016, in which the actual costs and benefits of INSPIRE were measured. The updated cost–benefit analysis demonstrated that the costs of INSPIRE implementation were significantly higher than was originally estimated[444]. These applies to both the investment and structural costs, that have to be made by all data providers, and the costs for coordination by the responsible coordination bodies. The total costs for the data providers, i.e. so-called investment and structural costs, are estimated at 52M EUR, which is 80% of the total costs. Costs for coordination are estimated at 12 M EUR.

For what concerns the benefits, three main types of benefits were distinguished: efficiency gains, quality and reliability gains and acceleration gains. Various efficiency gains are taken into consideration and further investigated: information can be shared, found, processed and reported in a more efficient way, data collection and provision processes can be harmonized and the INSPIRE- approach (including the standard) can be reused. The list of – potential – quality and reliability gains is even longer, and contains 9 different types of gains in total. These gains include improved data quality, more up-to-date and better accessible data, decentralization of responsibilities, better informed citizens, less damage, better decision making, development of added value services by the private sector, improved quality of research and reporting and more open service delivery by data providers. Acceleration gains refer to gains that are realized faster because of the INSPIRE Directive. These include an acceleration in the Dutch open standards policy, the more rapid implementation of internationally recognized standards and societal benefits that are achieved sooner. However, an important limitation to the study was that many of the identified benefits were difficult to measure and monetize. The table below provides an overview of the main types of benefits identified and measured in the report.

Table 9 - Main types of benefits identified in the Netherlands

Main types of benefits	Benefits
Efficiency gains	More efficient sharing, discovery, processing and use of information

[443] Ecorys & Grontmij (2009). Kosten-batenanalyse INSPIRE. Geonovum

[444] Ecorys (2016). Actualisatie KBA INSPIRE. Geonovum

	Re-use of INSPIRE approach Efficiency gains related to the use of one data format
Quality and reliability gains	Improved data quality More up-to-date and accessible data Uniformity enables decentralisation of responsibilities Better informed citizens Less accidents, damages, complaints Better information for policy making Development of value added services by companies Improved quality of research and reporting More open service delivery
Acceleration gains	Open standards lead to a better performing government Faster adoption of – European – standards Faster realization of societal benefits

Source: Ecorys (2016). Actualisatie KBA INSPIRE. Geonovum

Several studies also took place to investigate and measure the benefits of open spatial data, focusing on particular data datasets, such as topographic data[445] and elevation data[446]. These studies follow a similar approach, focusing on three main types of impacts: *external impacts*, i.e. impacts on society; *relationship impacts*, i.e. impacts on the relationship between the data provider and society; and *internal impacts,* i.e. impacts on the data provider. Both studies demonstrated that the main impacts of open spatial data were external impacts, with an increased use of the data by companies to develop new applications, products and services.

The findings from these four countries confirm the results of the broader analysis and especially in terms of **focus on efficiency gains which also characterised Spain, Belgium, the Netherlands and Poland**. Furthermore, these additional country examples show that the macro-categories of benefits identified are relevant, as all shortlisted countries provide evidence which falls under several categories while, at the same time, nothing was found not compatible with one of the different categories. If all the four countries insist on *efficiency gains* and *better, smoother and/or optimised processes,* there are some differences with respect to the other categories. For instance, for Belgium, the benefits linked to *better coordination of stakeholders* are crucial while this is not the case for all other countries (i.e. Spain). Similarly, the establishment of SDI based new and innovative services is not highlighted to the same extent in Poland and the Netherlands.

This shows that, as previously stated and as it could be expected, the institutional setting and characteristics of countries can contribute to determine the most important types of benefits at stake for them. Finally, it is interesting to note here that the benefits related to improved policy-making (which were one of the main drivers behind the adoption of the INSPIRE Directive) seems not to be the major focus at this stage of the Digital Government Transformation. In fact, most of the benefits and examples highlighted concerned the establishment of better, more innovative and more cost-effective public services rather than the improvement of policy planning itself. Building on this, one could argue that SDI development had many positive consequences for governments, which found themselves in the position of exploiting advantages from multiple perspectives.

[445] Bregt, A. K., Castelein, W., Grus, L. & Eertink, D. (2013). De effecten van een open basisregistratie topografie (BRT). Wageningen: Wageningen University and Research

[446] Bregt, A.K., Grus, L., Van Beuningen, T. & Van Meijeren, H. (2016). Wat zijn de effecten van een open Actueel Hoogtebestand Nederland (AHN)? Wageningen: Wageningen University & Research

5 Analysis of the OECD Recommendation

Main messages:

- In its Recommendation on Digital Government Strategies, the OECD proposed twelve principles to support the development and implementation of digital government strategies. These principles can be seen as a framework for understanding what digital government is about and what government policies and practices contribute to the Digital Transformation of Government. The investigation of how and to what extent SDI/INSPIRE development in Europe is adhering to each of these principles provides insight in the role of SDI in the Digital Transformation of Government.
- Overall it can be stated that SDI/INSPIRE clearly plays a key role in the Digital Transformation of Government in Europe, and many European countries are committed to strengthening this role. For each of the twelve principles, evidence was found of how SDI/INSPIRE have been putting these principles into practice. Many of the practices, policies and developments at country level that have been discussed in this report, are contributing to digital transformation of government, and can be seen as good practices in implementing the OECD Recommendation. At European Commission level as well, several interesting practices of supporting the Member States in strengthening the role of SDI in digital government transformation could also be observed.
- When comparing the status of implementation of the different principles, it can be seen that for some principles SDI/INSPIRE in Europe already reached an advanced stage of implementation. This especially applies to the principles of creating a data-driven culture in the public sector, ensuring a coherent use of digital technology across policy areas, establishing effective organisation and governance frameworks to coordinate and strengthening international cooperation with governments. At the same time, progresses can be made with respect to the principles of protecting privacy and ensuring security as well as developing clear business cases.

In 2014, the Public Governance Committee (PGC)[447] of the OECD developed a number of Recommendation on Digital Government Strategies[448] aimed at supporting the development and implementation of digital government strategies that bring governments closer to citizens and businesses. In the recommendations, it was recognised that technologies are not only a strategic driver for improving public sector efficiency, but could also support effectiveness of policies and create more open, transparent, innovative, participatory and trustworthy governments. The Recommendations hence aim to enable a fundamental shift from citizen-centric approaches to citizen-driven approaches, in which citizens and businesses formulate and determine their needs in partnership with governments. This document is structured around 12 principles to support the development and implementation of digital government strategies.

To support the implementation of the OECD Recommendation on Digital Government Strategies, the OECD also designed and made available a 'Digital Government Toolkit[449]'. The Toolkit provides a detailed review of the 12 principles and a collection of good practices that displays how countries are implementing the recommendations. On this platform, over 90 different good practices are collected and made available, from 23 different countries[450]. The Toolkit also contains a Self-assessment "note"[451] that countries can use to assess their digital governance capacity. This Self-assessment tool, divided according to the twelve principles, makes a distinction between three stages of development (early stage, intermediate stage and advanced stage) and provides key characteristics of countries in each stage of development, together with policies and practices that are relevant to progress in the implementation.

The aim of this chapter is to investigate the relevance and level of application of the 12 OECD principles in the context of the development and implementation of SDI within the countries in scope of this assignment and from the angle of Digital Government Transformation. After presenting the 12 principles, this section provides a short discussion of how and to what extent SDI/INSPIRE development in the 29 countries is

[447] http://www.oecd.org/gov/public-governance-committee.htm

[448] OECD, Recommendation of the Council on Digital Government Strategies, 2014, https://www.oecd.org/gov/digital-government/recommendation-on-digital-government-strategies.htm

[449] https://www.oecd.org/governance/digital-government/toolkit/

[450] https://www.oecd.org/governance/digital-government/toolkit/goodpractices/

[451] https://www.oecd.org/governance/digital-government/toolkit/self-assessment/

adhering to and putting in place each of the principles. In the final section, we provide a short conclusion on the overall relevance of the OECD principles from an SDI and Digital Government Transformation perspective.

5.1 The 12 OECD principles

The table below illustrates the twelve principles included in the OECD "Digital Government Toolkit".

Table 10 – 12 principles from the OECD Digital Toolkit

Name and number of the principle	Description
Principle 1 - Openness, transparency and inclusiveness	Ensure greater transparency, openness and inclusiveness of government processes and operations by: 1) adopting open and inclusive processes, accessibility, transparency and accountability among the main goals of national digital government strategies; 2) updating accountability and transparency regulations recognizing different contexts and expectations brought about by digital technologies and technology-driven approaches; iii) taking steps to address existing "digital divides" (i.e. the fact that societies can be divided into people who do and people who do not have access to - and the capability to use - digital technologies) and avoid the emergence of new forms of "digital exclusion" (i.e. not being able to take advantage of digital services and opportunities).
Principle 2 - Engagement and participation in policymaking and policy making and service delivery	Encourage engagement and participation of public, private and civil society stakeholders in policy making and public service design and delivery, through: i) addressing issues of citizens' rights, organisation and resource allocation, adoption of new rules and standards, use of communication tools and development of institutional capacities to help facilitate engagement of all age groups and population segments, in particular through the clarification of the formal responsibilities and procedures (e.g. adoption of guidelines clarifying roles and procedures for establishing and managing official government accounts on social media, norms of data sharing); ii) identifying and engaging non-governmental organisations, businesses or citizens to form a digital government ecosystem for the provision and use of digital services. This includes the use of business models to motivate the relevant actors' involvement to adjust supply and demand; and the establishment of a framework of collaboration, both within the public sector and with external actors.
Principle 3 - Creation of a data-driven culture in the public sector	Create a data-driven culture in the public sector, by: i) developing frameworks to enable, guide, and foster access to, use and re-use of, the increasing amount of evidence, statistics and data concerning operations, processes and results to (a) increase openness and transparency, and (b) incentivise public engagement in policy making, public value creation, service design and delivery; ii) balancing the need to provide timely official data with the need to deliver trustworthy data, managing risks of data misuse related to the increased availability of data in open formats (i.e. allowing use and re-use, and the possibility for non-governmental actors to re-use and supplement data with a view to maximise public economic and social value).
Principle 4 - Protecting privacy and ensuring security	Reflect a risk management approach to addressing digital security and privacy issues, and include the adoption of effective and appropriate security measures, so as to increase confidence on government services.
Principle 5 - Leadership and political commitment	Secure leadership and political commitment to the strategy, through a combination of efforts aimed to promote inter-ministerial co-ordination and collaboration, set priorities and facilitate engagement and co-ordination of relevant agencies across levels of government in pursuing the digital government agenda.
Principle 6 - Coherent use of	Ensure coherent use of digital technologies across policy areas and levels of government, by:

Name and number of the principle	Description
digital technology across policy areas	i) engaging relevant stakeholders and other levels of government to provide input to the development of the digital government strategy; ii) integrating the digital government strategy in overall public administration reforms; iii) identifying the complementarity, alignment and mutual reinforcement between the digital government strategy and other relevant sector strategies; iv) providing the institution formally responsible for digital government co-ordination with the mechanisms to align overall strategic choices on investments in digital technologies with technological deployment in various policy areas.
Principle 7 - Effective organisation and governance frameworks to coordinate	Establish effective organisational and governance frameworks to co-ordinate the implementation of the digital strategy within and across levels of government, through: i) identifying clear responsibilities to ensure overall co-ordination of the implementation of the digital government strategy; ii) establishing a system for "check and balances" of governments' decisions on spending on technology to increase the level of accountability and public trust, and to improve decision-making and management to minimise risks of project failures and delays.
Principle 8 - Strengthen international cooperation with governments	Strengthen international co-operation with other governments to better serve citizens and businesses across borders, and maximise the benefits that can emerge from early knowledge sharing and co-ordination of digital strategies internationally.
Principle 9 - Development of clear business cases	Develop clear business cases to sustain the funding and focused implementation of digital technologies projects, by: i) articulating the value proposition for all projects above a certain budget threshold to identify expected economic, social and political benefits to justify public investments and to improve project management; ii) involving key stakeholders in the definition of the business case (including owners and users of final services, different levels of governments involved in or affected by the project, and private sector or non-for profit service providers) to ensure buy in and distribution of realised benefits
Principle 10 - Reinforce ICT project management capabilities	Reinforce institutional capacities to manage and monitor projects' implementation, by: i) adopting structured approaches systematically, also for the management of risks, that include increase in the amount of evidence and data captured in the course of project implementation and provision of incentives to augment data use to monitor projects performance; ii) ensuring the availability at any time of a comprehensive picture of on-going digital initiatives to avoid duplication of systems and datasets; iii) establishing evaluation and measurement frameworks for projects' performance at all levels of government, and adopting and uniformly applying standards, guidelines, codes for procurement and compliance with interoperability frameworks, for regular reporting and conditional release of funding; iv) reinforcing their public sector's digital and project management skills, mobilising collaborations and/or partnerships with private and non-governmental sector actors as necessary; v) conducting early sharing, testing and evaluation of prototypes with involvement of expected end-users to allow adjustment and successful scaling of projects.

Name and number of the principle	Description
Principle 11 - Procurement of digital technologies	Procure digital technologies based on assessment of existing assets including digital skills, job profiles, technologies, contracts, inter-agency agreements to increase efficiency, support innovation, and best sustain objectives stated in the overall public sector modernisation agenda. Procurement and contracting rules should be updated, as appropriate, to make them compatible with modern ways of developing and deploying digital technology.
Principle 12 - Legal and regulatory framework	Ensure that general and sector-specific legal and regulatory frameworks allow digital opportunities to be seized, by: i) reviewing them as appropriate; ii) including assessment of the implications of new legislations on governments' digital needs as part of the regulatory impact assessment process.

Source: OECD 2014[452], tabulation by Deloitte and KU Leuven

[452] OECD, Recommendation of the Council on Digital Government Strategies, 2014, https://www.oecd.org/gov/digital-government/recommendation-on-digital-government-strategies.htm

5.2 Analysis of the relation between the OECD principles and SDI development and implementation

In the next section, we provide an analysis of the relevance of each of the principles listed above from the perspective of SDI implementation and Digital Government Transformation as discussed in the previous section. The purpose of this analysis is to assess to what extent the SDI developments are in line with the 12 OECD principles and to what extent the latter help driving Digital Government Transformation across countries.

5.2.1 Principle 1 - Openness, transparency and inclusiveness

While SDIs in Europe – and other parts of the world – strongly focused on the management and sharing of geospatial data *within the public sector*, in recent years several European countries and public administrations made a shift towards more open SDIs, in which businesses, citizens and non-governmental actors are also considered as key stakeholders of the infrastructure, and are more actively involved in its development and implementation. As further explained in Chapter 2 – Analysis of the Institutional Setting, **many European countries were successful in aligning the development and implementation of the SDI/INSPIRE with the national open data and open government agenda, and many geospatial data became available as open data**. In this context, many geospatial datasets are made available for free, under open licenses and in open formats. Some countries also adopted an 'open by default' policy, through which open data became the standard, and an explanation should be given if data are not open.

Transparency and accountability was enhanced in many European countries by making available information on the status of SDI/INSPIRE implementation, at the level of single datasets and data providers. Some countries also introduced mechanisms to make policy making on the SDI/INSPIRE more inclusive, through public consultations procedures and similar initiatives. Furthermore, as also illustrated in Chapter 2 – Analysis of Institutional Setting and further discussed in the next section, the governance model underpinning SDI development was open to stakeholder participation and input from non-public players in many countries (i.e. Spain, the Netherlands). This strengthened inclusiveness also opened the door to participation of non-governmental organisations in decision-making bodies, although mostly with a consultative role.

Additionally, in a number of countries the spatial data infrastructure itself contributed to accountability, transparency and inclusive policy making in many other domains by supporting the implementation of several geospatially enabled e-services, through which government could make available information on its policy making and service delivery processes, receive input and feedback from citizens and other stakeholders, and put in place public participation procedures.

As the previous paragraphs suggest, SDIs can be an instrument for further government openness, transparency and inclusiveness, and especially in a context where alignment of SDI and open data policies has been overall successful. For this reason, this first principle is relevant from an SDI point of view but the relation between the principle and SDIs development is bidirectional: on the one hand SDIs can support a transition toward more open, transparent and inclusive digital governments and, on the other, this OECD principle can strengthen the case for developing more open SDIs infrastructures and governance models and better ensuring stakeholders participation (see also the following section).

A good practice that demonstrates the application of this recommendation in the context of the SDIs is the SDI of the Netherlands, with its high level of alignment with the open data agenda and its different mechanisms for including non-government actors in the implementation of the SDI (see also Section 2.3.2 of this report).

5.2.2 Principle 2 - Engagement and participation in policymaking and policy making and service delivery

As mentioned earlier, many European countries are encouraging the engagement and participation of non-government actors in *SDI development and implementation (leading to service delivery) as well as in decision-making* concerning the infrastructure.

— On the one hand, spatial data and services are made more and more available in such a way that they easily can be accessed and re-used by other stakeholders. **More user-oriented and user-driven approaches can be seen in almost all countries, allowing to better integrate user's feedback and preferences in the way geospatial data are made available**. Users' feedback is also

considered as a driver for SDI development (see for instance the case of Poland and Spain) and several European countries are working on putting in place new and innovative mechanisms for consulting, accessing and re-using geospatial data. Application programming interfaces (APIs) are just one example of such mechanisms, which is proving to be very successful (see also Chapter 3 on the Analysis of the Technical Infrastructure in this respect). The provision of geospatial data via government – open – data portals and the inclusion of these data into more citizen-centered portals, is another way to make the SDI more open to other stakeholders. Some countries are even thinking about and preparing the shift from traditional geoportals towards more digital 'geospatial' platforms, which should allow and promote the co-creation of new products and services and the development of new components and content by non-government actors. Finally, countries are working more in a collaborative manner, including external actors and organisations, with businesses, research institutions and other stakeholders actively contributing to the development of various SDI components as well as to testing and promoting innovation and technological upgrades of the infrastructure (see also Chapter 3 – Analysis of the Technical Infrastructure in this respect).

— At the same time, in terms of decision making on the SDI, many countries have put in place a governance structure through which non-government actors are actively engaged. Although engagement of non-public stakeholders in SDI governance bodies can be mapped on a continuum from no engagement (which is still the case in a minority of countries) to full decision making power (which is still rare), most of the countries in scope of the analysis fall in between these two extreme and allow external stakeholders to be consulted and even sometimes to have a say in SDI development (see also Chapter 2 on Institutional setting indicators in this respect). While academia, private sector and also the biggest NGOs are normally closely associated and engaged, the key challenge in terms of decision making remains however the engagement and participation of the citizen, and the non-expert user in general.

To conclude on this second principle, it can be argued that 1) it is relevant to the topic of SDI and 2) that SDI implementation follows this recommendation both in terms of associations of stakeholders in the development of the infrastructure and eServices but also from the governance and decision-making perspective. However, as the results of this study highlight, there are still countries which do not yet fully engage with external stakeholders and, in general, this principle can remind countries of the importance of stakeholder participation and engagement.

A good practice of applying this recommendation at country level can be found in Finland, which is characterized by its high level of engagement and participation of non-government actors in the SDI through the National Spatial Data Network (see also Section 2.1.1 of this report).

5.2.3 Principle 3 - Creation of a data-driven culture in the public sector

Principle 3 of the OECD recommendations is particularly important in the context of this study as SDI implementation strongly deals with the creation of a data-driven culture in the public sector, and more in particular, a culture of sharing and re-using data, within public administrations and also across-borders. The INSPIRE Directive itself is one of the best example of how SDI can drive a cultural shift and oblige public administrations not only to cooperate better around data but also to ultimately become more data driven.

Data sharing and the INSPIRE Directive

The INSPIRE Directive[453] is based on a number of common principles which are all about data-driven public administrations. It requires public authorities in Europe 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. Through the implementation of these key components – metadata, network services, interoperability of data and services, but also data sharing arrangements – the Directive aims to realize its underlying principles.

Thanks to this Directive and its principles, a high level of technical and semantic interoperability has been

[453] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE), https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32007L0002

achieved, and INSPIRE can be seen as the largest data interoperability effort ever undertaken in Europe. The INSPIRE Geoportal currently contains metadata records of more than 145000 geospatial data sets and services, 23000 viewable datasets, and 12600 downloadable datasets.

While the process of implementing the different components established by the INSPIRE Directive takes time and efforts, from the very beginning this Directive has contributed to creating a culture of – geospatial – data sharing in the public sector. **SDI/INSPIRE now can be seen as a best practice in data management in the public sector and an effective framework to enable and guide the publication and sharing of high quality data**. Furthermore, the (strengthened) links between INSPIRE implementation and Open Data Strategies in the last few years also contributed to make SDI one of building block for Digital Government and Data Driven public sector. In fact, as geo-spatial data are amongst the most valuable datasets hold by public authorities, initiatives such as INSPIRE and SDI development policies, which contribute to making them more accessible, are a key enabler for the establishment of a data driven culture across countries. Nonetheless, although SDI helps significantly in the "cultural shift" which is required to make public sector data driven, there are still some barriers to address and notably in terms of actual reuse of SDI and geospatial data by public sector and concerning the interoperability of datasets at the European level. Despite these challenges, this study also helps demonstrating that SDIs play a role in the creation of a data driven culture in Europe and, for this reason, the link between this OECD principle and SDI development can be considered as very strong.

Many good practices in implementing this principle in the context of the national SDI can be found in Europe, but the case of Denmark with its national Basic Data Programme can be highlighted (see also Section 2.3.1 of this report).

5.2.4 Principle 4 - Protecting privacy and ensuring security

While the main aim of SDI/INSPIRE is to promote sharing of and availability of geospatial data and services, potential digital security and privacy issues also need to be addressed. Many European countries are aware of this, and are preparing and taking necessary actions. **Since data access and security are also relevant to many other types of government data, this is an area in which several countries have been exploring and testing more generic ICT solutions**. Important to mention here is the relevant work done at EC level to support member states in doing this, both from a technological and organisational point of view. As part of the ISA Action 'A Reusable INSPIRE Reference Platform (ARE3NA)' a specific project was launched in 2014 by the EC Joint Research Centre (JRC) on Authentication, Authorization & Accounting for Data and Services in EU Public Administrations, with a focus on the access control needs of the INSPIRE Directive. Aim of this project was to develop and provide guidelines and best practices for access control. Also relevant in this context were the guidelines for public administrations on location privacy developed in 2016 under the European Union Location Framework (EULF). As these initiatives show, although initially data and security was not the primary concern for SDI implementation, this is increasingly becoming a hot topic and something which is high on the agenda of the European countries. For this reason, this fourth principle is also relevant in the context of SDI and Digital Government Transformation and from the perspective of this study. Furthermore, it is also expected that this aspect will become more and more relevant in the future when the number of SDI based eGovernment services and also private sector applications will increase.

At present, the SDI in Germany can be highlighted as a good practice in this domain, due to its activities in testing and implementing secure access mechanisms in the context of SDI (See also section 3.1.1 of this report).

5.2.5 Principle 5 - Leadership and political commitment

In many European countries, SDI/INSPIRE is hardly seen as a priority for politicians and decision makers, which makes it necessary to further demonstrate the importance of this domain and especially in conjunction with Digital Government Transformation. From this perspective, **several countries are investing in better showing and communicating how geospatial data and technologies are essential for realising key political priorities, being them the United Nation Sustainable Development Goals[454] or topics related to national/regional and local political agendas.** The alignment with open data and digital transformation strategies recently contributed to a stronger political support for the SDI/INSPIRE agenda and

[454] United Nations, Sustainable Development Goals, https://www.un.org/sustainabledevelopment/sustainable-development-goals/

a better visibility of these initiatives. Nonetheless, there are marge of improvements for making SDIs better supported politically and not only at the administrative level.

In fact, in most European countries, coordination and collaboration on SDI related matters mainly take place at the level of the administrations, ministries and agencies, and there seems to be limited political involvement. However, there are a few countries in which decisions on SDIs are taken at a very high political level and with a strong involvement of national level politicians. While this leads to a strong political recognition of and support to the SDI, there is also a risk of political changes having a strong impact on the SDI. Nonetheless, despite this possible challenge, ensuring that political leaders takes ownership of SDI development and support it is one of the key for the future sustainability of the infrastructure. Furthermore, leadership and political commitment are needed to link SDI with all other related topics including open data and Digital Government Transformation. Without a coherent and political video behind these domains in fact it will be much more difficult to transform public administration and implement solid digital transformation strategies for the public sector. For all these reasons, it is important to take this OECD principle in account when discussing SDI and Digital Government Transformation.

A good practice in promoting this principle in the context of SDIs is the effort done in the Netherlands on investigating the coalition agreement to demonstrate the importance of geospatial data for tackling the challenges mentioned in the coalition agreement (See also section 2.2.2 of this report).

5.2.6 Principle 6 - Coherent use of digital technology across policy areas

SDI can be seen as an important enabler of a more coherent use of geospatial data and technologies across policy areas and the INSPIRE Directive has also played a pivotal role in this respect. **SDIs in fact provide a *coherent and consistent approach* to the collection, management, sharing and use of geospatial data in the public sector, ensuring technical, and semantic but also legal and organisational interoperability.** Furthermore, the INSPIRE Directive provides indications on standards and services which should characterise the infrastructure notwithstanding the country and datasets considered. The SDI/INSPIRE developments hence enable the implementation of the OECD principle number 6 on the coherent use of technologies amongst the countries in scope.

The role of SDI as building block and coherent technological approach is often supported by a strategic vision and strategic thinking. In several countries, the development of an overall national strategy on the SDI (or on geospatial information in general) and/or the inclusion of SDI related aspects in broader digital government transformation strategies has been an important mechanism for realising alignment with different sectoral or thematic strategies (see also Chapter 2 on Institutional Setting indicators). When there are SDI specific strategies, these allow positioning the SDI in a coherent way towards all other domains. **When SDI is part of Digital Government Transformation documents and strategies, countries can leverage an overarching framework and vision for use of technology within the public sector and which also involves SDIs.**

Furthermore, stakeholders from different sectors and thematic areas are often engaged in the development of strategies, thus ensuring the vision on SDI represents the views and interests of stakeholders in different policy domains and from different sectors (public sector, private sector, academia etc.). Additionally, these strategies are usually developed jointly by different levels of government, which hence ensure representation of regional and local authorities. In this way, also a coherent 'geospatial' approach is realised across policy levels and policy domains. For this reason, SDI is very important as enabler for a coherent use of technologies within and across governments and this OECD principle is relevant for this study.

The case of Germany, where different levels of government have been involved in the development of the national geo-information strategy and this strategy has been aligned with the e-government strategy, can be highlighted as a good practice in applying this principle (see also Section 2.2.1 of this report).

5.2.7 Principle 7 - Effective organisation and governance frameworks to coordinate

SDI/INSPIRE implementations in Europe are characterized by strong governance and organisation frameworks, which aim at coordinating the activities and contributions of different stakeholders in the implementation of the SDI. Often, these frameworks also foresee the establishment of a coordinating institution or body, responsible for leading and coordinating the work and activities of other involved actors. Historically, there have been two different approaches for the establishment of such coordinating institutions:

Creation of an entirely new structure; or

Delegation of the responsibilities to coordinate the SDI to one of the existing bodies (most often the national mapping agency or the ministry of environment)

Interestingly enough, in several countries, the role of these coordinating bodies clearly changed in the past years, and went beyond implementing SDI/INSPIRE. In fact, the uptake and integration of SDI/INSPIRE data, services and components in the digital transformation of governments became a new responsibility – or even priority - for some of these coordinating bodies. In other countries, this became the responsibility of the body or unit in charge of eGovernment or Digital Government Transformation. Finally, some countries saw the integration of SDI and Digital Government Transformation bodies in the same entity or organisation. As the description of these approaches shows, there are many different ways for ensuring a coordinated approach to SDI in the wider context of Digital Transformation of Government

What all these approaches and ways to organise and coordinate SDI implementation have in common is a rather clear definition of roles and responsibilities for the different stakeholders. The INSPIRE Directive was an important driver in this, distinguishing and addressing 34 different spatial data themes. As a result, many European countries started with the identification of data providers under each of these 34 themes. However, throughout Europe, one can distinguish different approaches to the allocation of roles and responsibilities, ranging from the dual model of 'users' and 'providers' to more complex models with multiple roles (and associated responsibilities). Linked to this understanding of roles, different ways of involving different stakeholders community in SDI implementation also emerged (as further discussed for Principle 2 above). All these aspects are particularly relevant in the framework of the present assignment and from the perspective of Digital Government Transformation.

It can be argued that SDI developments in Europe strongly follow principle 7 of the OECD recommendations and even constitute a good example of how this principle could work in practice.

5.2.8 Principle 8 - Strengthen international cooperation with governments

SDI is an area characterised by high level of European and international cooperation as the example of the INSPIRE Directive[455] suggests. Already in the preparatory phase of the INSPIRE Directive, there has been a high level of involvement and exchange of views across experts and stakeholders from the different countries, through the establishment of Spatial Data Interest Communities (SDICs), feedback on the feasibility of the implementation from the legally mandated organisations (LMOs), and the formation of drafting teams (DTs) to develop the implementing rules. Another example of the international cooperation between governments in the SDI/INSPIRE domain, is the annual European INSPIRE Conference[456], which replaced the EC-GI workshops series that was organised for many years. Each year a European INSPIRE conference provides a forum for stakeholders from government, academia and industry to hear about and discuss the latest developments of the INSPIRE Directive and SDIs, through a series of plenary sessions and parallel session and workshop focusing on particular topics, technologies or applications. Every year, hundreds of practitioners, decision makers, researchers and other stakeholders from different European countries participate in the INSPIRE Conference and contribute to the presentations, discussions and workshops. The involvement and contribution of many national experts to the work of the INSPIRE Maintenance and Implementation Group (MIG) and of the permanent sub-group focusing on technical aspects also demonstrates the high level of cross-national cooperation.

At the international level, several European countries, public authorities and experts are actively involved the work of standardisation bodies such as Open Geospatial Consortium[457] and ISO[458], and of other international bodies such as the United Nations Committee of Experts on Global Geospatial Information Management[459]. On top of that, international cooperation around SDIs takes the form of many cross-border initiatives for knowledge sharing, collaboration and harmonization in the domain of geospatial data. A very high number of European countries are involved in one or more of such cross-border initiatives, which clearly demonstrates the high level of international cooperation.

[455] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE), https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32007L0002

[456] https://inspire.ec.europa.eu/portfolio/inspire-conferences

[457] http://www.opengeospatial.org/

[458] https://www.iso.org/home.html

[459] http://ggim.un.org/

The key challenge here is to extend this cooperation, knowledge sharing and coordination to the non-geospatial domain, and connect with other communities and initiatives in the domains of digital government, open government and open data. Therefore, although principle 8 is not only relevant but also already largely applied in the SDI domain, there is some marge for improvement in the context of more international cross-domain collaboration.

Poland can be named as a good practice, as it sees international cooperation as a strong driver for innovation in the development of the national SDI, and is very active in cross-border initiatives (see also Section 3.3.2 of this report).

5.2.9 Principle 9 - Development of clear business cases

Business cases of SDI/INSPIRE have been developed in some European countries, and the European level and pan European associations also invested time and efforts in identifying, estimating and afterwards measuring the economic, social and political benefits of SDI, INSPIRE and cross-border geo-spatial data sharing[460]. In this context, the INSPIRE Directive in particular requires the Member States to regularly report on the on the costs and benefits of its implementation. While this has been a driver for most countries to monitor and measure the costs and benefits at least to a certain extent, this remains a difficult exercise in many cases and there has been a limited number of more in-depth studies on the business cases behind SDI implementation and data sharing at the national and international level.

As the overall technical coordinator of INSPIRE, the Joint Research Centre of the European Commission launched a program of activities to identify frameworks that could be used for assessing the impact of INSPIRE. As part of this program, analyses have been undertaken of the socio-economic impact of the SDIs of Catalonia[461] and Lombardia[462]In the Netherlands, a cost-benefit analysis of INSPIRE was conducted a first time in 2009 and repeated in 2016[463]. In Sweden, particular effort was taken to assess and monitor the social value of the national SDI[464], while in Denmark a study was carried out on the impact of open geospatial data[465]. Especially the Danish study clearly shows the business case of SDI and open geospatial data, and can be highlighted as a good practice in putting in practice this principle in the development of SDIs (see also Section 4.2.2 of this report).

As these findings suggest, the question of business cases has not been entirely neglected in the framework of implementation of SDIs. However, this proved to be a difficult exercise and, despite some efforts, further work on business and use cases would be needed in order to clearly identify the economic and social benefits linked to the SDI and all possible uses and advantages of such infrastructures.

5.2.10 Principle 10 - Reinforce ICT project management capabilities

Several European countries seem to follow a structured approach to managing SDI/INSPIRE implementation and adoption projects. Again, SDI coordinating bodies often play a key role in providing the required project management capabilities, and are guiding and supporting SDI/INSPIRE projects in different organisations and thematic fields.

In this respect, several interesting practices and approaches can be mentioned:

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[460] See for instance the recent study on The Socio Economic Impact of Open ELS, Deloitte, November 2018, https://openels.eu/wp-content/uploads/2019/04/Open_ELS_socio_economic_benefits_final_report_Website.pdf

[461] See: Garcia Almirall, P., M. Moix Bergadà, P. Queraltó Ros, and M. Craglia (2008). The socioeconomic impact of the spatial data infrastructure of Catalonia. M. Craglia (Ed.). Ispra, JRC Joint Research Centre, p. 62. http://www.ec-gis.org/inspire/reports/Study_reports/catalonia_impact_study_report.pdf

[462] See: Campagna, M. and M. Craglia (2012). The socioeconomic impact of the spatial data infrastructure of Lombardy. Environment and Planning B: Planning and Design 39(6): 1069–1083. doi:10.1068/b38006.

[463] See: Ecorys & Grontmij (2009). Kosten-batenanalyse INSPIRE. Geonovum & Ecorys (2016). Actualisatie KBA INSPIRE. Geonovum.

[464] See : Country Report of Sweden, Swedish Spatial Data Infrastructure and the National Geodata Strategy, Submitted to United Nations Committee of Experts on Global, Geospatial Information Management, Seventh Session, New York, August 2017, Submitted by Bengt Kjellson, Director General Lantmäteriet. Prepared by Lantmäteriet (the Swedish mapping, cadastral and land registration authority), Statistics Sweden, the Swedish Maritime Administration, the Swedish Environmental Protection Agency, the Swedish Meteorological and Hydrological Institute and the Geological Survey of Sweden.

[465] See: The impact of open geographical data – Follow up study, March 17th, 2017, PWC, https://sdfe.dk/media/2917052/20170317-the-impact-of-the-open-geographical-data-management-summary-version-13-pwc-qrvkvdr.pdf.

- Countries have carried out/are carrying out several initiatives to integrate SDI components and document them in a way that makes them visible in other government portals (see Chapter 3 on the Analysis of the Technical Infrastructure for further details). The same is done for existing components and so-called *building blocks* that are available and could be re-used by other public authorities
- At the European Commission level, the INSPIRE in Practice portal[466] provides access to a collection of real SDI implementations and contains an inventory of useful tools.
- Some countries developed approaches for experimenting with and testing new solutions and developments through pilot projects, testbeds and similar initiatives ((see Chapter 3 on the Analysis of the Technical Infrastructure for further details). This allows them explore and prepare a potential implementation of these solutions afterwards. Often this is done in collaboration with end-users and other interested stakeholders, also outside the public sector.

Finally, the existence of a strategic approach to digital geospatial skills in some countries also contributes to reinforcing project management capabilities for geospatial projects. Although specific geospatial skills strategy are rare, most of the countries have established digital skills initiatives which also include aspects related to spatial literacy and use of geospatial information. With the establishment of a specific working group on capacity building as part of the governance structure, Croatia provides a good practice in implementing this principle in the development and implementation of the national SDI (see also Section 2.3.1 of this report). The combination of strong coordination on SDI with the provision of building block and reusable solutions and the improvement of human capacity should all help with the reinforcement of project management capabilities in this domain.

5.2.11 Principle 11 - Procurement of digital technologies

Procurement of geospatial technologies and services is part of the overall government procurement policy and regulated by public procurement legislation at EU and national level. Data on the public procurement performance of countries show how European countries are performing differently in this respect. In particular, significant differences exist between European countries with regard to public procurement policies and practices[467].

One could expect that these differences would also apply to the procurement of geospatial technologies and services. In our study, we were able to detect some particularly **good and innovative practices in the procurement of geospatial technologies and services at country** level. In some countries, one of the roles of the organisation leading and coordinating SDI/INSPIRE implementation is to provide guidance and support to the process of public procurement of geospatial technologies. Cooperative procurement practices, where multiple public buyers jointly organise a procurement procedure to buy a geospatial product or service, are also a common practice in some countries. Again, in these cases very often it is the SDI coordinating body that plays a key role in the preparation of the procurement procedure. Innovative practices include the use public procurement on more experimental and explorative topics, involving close collaboration between the public sector and multiple private companies and/or academic partners responsible for different lots. Such an approach also allows smaller, specialised companies to make an offer, and enhances exchange of knowledge and views between parties. **The pilot project approach applied in the Netherlands, and in particular the testbed on spatial data on the web, can be seen as a good practice of implementing this principle in the context of SDIs** (see also Section 3.3.1 of this report).

At the European level, several interesting initiatives have been taken to support the public procurement of geospatial technologies and services. As part of the European Union Location Framework (EULF)[468], a set of guidelines have been developed on the procurement of location information products and services, such as the acquisition of new location data to support applications, the acquisition of solutions for using location data and services in eGovernment processes and products and/or services for making data interoperable and/or accessible[469]. The guidelines provide recommendations on elements of best practice in procurement in which location information and location enabled services are important, with some practical examples.

[466] https://inspire-reference.jrc.ec.europa.eu/

[467] http://ec.europa.eu/internal_market/scoreboard/performance_per_policy_area/public_procurement/index_en.htm

[468] https://inspire.ec.europa.eu/eulf/31

[469] See : Francesco Pignatelli, Paul Smits, Danny Vandenbroucke, Glenn Vancauwenberghe, Raymond Boguslawski, "EULF guidance for public procurement of geospatial technologies" , 2016, http://publications.jrc.ec.europa.eu/repository/handle/JRC100712

Another interesting initiative are the different vocabularies made available via the INSPIRE in Practice platform, such as the vocabulary on 'Actors and Skills' and on 'Tasks'[470]. These vocabularies are very helpful for understanding the skills and the resources needed, and provide a common vocabulary that also can be used in procurement procedures. The inventory of useful tools for the INSPIRE implementation[471], through which developers and solutions providers can showcase their products and experiences, could also support the procurement of geospatial technologies and services.

Procurement of geospatial digital technology is hence an area in which the SDI is aligned with principle 11 of the OECD recommendations. Nonetheless, further work on innovative procurement practices as well as cross-border joint procurement could be needed in the future to help public administration innovate faster and collaborate better across-borders.

5.2.12 Principle 12 - Legal and regulatory framework

The transposition of the INSPIRE Directive into national legislation resulted in the establishment of legal and regulatory frameworks on SDI in all European countries. In some European countries such a framework –or certain parts of it–already existed before the adoption of the INSPIRE Directive in 2007. In many European countries, however, there was no formal SDI in place before the implementation of INSPIRE, and the transposition of the INSPIRE Directive was the first step in the creation of a legal and regulatory framework for the national SDI.

In those countries where a legal and regulatory framework already was in place, the INSPIRE Directive often offered an opportunity to revise and update the existing legislation. Interestingly enough, some countries went beyond INSPIRE in the establishment of the legal and regulatory framework on SDI, and also formalised additional components or aspects of the SDI into legislation. In some countries, for instance, the legal framework on SDI also determines and regulates the roles and responsibilities of the different actors in the SDI. A small group of European countries has established a national system of so-called base registries (or key registries), i.e. trusted, authentic sources of basic information on items such as persons, companies or vehicles, but also on locations, buildings and roads or unique identifiers. A legal framework on these base registries and basic data is put in place, to assure the quality, accuracy and validity of the data, but also to make the use of these data mandatory for public authorities (see also Chapter 2 on Analysis of the Institutional Setting indicators). **As one of the European countries with such a system of base registries in place, the Czech Republic can be recognized as a good practice in applying this principle** (see also Section 2.3.1 of this report).

It is important to notice here that the legal and regulatory framework on SDI does not only consist of laws, regulations and other binding rules that refer directly to SDIs, and geospatial data but also of legislation that applies to data or information in general (e.g. data protection, public sector information, legislation on freedom of information, copyright, etc.). Recent advancements these legislative frameworks, such as the revised Public Sector Information Directive[472] and the EU General Data Protection Regulation (GDPR)[473] also contributed to the establishment of a stronger legal and regulatory framework on SDIs in Europe. **By looking at all these (recent) legislative initiatives in combination with the INSPIRE Directive, it can be argued that they allow to seize the opportunity of digitalisation and provide SDI with a sufficient and solid legal context for enabling it to play a role in Digital Government Transformation.**

5.3 Conclusions on the relation between OECD recommendations and SDI developments

In the previous sections of this chapter, we provided a short analysis of the extent to which and the ways in which SDI implementation in Europe is following the 12 principles contained in the OECD Recommendation on

[470] https://inspire-reference.jrc.ec.europa.eu/vocabularies

[471] https://inspire-reference.jrc.ec.europa.eu/tools

[472] Directive 2013/37/EU of the European Parliament and of the Council of 26 June 2013 amending Directive 2003/98/EC on the re-use of public sector information, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32013L0037

[473] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC, https://eur-lex.europa.eu/eli/reg/2016/679/oj

Digital Government Strategies[474]. **Based on this investigation and on the findings of this study, an assessment can be made of the status of SDI with regard to each of these principles.** The result of this assessment is presented in the table below, in which we make use of the three stages of development - *early stage, intermediate stage and advanced stage* – defined in the OECD Self-assessment toolkit[475] to illustrate to what extent the different recommendations are followed in the context of SDI and Digital Government Transformation. While a more detailed description of these three stages and how they apply to each of the 12 principles can be found in the OECD Self-assessment toolkit, an application of these principles at a more general level allows demonstrating their relevance in the context of SDIs in Europe. In this table, we also briefly summarise the current practices and approaches adopted by the European countries in scope of this analysis and related to or relevant for each of these principles.

Table 11 State of implementation of the OECD principles in the context of SDI and Digital Government Transformation

Principles	Status
Principle 1 - Openness, transparency and inclusiveness	***INTERMEDIATE***
- Huge amount of geospatial data is available as open data, in line with open data and open government agendas; - There have been efforts to establish inclusive decision making processes on SDI/INSPIRE implementation, and be transparent on the status of SDI/INSPIRE implementation; - SDI/INSPIRE has an impact on openness, transparency and inclusiveness in various policy areas, supporting the provision of information to citizens and public participation processes	
Principle 2 - Engagement and participation in policymaking and policy making and service delivery	***INTERMEDIATE***
- Countries have adopted user-driven approaches to the provision of geospatial approaches, taking into account users' feedback and preferences; - Governments have also developed new and innovative approaches to allow the access to and re-use of geospatial data and services by different user groups; - Collaboration with non-government stakeholders in the governance and implementation of the infrastructure is increasing.	
Principle 3 - Creation of a data-driven culture in the public sector	***ADVANCED***
- SDI/INSPIRE strongly contributed to creating a culture of – geospatial – data sharing in the public sector; - A high level of technical and semantic interoperability has been achieved, and INSPIRE can be seen as the largest data interoperability effort ever undertaken in Europe; - SDI/INSPIRE now can be seen as a best practice in data management in the public sector and an effective framework to enable and guide the publication and sharing of high quality data.	
Principle 4 - Protecting privacy and ensuring security	***EARLY***
- There is a general recognition of the importance of privacy and security in the context of SDI/INSPIRE; - The use of more generic IT solutions for data access and security is growing; - There are many EC efforts and initiatives to support member states in taking further actions in this area.	
Principle 5 - Leadership and political commitment	***INTERMEDIATE***
- Different levels of political commitment to the SDI across countries, and a general need to demonstrate the importance of SDI/INSPIRE at the political level; - The alignment with open data and digital transformation agenda is growing and this will increase the level of political commitment behind SDI - There is strong interdepartmental and sometimes also inter-level coordination on SDI/INSPIRE in European countries.	
Principle 6 - Coherent use of digital technology across policy areas	***ADVANCED***

[474] OECD, Recommendation of the Council on Digital Government Strategies, 2014, https://www.oecd.org/gov/digital-government/recommendation-on-digital-government-strategies.htm

[475] https://www.oecd.org/governance/digital-government/toolkit/self-assessment/

- SDI/INSPIRE is a coherent approach across policy areas to geospatial data in the public sector;
- Geospatial data and SDI/INSPIRE as part of the broader digital government strategy;
- There is a strong alignment with sectoral strategies and engagement of stakeholders from different sectors.

Principle 7 - Effective organisation and governance frameworks to coordinate ***ADVANCED***

- Establishment of coordinating bodies for SDI/INSPIRE and Digital Government actors and assignment of clear roles and responsibilities to users, providers and other involved parties ensures effective organisation of the SDI;
- There are effective structures and mechanisms put in place to involve different domains, sectors and administrative levels in decision making;
- There is a need for new models and approaches for effective organisation and governance on the SDI/INSPIRE as part of Digital Transformation policies.

Principle 8 - Strengthen international cooperation with governments ***ADVANCED***

- There is a strong participation of national experts and stakeholders in the preparation and maintenance of the INSPIRE Directive;
- The involvement in and contribution to the work of international standardisation bodies such as OGC and ISO is also very strong.
- All countries are involved in cross-border initiatives on knowledge sharing, collaboration and harmonization of data.
- Most countries present Delegates to the European Region of the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM: Europe) and nominate Members to its Executive Committee and Working Groups within SDI communities.

Principle 9 - Development of clear business cases ***EARLY***

- INSPIRE Country Reports require Member States to collect information on the costs and benefits of INSPIRE implementation, while ex ante and ex post cost-benefit analyses related to SDI/INSPIRE have been undertaken in several European countries;
- The Joint Research Centre has also invested in trying to understand the impact of SDI development and has done so via a number of initiatives;
- Business cases have been developed not only on the SDI/INSPIRE, but also on particular datasets, services, platforms, etc.
- Regulatory reporting started to be organised around SDI/INSPIRE (National and European levels)

Principle 10 - Reinforce ICT project management capabilities ***INTERMEDIATE***

- SDI Coordinating bodies often provide the necessary knowledge and capabilities for project management on SDI/INSPIRE;
- There is some documentation of past and ongoing SDI/INSPIRE projects and of – reusable – tools and components available (e.g. Registries);
- There is a new focus on experimenting with and testing of new and innovative solutions, to prepare the implementation of these solutions in the SDI/INSPIRE.

Principle 11 - Procurement of digital technologies ***INTERMEDIATE***

- SDI Coordinating bodies are normally supporting and guiding the procurement of geospatial technologies and services;
- Cooperative procurement practices, where multiple public buyers jointly organise a procurement procedure to buy a geospatial product or service are becoming more frequent;
- There have been EC initiatives and actions to support the public procurement of geospatial products and services.

Principle 12 - Legal and regulatory framework ***INTERMEDIATE***

- The legal and regulatory framework on SDI in all European countries has been primarily driven by the transposition of the INSPIRE Directive into national legislation;
- The legal framework on key registries further regulates the collection, management and use of geospatial data in some countries;
- Impact of advancements in the legal framework on data and information in general (e.g. PSI, GDPR, etc.).

Source: Deloitte and KU Leuven, 2019

6 Conclusions

6.1 Conclusions on the analytical framework and data collection methods used

The data collection and analysis process applied in this study was based on a structured and jointly agreed **analytical framework.** The team continuously reviewed and refined this analytical framework building on the experiences and lessons learned gained while applying it during the different stages of the assignment. This iterative and "agile" approach resulted in a final analytical framework that allows to better (although not perfectly) understand the role of SDI in Digital Government Transformation in European countries.

While many frameworks for analysing the status and performance of SDIs and Digital Government Transformation already exist, it was clear since the beginning of this study that a joint analysis of the relation between these two aspects required a *new approach* and an appropriate analytical framework. The development of such ad hoc analytical framework followed the identification of four essential requirements:

- **Relevance:** The focus of the framework should not be on the status of implementation of various SDI components. The central question underpinning the framework should be to what extent and in which way SDIs and their components fit into and contribute to the Digital Transformation of Government, and to what extent and in which way new components are added to the SDI to strengthen its role and contribute to the Digital Transformation of Government.
- **Completeness:** The framework should allow a complete analysis of the role of SDI in Digital Government Transformation, which means all relevant aspects should be taken into account. The framework should address both the institutional and the technical infrastructure of SDIs, as well as the impact of SDIs to the Digital Transformation of Government.
- **Understandability:** The framework should be simple and easy to understand. This means the overall structure of the framework should be logic, the number of indicators should be adequately targeted, and all indicators should be clear and unambiguous.
- **Applicability:** The framework should be applicable in any European setting. It should be possible to collect the empirical data that are needed for applying the framework in practice. The process of data collection and data analysis should be clear and well-defined.

A fifth requirement can be added, as the framework should allow analysing progresses within countries and/or comparison between countries. A comparative analytical framework hence also requires clear rules on how to compare different situations without necessarily establishing hierarchies of best practices. This means it should be possible to explain the purpose and scope of each indicator well enough to avoid different interpretations and subjectivity in the comparison of countries. The procedure of defining the purpose and scope should be determined and described at the level of each individual indicator, with clear and specific definition of the requirements for each of the three levels (see Annex 4 for further details on this aspect).

The aim of this study was to contribute to the development of an analytical framework meeting these five requirements. The original framework was based on the seven topics that are central in the INSPIRE Country Reports[476] and are also treated (although from a different perspective) under the eGovernment factsheets[477] and it defined 29 different indicators structured around these seven topics. In applying and testing the framework throughout different stages of the study, several revisions and changes were made, motivated also by the impossibility to obtain the necessary information for the initial defined level of detail, to improve the framework over time and meet the requirements identified. The main changes can be summarised as follows:

- **Revision of the original indicators** and the way these indicators were defined, to ensure the focus was on the role of SDI in Digital Government Transformation (and not on the development and implementation of the SDI) *[Relevance + Applicability].*
- **Removal of indicators** that were not relevant and/or measurable, and merging of related and overlapping indicators, also to reduce to number of indicators to 17 indicators in total [*Relevance + Understandable].*

[476] https://inspire.ec.europa.eu/INSPIRE-in-your-Country

[477] https://joinup.ec.europa.eu/collection/nifo-national-interoperability-framework-observatory/digital-government-factsheets-2018

— **Restructuring the indicators** (groups) into three main categories of 'Institutional setting', 'Technical Infrastructure' and 'Impact', each consisting of several relevant indicators groups [*Completeness + Understandable].*

— **Testing of different data collection methods** and sources of information, which provided insights into the relevance but also the weaknesses of different methods and sources *[Applicability].*

— **Development and testing of an approach for monitoring the progresses and status of development of certain initiatives**, in line with other approaches such as the OECD Digital Government Self-assessment[478] and the Open Data Barometer[479]. A clear distinction was made between three stages of development, which were further described for each of the 17 indicators. Clear rules for assessing different situations were defined *[Comparability]* (see also Annex 4 for further details on these rules).

The final version of the framework is presented in the Introduction and in Annex 4 of this report. The key characteristics and elements of this framework are:

— The framework consists of three main components or categories of indicators (similarly to the structure of the Open Data Barometer[480]): 'Institutional setting', 'Technical framework' and 'Impact', which all three are important and even essential for understanding and describing the role of SDI in Digital Government Transformation.

— Each of these three categories consists of several indicator sub-groups, which contain several related indicators. In total, there are eight sub-groups of indicators:

— Governance, Strategy and Legal framework (Institutional setting);

— Extended infrastructure, Interoperability and Innovation (Technical Infrastructure);

— Usage and Benefits (Impact).

— Under each of these sub-groups there are several indicators. Most sub-groups consist of two indicators, only the sub-group on usage contains three indicators.

— Each indicator consists of a description, a list of aspects that are considered to be relevant for assessing the indicator and guidance on assessing countries on the indicators (see Annex 4 for further details).

For the collection of data, two main methods were used: desk research and interviews. The desk research mainly focused on two main types of documents and sources: literature related to SDI/INSPIRE implementation and literature related to e-Government, open data and digital government. For both types of documents, some key sources of information could be identified:

Key sources of information on SDI/INSPIRE Implementation are:

— The official INSPIRE Country Reports, Country fiches and JRC Webinars on national INSPIRE implementations;

— Presentations at the INSPIRE Conferences and other relevant international/national events and conferences;

— The national geoportals, policy reports and other documents on SDI/INSPIRE.

Key sources of information on e-Government, open data and Digital Transformation include:

— The eGovernment Factsheets and Infographics;

— Open data assessments and studies such as the 'Open Data Maturity in Europe' study of the European Data Portal and the Open Data Barometer;

— The OECD Digital Government Reviews and Good digital government practices;

[478] https://www.oecd.org/governance/digital-government/toolkit/self-assessment/

[479] https://opendatabarometer.org/?_year=2017&indicator=ODB

[480] Open Data Barometer - Leaders Edition, ODB Methodology - v1.0 | 15 September 2017, http://opendatabarometer.org/doc/leadersEdition/ODB-leadersEdition-Methodology.pdf

— The national data and e-government portals, policy reports and other documents on e-government, open data and Digital Transformation.

Throughout the study, it became clear that data collection via desk research is adequate for a first exploration of developments and practices related to the role of SDI in Digital Transformation, but does not allow a complete analysis on the role of SDI in Digital Transformation. There are great differences between countries with regard to the availability of data and information on the topic. Even for countries that are very active in documenting and communicating on their practices and experiences it was difficult to collect information on all indicators of the framework. Therefore, the desk research was complemented with interviews, with SDIs representatives at the national level and other key actors/experts in the domains of SDI, INSPIRE and e-Government. While the in-depth interviews with the SDIs representatives at national level already allowed a more comprehensive data collection, interviews with additional experts are recommended and sometimes even required to be able to cover all indicators.

6.2 Conclusions on the role of SDI for the countries in scope

This study shows that countries' experiences with national and European Spatial Data Infrastructures have paved the way for more data sharing in Europe and for a better organised Digital Government Transformation. The implementation of the INSPIRE Directive also helped as it has led to the obligation of sharing data in a certain way and building interoperable infrastructures across countries. It has also obliged countries to think about cross-domain cooperation and to take into account different types of users. This experience with SDIs (within and outside the context of the INSPIRE Directive) is precious for countries which are more and more confronted with the intense process of Digital Government Transformation.

Based on the key findings emerging from this assignment, it can be argued in fact that (spatial) data infrastructures should be considered as *building blocks for Digital Government Transformation (DGT)* as they not only constitute one of the key initiatives or stepping stones for succeeding in this difficult yet rewarding journey but they also provide a set of lessons learnt in terms of data sharing which are relevant in many more public sectors' domains. If SDIs are strongly linked to successful Digital Government Transformation journeys, this study also showed that the relation between these two concepts has not always been evident or clear. The interest in connecting the dots, exploring how SDIs can help DGT and understanding how these concept relate to each other is rather recent.

For a long time, these SDI and DGT phenomena have not been considered as (entirely) related nor have been linked from a strategic or even academic point of view[481]. With the conceptual evolution from eGovernment to Digital Government and the transition from "digital" to user-centric and human centered public services, SDIs and data infrastructures more in general have been increasingly recognised as a key tool for governments to manage and make data available for reuse within their digital transformation. The experience of building SDIs has also been recognised as very relevant from a general data sharing perspective within governments. People have hence started speaking about SDIs as "building block" or "enablers" of Digital Government Transformation. In fact, **without SDIs and solid data infrastructures in place coupled with strategies for data sharing and coordination between sectors and communities, the development of innovative and citizens friendly public services as well as the formulation of data-driven policies cannot be ensured**[482].

Furthermore, as Tom Loosemore suggests, for the development of cheaper, more efficient and more empathetic public services "there is a need to provide a new digital infrastructure serving the whole society"[483]. **Data is the foundation of this new infrastructure and sharing data (also through SDIs) is the very basis on which platforms and services for users are built.** From this perspective, **SDIs are particularly important as key data sharing initiatives (within countries and at the EU level) but also very successful examples of data sharing and coordination across domains**.

[481] In this respect, see also the ELISE Rapid Study Webinar on the role of Geospatial for Digital Government Transformation, May 2019, https://joinup.ec.europa.eu/event/elise-action-webinar-role-geospatial-digital-government-transformation

[482] See for instance the UK Digital Strategy 2017, Policy paper7. Data - unlocking the power of data in the UK economy and improving public confidence in its use, https://www.gov.uk/government/publications/uk-digital-strategy/7-data-unlocking-the-power-of-data-in-the-uk-economy-and-improving-public-confidence-in-its-use and also Tom Loosemore, "Making Government as a Platform Real", 2018, https://public.digital/2018/09/25/making-government-as-a-platform-real/

[483] Tom Loosemore, "Making Government as a Platform Real", 2018, https://public.digital/2018/09/25/making-government-as-a-platform-real/

In this context, characterised by an increasing understanding of the role of SDIs in DGT, this study confirms that SDIs and Digital Government Transformation are now crossing their paths although they are only at the beginning of their common journey. While **there are very interesting convergences in the governance of these two phenomena and countries develop more and more often joint strategic approaches for tackling them**, the synergies between SDI and DGT will most likely further increase in the future. This becomes evident when looking for instance at the level of interactions between stakeholders from these two communities already existing today as well as the extent to which countries' strategies make connection between SDIs and DGT. In general, an increased proximity of the SDI and Digital Government Transformation community could be found across all countries and there is an increased institutionalisation of contacts and coordination mechanisms. Although there no "mainstream" approach yet to linking these two domains, and countries have all adopted their customised governance and strategic approaches, it is evident that, for all of them, **the experience of coordination across policy areas, sectors and government levels coming from SDIs implementation has a role to play in ensuring that Digital Government Transformation comes together in an effective manner**. The history of dialogue between stakeholders and with data users which characterises the SDI community can help fostering an equivalent level of dialogue in the context of DGT and lead to the development of overarching strategies for exploiting the role of SDI in DGT. Furthermore, the obligation to use SDIs imposed by the INSPIRE Directive is more and more combined with national level measures (binding or not) which will ensure that SDIs will be recognized a building block for the development of data driven services and policies.

Without necessarily comparing countries in this respect, this study is a first attempt to highlight different approaches and behaviours, which are leading to different results in terms of impact and role of SDI in the broader Digital Government Transformation. To investigate and understand how the impact and role of SDI is valued by different countries, the analysis of only the institutional settings is insufficient as it must be complemented by the analysis of the technical infrastructure in place. While the institutional setting indicators define the policy, legal and even "social" environment in which the SDIs are implemented and therefore in which they interact with the DGT community and objectives, **the analysis of the technical infrastructure highlights the length to which countries have gone in setting down this key data infrastructure, to what extent they have spent time building a truly interconnected and interoperable ecosystem and whether they consider innovation of SDI as an asset and a strategic direction for their digital government transformation**. In this respect, this study showed that **there is a certain maturity in the technical infrastructure of countries and they all looked beyond the INSPIRE Directive when building their SDIs and considered that this area deserved further attention and investments in line with evolving technologies, policy requirements and demand of society**. At the same time, the level of efforts done in domains such as interoperability and innovation differ quite significantly between countries and sometimes between regions within a country. Some challenges emerge in these areas, bringing to different outcomes, for instance in terms of reuse of generic solutions as well as capacity to integrate new technologies in the infrastructure. Nonetheless, the analysis of technical infrastructure indicators also pointed at the emergence of **positive trends and innovation developments such as the growing provision of APIs for facilitating reuse of SDIs and the increased attention paid to interconnection between platforms at different levels**. The reusable tools and guidelines are practices that have been developed and may be further incremented to facilitate that process.

Countries institutional setting and their characteristics in terms of technical infrastructure indicators all influence the impact of SDIs on Digital Government Transformation. When analysing this impact, we looked at two aspects in particular: the extent to which the SDIs are used (in delivery of public services, in policy making and/or by business for building products and services etc.) and what are the benefits linked to this usage for different categories of stakeholders (public authorities, private sector and citizens themselves). **The analysis showed that SDIs in Europe are more and more used both by the public and the private sectors.** All quantifiable information coming from the different countries point at this positive trends. Qualitative examples of publicly and privately developed applications also confirm this finding. **Citizens benefit from this increased provision of SDIs based services and applications, both in their interactions with government and as a consumers of innovative products and services**. Although usage of SDIs to develop cross-border services and applications is rarer to find, there are many cross-border initiatives which focus on SDIs services and the development of applications or eGovernment services on top should not be long to come. Such a positive trend in terms of usage also translates in **clear evidence concerning benefits of the SDIs in DGT**. Although public authorities do not necessarily measure benefits and/or they do

not do so in a quantifiable way, evidence shows that different categories of benefits for citizens, businesses and public administrations can be linked to SDIs usage.

Table 12 – Categories of identfied benefits

Benefits for public authorities/governments	*Benefits for businesses*	*Benefits for citizens*
More cooperation between public authorities Improved environmental policy making Efficiency gains (time and money savings) Optimised and improved procedures (e.g. less manual workflows, reduced errors) Reduced duplication of datasets Easiness of merging datasets Cheaper IT development and economies of scales in IT development Production efficiency Better/up-to-date data analysis and reliability Innovation and increased investments in innovative data sharing activities Reduction of burden on public officials and increased motivation of the staff Simplification of budgetary procedures for data acquisition	Better accessibility of datasets and better access to information More efficient interaction with governments Burden reduction Market efficiency Potential for innovation Better policy making outcomes	Better accessibility of datasets and better access to information More efficient interaction with governments Burden reduction Job creation Increased possibility to participate in public life Better policy making outcomes

Source: Deloitte and KU Leuven, 2019

For the analysis, these benefits have been aggregated in five macro categories for which substantial evidence could be found: 1) efficiency gains, 2) better, smoother and optimized processes, 3) better cooperation and exchange between stakeholders, 4) better policy outcomes and 5) more innovative processes and services. Although most of the literature and evidence available refer to the efficiency gains and the optimization of processes, the other benefits are not to be forgotten and in particular the role that SDIs play in driving innovation in policies and services.

This study constitutes only a first attempt to highlight SDIs role in the context of Digital Government Transformation and to explain the importance of SDIs experience as foundation for the digitalization of governments. This assignment allowed to learn about how 29 countries see and establish the link between these phenomena and how different approaches and national contexts bring to different patterns of innovation in time along the same path of digital transformation. However, further research is needed to provide a more accurate and detailed picture of the situation and to further study the role SDIs can play in Digital Government Transformation. Nonetheless, this first analysis of the available data on SDIs and Digital Government Transformation brought to a number of lessons learnt which are further discussed in the following section.

6.3 Lessons learnt

The conclusions derived from the experience in developing the analytical framework and collecting evidence as well as from the analysis of the role of SDI in Digital Government Transformation can bring to formulating a number of lessons learnt:

— The first overall lesson from this study is that SDIs in Europe already play a key role in the Digital Transformation of Government and that this role is more and more explicitly acknowledged. SDI contributes to the Digital Transformation in many different ways and principally as *key data infrastructure* on which services, platforms and policies can be built. Furthermore, *the SDIs experience of data sharing has taught many important lessons to countries* in terms of collaboration across domains,

listening to the data users and having a dialogue between different stakeholders. In some cases, *SDIs are even the main driver of this governmental transformation*. In this respect, it is very interesting to note that, when comparing the situation across European countries, differences can be seen in the approaches followed and components implemented to support and strengthen SDIs role in digital government transformation. The impact of these differences and the identification of best practices would deserve additional analysis.

— Our initial analysis of the institutional setting underpinning SDIs and Digital Government Transformation reflects the differences and diversity concerning how SDIs are governed and how national legal frameworks and digital strategies are conceived. For this reason, while looking at countries in a comparative way is relevant and best or common practices can be detected, it is not helpful to make rankings of approaches or identify methods which could or should be generalised. In fact, each country has its own specificities and trajectories in terms of the role SDIs can play in Digital Government Transformation and these require customised and context related approaches and entail ad hoc choices for the governance, strategy and national legal framework of the SDIs.

— To fully understand the role of SDIs in the digital transformation of government, it is also essential to look at the technical infrastructure of the SDI. The study showed that considerably efforts have been deployed to further develop this infrastructure beyond the traditional SDIs in order to strengthen the effective role of SDIs in line with the digital transformation of government and society. These efforts include the development of new components, such as new web services, registries and others, the harmonization of geospatial and non-geospatial data across thematic domains and borders, new approaches of making geospatial data accessible and reusable, via APIs and platforms, and experimenting with and implementing new technological developments.

— The actual impact of SDIs on the digital transformation of government can be seen in the use of geospatial data and services provided by the SDIs paving the way for more data sharing as well as collaboration between sectors and stakeholders. These in turn results in significant benefits for public administrations themselves, business and citizens achieved through the use and integration of these data and services. Benefits especially relate to the daily use of SDIs by public authorities in their decision-making and service delivery processes in different domains. Outside the public sector, SDIs are used by private companies and other organisations in many different ways and for many different purposes but manly for the development of new and innovative services and products. Citizens are the ultimate beneficiaries of SDIs usage in their interaction with public authorities but also as consumer of better services and products. Quantitative evidence is available on the socio-economic benefits of SDIs for these different categories of stakeholders and in several countries, but there is a clear need for a more complete and consistent assessment of the impact of SDIs in Europe, recognising the value of geospatial data for policy making, public services, industry, SMEs and citizens in general, as well as the cross sectorial aspects involved. This is hence another domain that would deserve more in-depth research and analysis.

— The important role of SDIs in Digital Government Transformation in Europe is also shown by concrete links between SDIs implementation and the OECD Recommendation on Digital Government Strategies. These twelve principles can be seen as a framework for understanding what digital government is about and what government policies and practices contribute to the Digital Transformation of Government. For each of these twelve principles and across all countries in scope, evidence was found of how SDIs have been putting them into practice. In fact, many of the practices, policies and developments at country level that have been discussed in this report, are contributing to digital transformation of governments and can be seen as good practices in implementing the OECD Recommendation.

— The investigation of the role of SDIs in Digital Transformation of Government requires a particular analytical approach and framework, which is different from previous approaches for studying and assessing SDIs, placing it as a part of a broader national government digital strategy and context. In this study, an attempt was made to develop such a framework, with the identification of key indicators and the application and testing of several methods for collecting information related to these indicators. Although this framework has been improved in an iterative way all thorough this study, the current version should not be considered as a final and perfect product. On the opposite, improvements could still be made and especially on the impact indicators which revealed to be quite challenging. For this reason, we consider this study as a first step in trying to place the role of SDIs in Digital Government Transformation and we believe that by no means it represents a full picture of the situation. Hoping however that these results stimulate the need for knowing more about this topic, further research and

analysis will come to complete this picture in the future and possibly to improve the analytical framework suggested in this report.

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List of figures

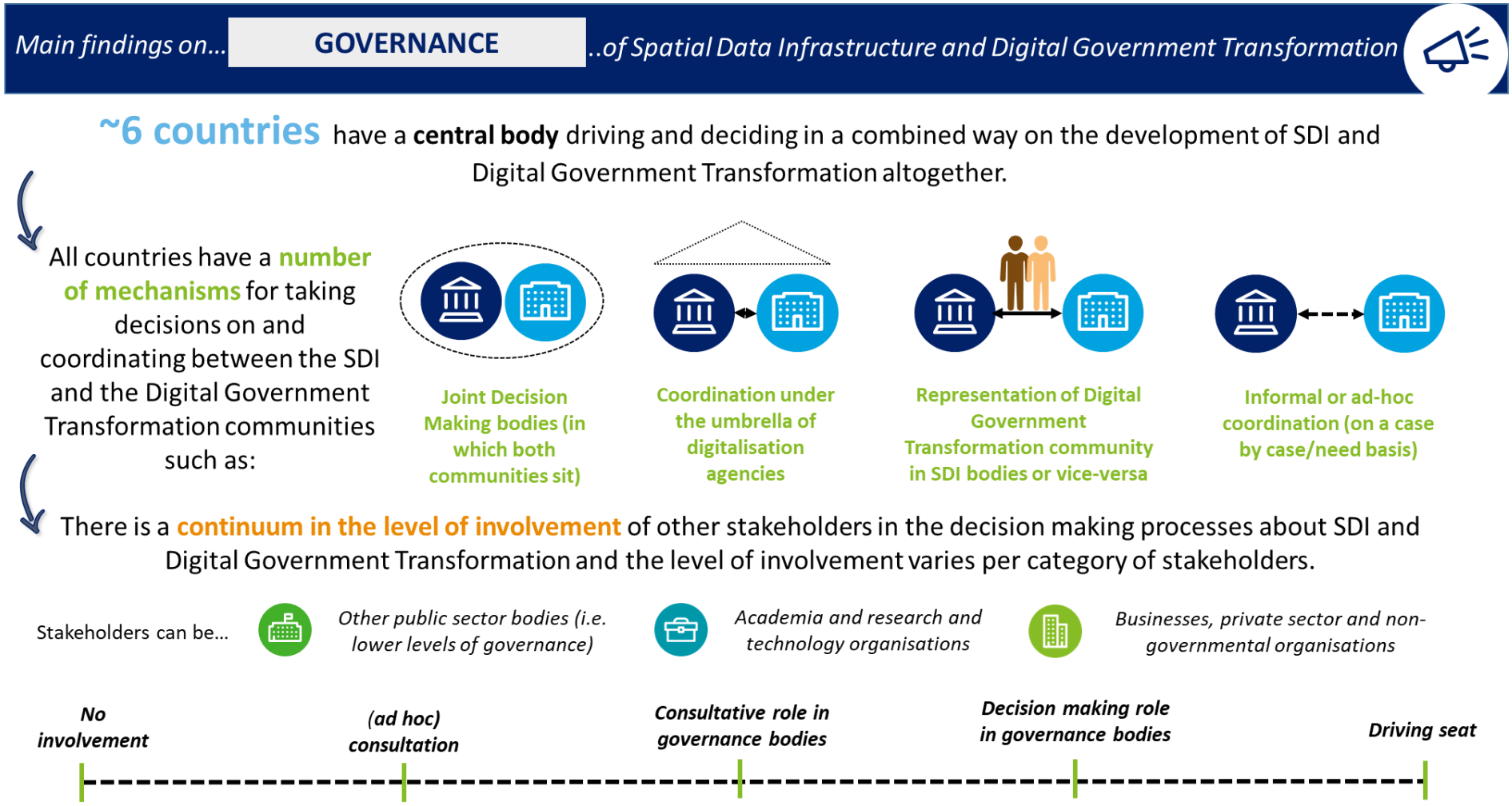
List of tables

Annexes

Annex 1. (Visual) Summary of findings per category of indicators

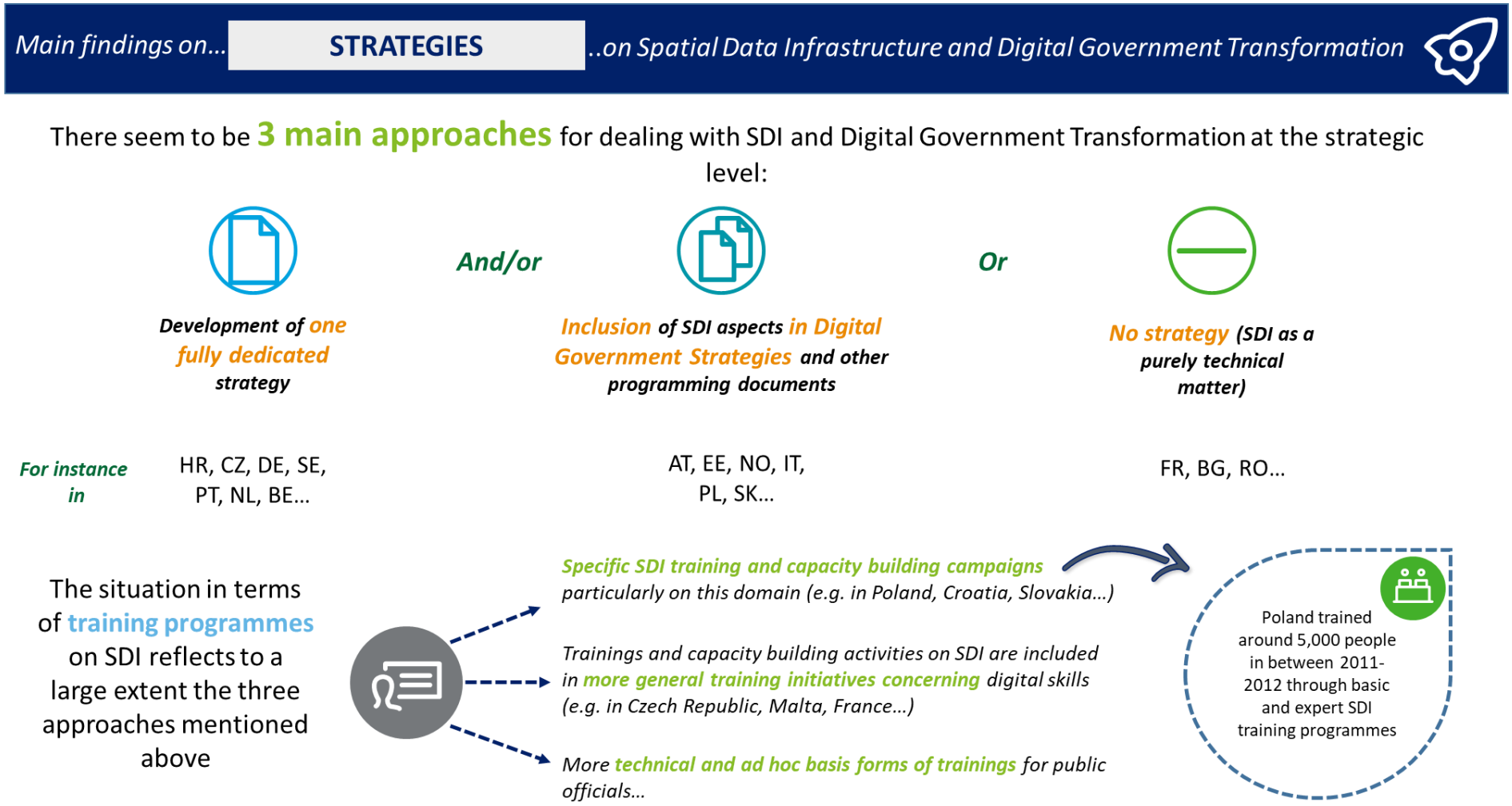
The figures below summarise in a visual way the main findings obtained for each category of indicators and concerning the 29 countries in scope of this assignment.

Figure 10 - Main findings on the governance indicators



Source: Deloitte and KU Leuven, 2019

Figure 6 - Main findings on the Strategy indicators



Source: Deloitte and KU Leuven, 2019

Figure 7 - Main findings on legal framework indicators

Main findings on... **LEGAL FRAMEWORKS** *..behind Spatial Data Infrastructure and Digital Government Transformation*

The legal framework underpinning SDI and Digital Government Transformation together is composed of **two main angles**

Base registries (and mandatory use of the SDI but also national legislation on organisation and governance of the SDIs)

The use of SDI (as base registry) is mandated by law in a limited number of countries

In **Flanders**, the 2009 Decree on the Spatial Data Infrastructure states that the use base registries, of which the quality in terms of accuracy, completeness and up-to-dateness will be guaranteed, is mandatory for all public tasks

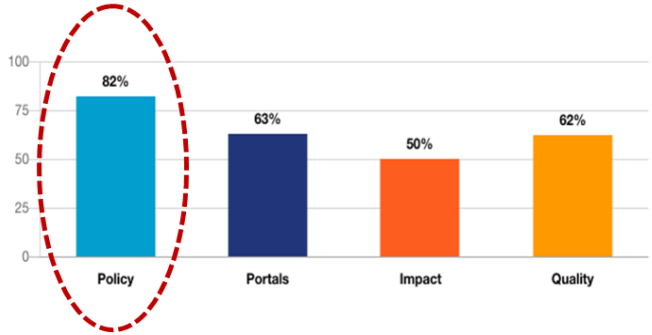
Many countries have "soft approaches" for increasing the use of SDI within the public sector

Spain is following a step-by-step approach for convincing employees from all public authorities to use the SDI in their daily activities and this approach is based on the quality of the SDI rather than on the obligation to use it.

Due to the growing importance of the "only-once principle", national legislation on SDI use might increase in the future!

Coordination with Open Data policies

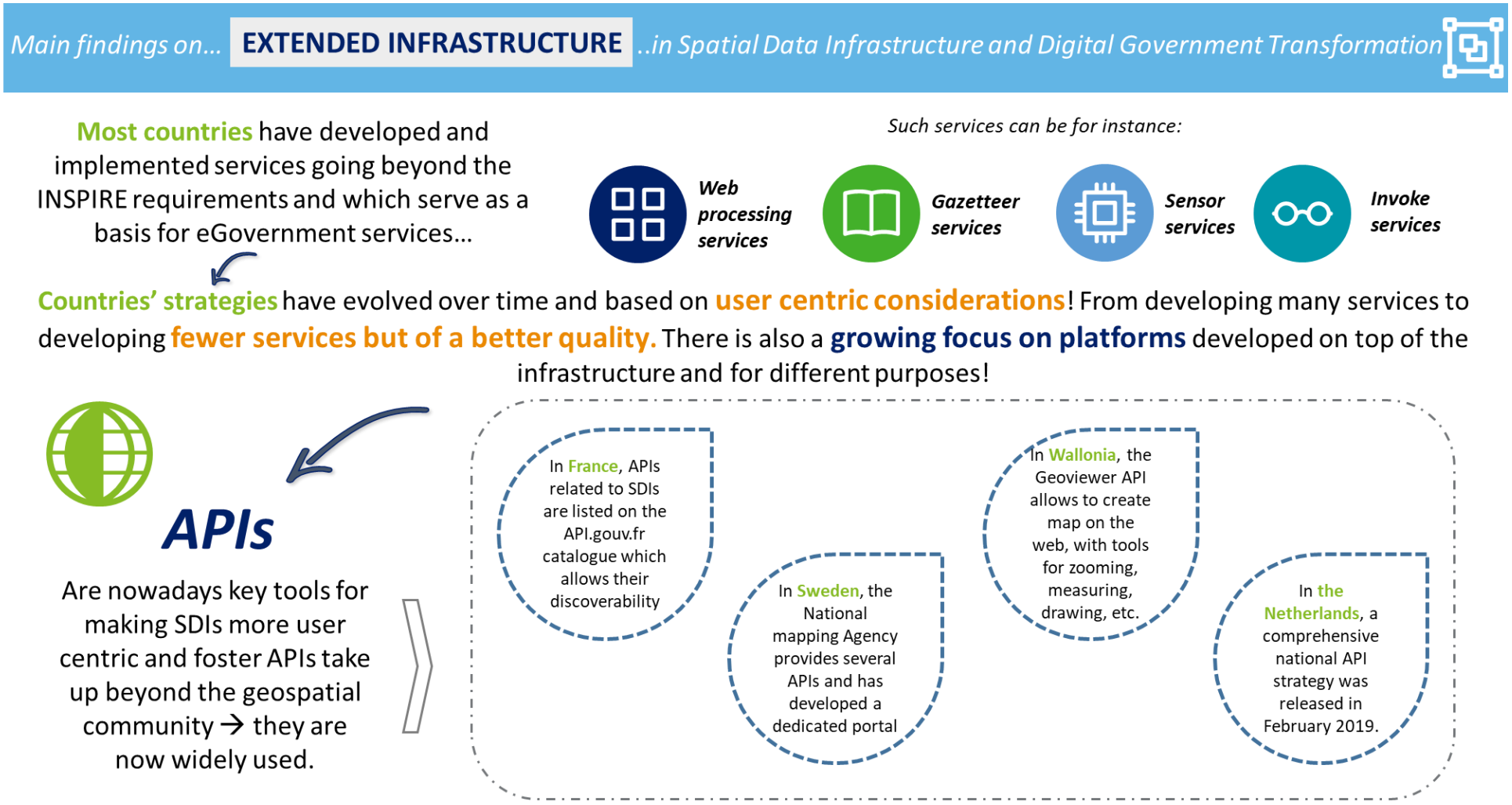
In the past decades, there have been **a lot of efforts** on aligning SDI and Open Data Policies as also shown by the policy scores of the countries in the Open Data Maturity index.



It can be argued that SDI and Open Data policy frameworks are sufficiently aligned in Europe.

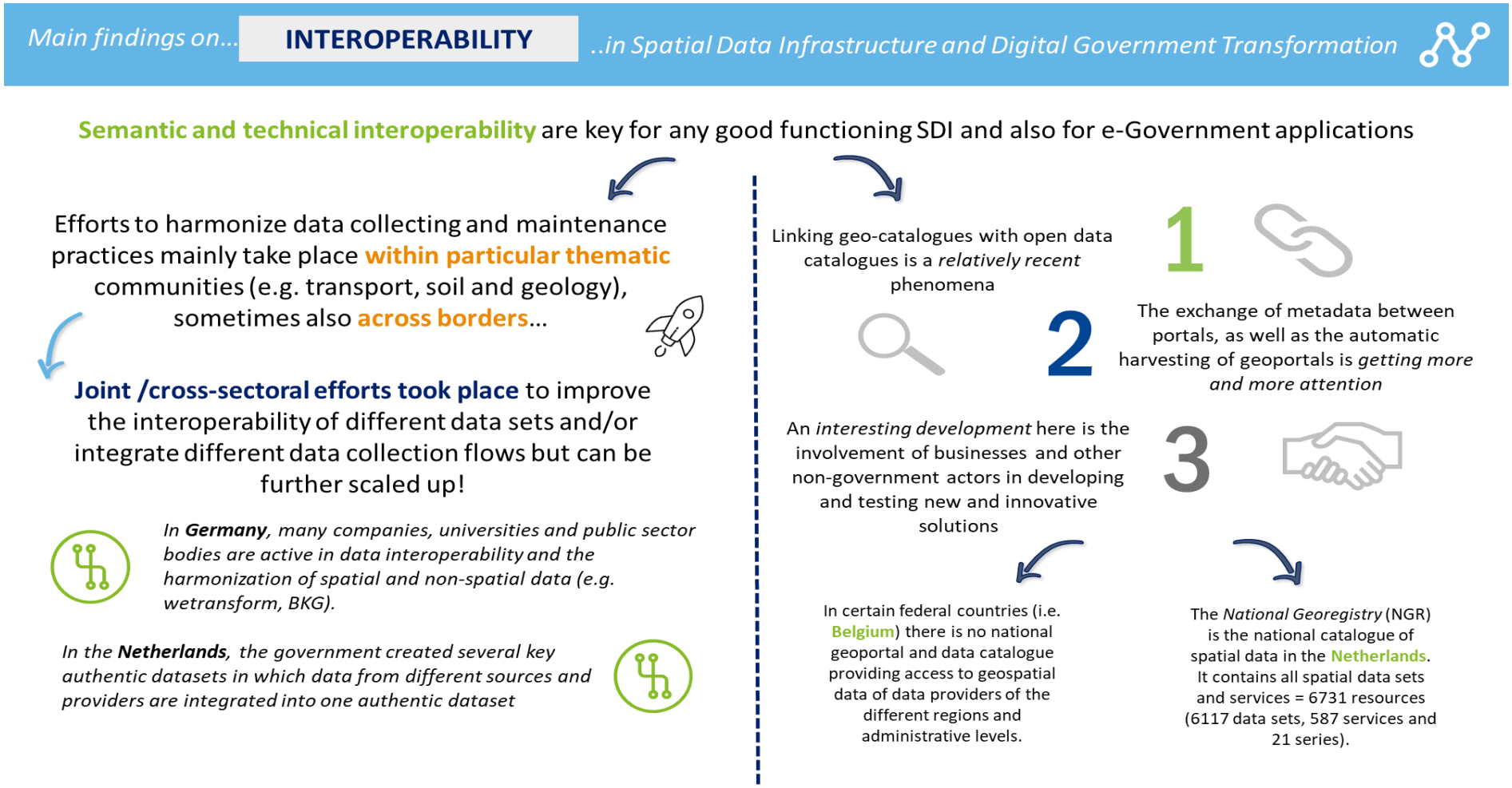
Source: Deloitte and KU Leuven, 2019

Figure 8 – Main findings on extended infrastructure indicators



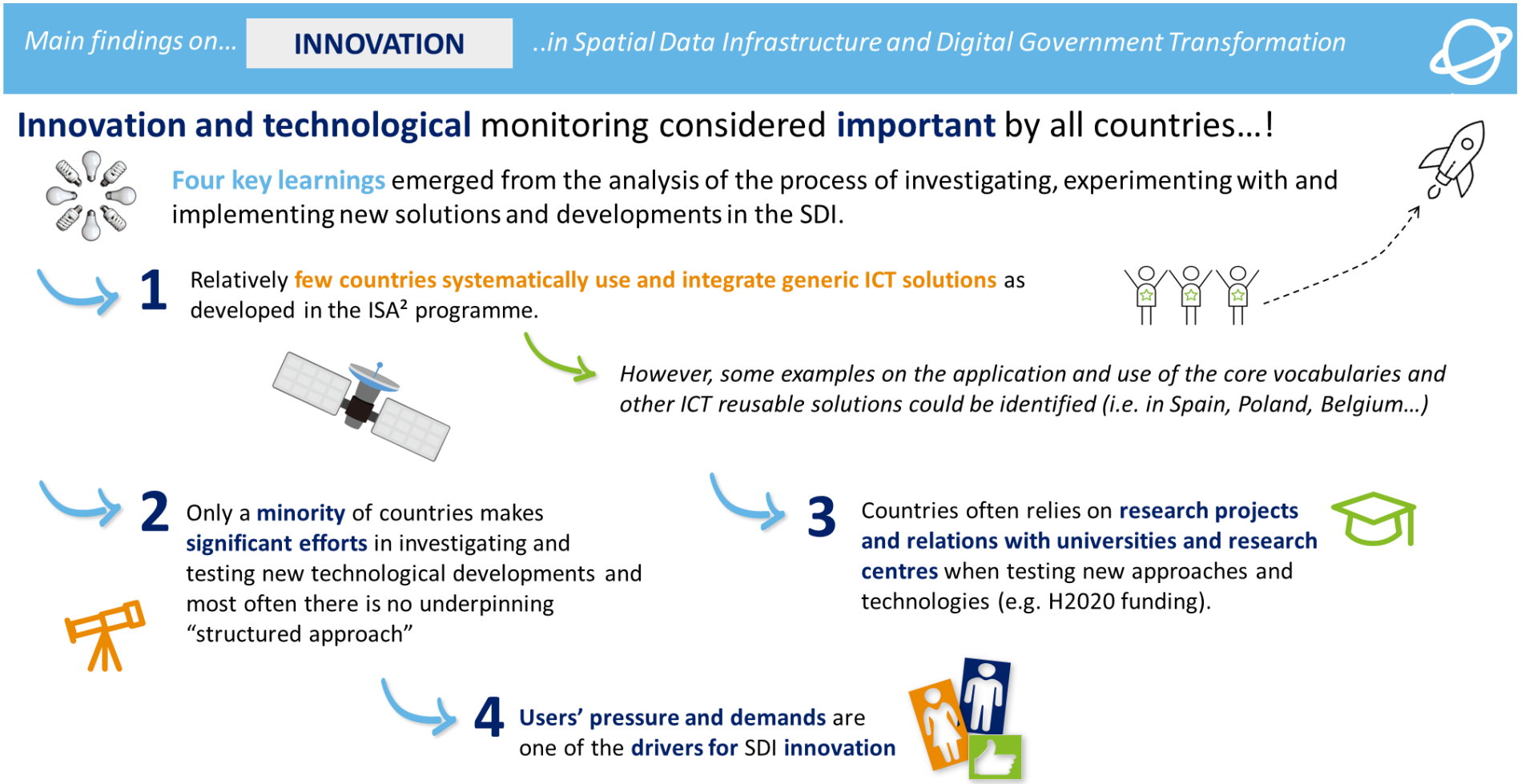
Source: Deloitte and KU Leuven, 2019

Figure 9 - Summary of the main findings for interoperability indicators



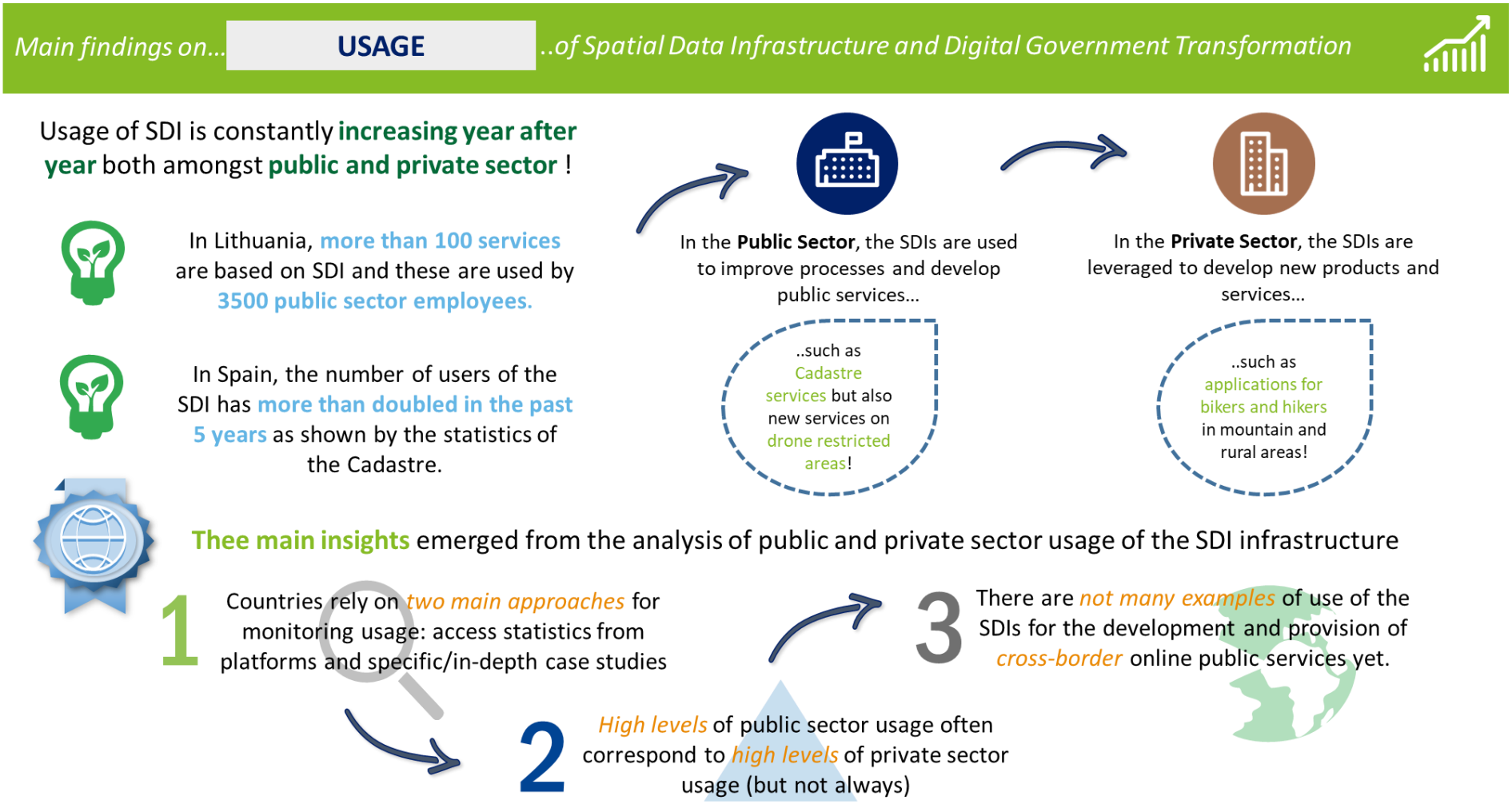
Source: Deloitte and KU Leuven, 2019

Figure 11 – Main findings on innovation indicators



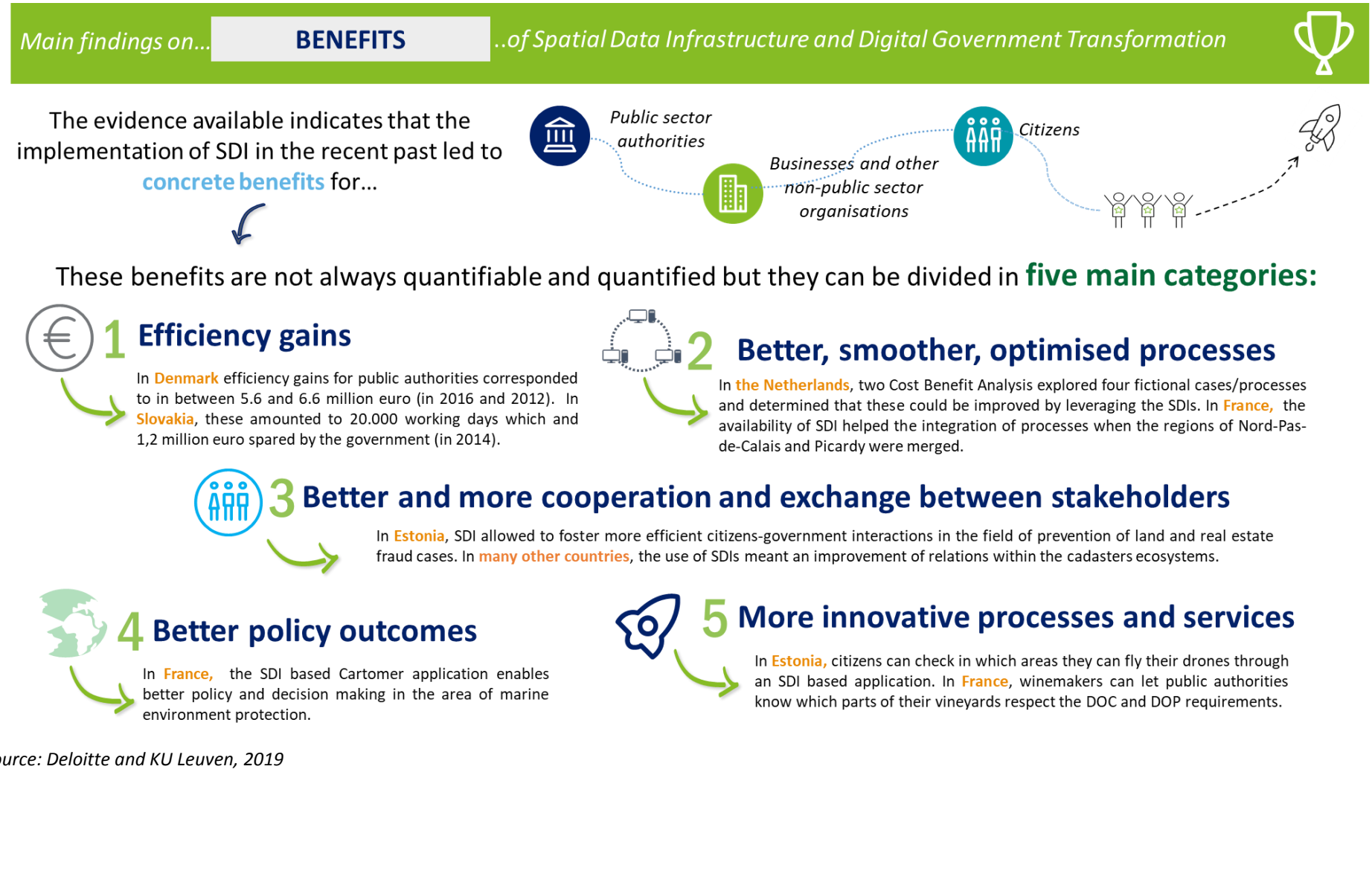
Source: Deloitte and KU Leuven, 2019

Figure 12 – Main findings on usage indicators



Source: Deloitte and KU Leuven, 2019

Figure 13 - Maing findings on benefits indicators



Source: Deloitte and KU Leuven, 2019

Annex 2. Countries' tables

This annex contains a table summarising the main findings for each of the indicators and the four countries analysed in-depth.

Table 13 - Summary of the findings for all indicators and four countries analysed in-depth

	Poland	Spain	Belgium	The Netherlands
A governance structure or mechanism is in place in which different communities, domains, administrative levels and sectors, are involved in decision making on the role of SDI in Digital Transformation.	Separate governance structures are in place for the SDI (Council of the Infrastructure for Spatial Information) and Digital Government (Committee of Council of Ministers on Digital Affairs), and links between SDI and Digital Government communities and their governance recently became weaker after a reorganisation of the competences.	There are three main governance bodies in place for SDI and/or digital government, which are however separated from a governance perspective. In the SDI domain, the main role is played by the Consejo Supérior Geografico (CSG) and in the digital government area by the General Secretary for Digital Administration (SGAD). The governance of the SDI has historically been very open to participation of different stakeholders and players and ensuring high levels of inclusiveness as the example of the Working Group on SDI - GT IDEE shows.	There a separate governance structures in place at different levels and regions (Flanders, Wallonia and Brussels), with overarching national governance, consisting of representatives of the federal and regional levels, focusing strongly on INSPIRE implementation.	There is a strong tradition of collaboration and openness towards private sector, academia and non-governmental organisations, with various consultative bodies and regular consultations.
There is a central organisation responsible for leading and coordinating the implementation of policies on the role of SDI in Digital Transformation.	While there was one central organisation in charge for leading both SDI and Digital Transformation until 2018, the responsibility of leading the SDI recently was shifted to another ministry and there is no central organisation in charge anymore.	SDI and Digital Transformation are managed by different bodies and under the responsibility of different ministries, with the General Secretary for Digital Administration having a strong political mandate for digital government policies.	At the federal level, the NGI takes the role of geobroker to support the dissemination but also the use of geospatial data, and increasingly collaborates with the DG Digital Transformation. Interesting development is the creation of a single agency for Information policy in the Flemish region.	In 2017, all responsibilities and tasks related to data and information were shifted to the Ministry of the Interior and Kingdom Relations. Geonovum is the executive body for the national SDI, and strongly cooperates with other actors and organisation in the IT and digital government domain.
A strategy exists on the role of spatial data and the SDI in Digital Transformation.	There was a strong involvement of SDI stakeholders in the Operational Programme Digital Poland 2014-2020, in which the presentation and provision of spatial data is mentioned as a priority multiple times and as a key area for e-services at the national level.	There is no overarching strategic approach on SDI in the context of digital transformation yet, but some references to location-based information in the Strategy TIC, as well as in the third national action plan for the Open Government Partnership.	Several strategies at the regional level addressing the role of SDI in Digital Transformation, such as the Geospatial Strategy for the Walloon Region and the 'Flanders Radically Digital Programme'. The federal action plan Digital Belgium does not address spatial data in particular, but includes several actions that are extremely relevant to the SDI.	Different strategies on SDI and geospatial in the context of e-government and digital government since the 2008 GIDEON Strategy. The Dutch Agenda Digital Government but also the latest coalition agreement are seen as drivers to the further development of the SDI.
A strategic approach exists on skills and training related to innovative geospatial solutions.	The Operational Programme Digital Poland 2014-2020 sets a vision in terms of training and capacity building also with respect to spatial literacy, while large-scale training and capacity building on the SDI took place between 2011 and 2012. Training activities continue today but at a smaller scale.	There are no formal digital skills plan related to SDI in place, but many different training activities are organised targeting both the public sector but also the general public, with also an online training programme put in place by the NGI.	INSPIRE Tasks and Actors vocabularies used in human resource planning at the federal level, digital skills and knowledge transfer recognized in several regional and federal plans, and various types of training and awareness raising activities being organised in the regions and at the federal level.	Partners in GEO vision recognizes need for training and knowledge exchange on SDI, while training and capacity building is done via regular training and knowledge sessions, but also via online tools such as webinars and WIKIs.
The use of SDI for eGovernment services is mandated/defined by law.	There is no additional legal framework on top of the INSPIRE Directive, but the Operational Programme Digital Poland strongly pushes for the development of SDI-based eGovernment	There is no additional legal framework covering the obligatory use of SDI data and services (on top of the INSPIRE Directive), but the approach taken by the country consists rather in promoting and increasing the use of SDI	Legal framework on SDI mainly consists of transposition of INSPIRE Directive into federal and regional legislation. Strong legal framework in place in Flemish region, with specific legislation on various – authentic – datasets	National system of base registries in place, with specific laws on each base registry. Use of base registries, among which also several 'spatial' registries, is that the use of the registries is

	Poland	Spain	Belgium	The Netherlands
	services.	through awareness raising and developing a high-quality and user-centred SDI.	and types of geographic information, such as large-scale reference data, address data, underground data, etc.	compulsory for the entire public sector.
A well-defined government-wide policy on open data is in place and also applies to geospatial data.	The individual data providers responsible for alignment with open data agenda, through release of their geodata via the open data portal, but no mandatory use of specific licenses.	The country worked on the definition and adoption of a Spanish standard for Open Geographical Data, defining that Open Geographic Information must be available, documented, under an open license and in an open format. Use of standard licenses is promoted, but not obligatory.	Strong alignment between SDI and open data agenda especially at the regional level, and the Flemish and Brussel-Capital Region in particular. At the federal level, several providers of geospatial data make their data available as open data.	Development of the national SDI is strongly in line and linked with the national open data agenda, with Open GeoData Breakthrough project and "Creative Commons, unless" principle demanding the use of Creative Common licenses for geodata. Netherlands in fact has a high level of alignment with the open data agenda and different mechanisms for including non-government actors in the implementation of the SDI.
The SDI goes beyond what a traditional SDI or INSPIRE requires by developing additional components in the infrastructure	Looking at new methods for making SDI data more re-usable, also by non-expert users, e.g. via APIs and good search integrated services. Additional services beyond INSPIRE include metadata validation services, API service, dictionary service and OpenLS service.	Many additional web services on top of the INSPIRE services, also including processing and transformation services. Focus shifted towards provision of – a smaller set of – high quality services (doing less but better).	Significant differences between the administrative levels and regions. At the federal level, new components mainly developed by the DG Digital Transformation, of which applicability in the SDI is further explored.	Development and implementation of various components beyond traditional SDI and INSPIRE, such as provision of linked data, WFS 3.0 and SensorThingsAPI. 'SDI.Next' programme on using new technologies for making geospatial data accessible and usable.
API's have been developed on top of INSPIRE/SDI	Several APIs are already in place, and further upgrades and improvements of the APIs are planned. The Polish geo-portal offers an API allowing users to easily embed maps on their own webpages and to exploit additional functionalities such as finding an address point, zooming in to specific coordinates and adding text information to maps.	Significant efforts to develop APIs, as an approach to enable the use of geospatial data and information by IT developers. Ambition to publish all government APIs on a single platform, but a more coordinated approach is needed, especially between the central and local levels.	At the federal level, the NGI is exploring the use of APIs for supporting other federal organisations in developing applications. The different regions have more experience in setting up APIs, the Flemish region even developed an API strategy.	Establishment of a national 'Knowledge Platform on APIs', with involvement of different organisations and actors through various working groups focusing on particular aspects of APIs. Release of a national API strategy and organisation of competition for the best API implementation in the Netherlands.
Joint efforts have been made to improve the interoperability of reference/core thematic data and/or integrate different data collection flows.	While data providers are considered to be responsible for making their own data interoperable, joint efforts have been done through the creation of key reference datasets, harmonization efforts across administrative levels in particular domains (such as spatial planning) and also through cross-border harmonization initiatives with the Czech Republic, Slovakia and Germany.	Various harmonization and integration efforts exist, with CartoCiudad, the official cartographic database of the Spanish cities and villages, as one of the best practices. Other harmonization efforts focused on geographical names, land use data, etc. while also within several autonomous communities harmonization initiatives took place, not only between different departments but also with local authorities in the region.	Collaboration between federal level and regions on harmonization of data across levels and data providers. Good example is the BeSt Address) project was to create an authentic source of addresses in Belgium, based on the three regional address registers, while similar work is done for building data and administrative units. Also within the regions, particular effort is done on the harmonization and integration of data, with the development of a Flemish URI standard as one example.	Strong efforts on harmonizing and integrating data from different sources, through the creation of authentic datasets integrating data from different sources, but also the integration of various datasets into INSPIRE products. Recent efforts focus on improving interoperability between geospatial and administrative data, through creation of a metamodel for information modelling and the creation of a registry of objects.
There are different platforms, portals and	The national geoportal is the central access point to spatial data and services in Poland, and also contains the official national discovery	A methodology was developed to verify the practical interoperability of geoportals, analysing aspects of interoperability,	Mainly harvesting of data between geoportals and open data portals within the region, but some of these portals also harvest data from	Several data registers and portals in place, and data from the national Georegistry is harvested by the Dutch open data portal data.overheid.nl.

	Poland	Spain	Belgium	The Netherlands
catalogues operational that link to each other and exchange information and other components for stimulating the reuse and uptake of geospatial data.	service, harvesting metadata from the catalogues of many different data providers. Many organisations have their own portal. The national geoportal also contains several applications for browsing, searching and viewing specific – thematic - sets of geodata and services.	accessibility, usability, multilingualism, use of standards, etc. A study on different geoportals in Spain identified more than 100 different geoportals. A separate catalogue has been created for INSPIRE data and services, while the national open data portal harvest data from the national geoportal but also uses the WMS of the geoportal to allow users to view data.	other levels. Currently, the Belgian data portal data.gov.be contains the largest offer of – geospatial – data in Belgium, harvesting data from many different portals.	A recent initiative is the creation of Geoforum, on online platform that aims to establish an active geo-community exchanging not only data, but also knowledge, experiences, etc.
Generic ICT solutions, such as those designed by the ISA/ISA² programme, are (re-)used in the SDI.	Use of re3gistry software and INSPIRE validator.	Use of re3gistry software developed under ELISE action, and added value of other generic solutions of ISA and ISA² programme is recognized and further explored.	Implementation of EU ISA Core Vocabularies in the Flemish Region, where also generic IT aspects such as secure access mechanisms and semantic web solutions are further explored.	Recent attention to adoption of generic ICT solutions in SDI, with secure access mechanisms and core vocabularies currently being further investigated.
A procedure is in place to discover, explore and incorporate new technological features or emerging technologies.	Participation of individual experts in international conferences and other events as important mechanism to learn more about promising developments and technologies.	Strong collaboration with the academic sector – and also private sector – on new technological developments, while new user needs and demands strongly determine new developments and innovations.	Especially strong involvement in national and European research projects, on topics such as flexible geospatial e-services (federal level), using big data for collaborative policy experimentation, harmonization of air quality data and open data for mobility in smart cities (all Flemish region).	Long history of experimenting with and testing of new technologies in collaboration with non-government actors, with pilot projects on 3D geo-informed and linked data, and more recent pilot on spatial data on the web.
Public administrations use consistently SDI to in decision- making and service delivery processes.	Poland pays particular attention to the question of SDI usage which is a priority for the country. The CAPAP initiative aims at increasing the utilization of spatial information by citizens, entrepreneurs and public administration and is currently developing some user-friendly solutions. Already today, the public sector uses SDIs to a large extent and especially in the context of emergency services and police.	The usage of the SDI by public sector in the provision of public services is increasing year after year. For instance, today almost all ministries use web-services and produce web-services built on the SDI and this was surely not the case a few years back. This is due to the quality of the SDI services which are helping to increase the take up within the public sector and across different policy sectors and domains (environment, urban planning, housing etc.)	In Belgium, the various regional and federal SDIs in Belgium are strongly used by public authorities at different administrative levels and in different thematic domains. Especially the Flemish SDI as developed a set of applications and services on top of the SDI that are strongly used by public organisations and other stakeholders in particular domains. Several of these applications and services have been recognized by the e-government community as best practices.	The usage of the SDIs is progressing steadily in the Netherlands. Within the public sector, many use cases of SDIs based services could be identified, in many different domains and for instance transport, housing and environment. City level SDI based services such as the Amsterdam City Dashboard are particularly interesting in this respect and show a good take up of SDI at a local level.
There is a considerable take up of the SDI by private sector and other organisations (e.g. NGOs) for delivery of – new and innovative – applications, products and services.	Usage amongst private sector in Poland is carefully monitored and the trend is very positive. The number of unique accesses and downloads to the Geoportal are in fact constantly growing. The country is also working on improving business usage by lowering barriers to reuse. Polish NGOs also use the SDIs and especially in the environmental sector.	Private sector is an intense consumer of SDI services in Spain and the use of SDI by private companies keeps increasing as proven by available statistics on usage (58% of users of Cadaster datasets are from private sector) and on apps (there is an increase in the cycling apps based on SDIs for instance).	In Belgium and in Flanders in particular, there are many example of private sector usage of the SDI. The impact of the SDI on the private sector in Flanders especially increased when data became available as open data, which could be reused by private companies for developing new services and products. This does not only apply to the geo-ICT sector, but also to other sectors such as the construction and housing industry.	User statistics show that data in the national geo-catalogue are intensively used by private companies, and several applications of the use of the SDI data and services by non-government actors exist. A study by the association of geo-information companies shows the importance of open geospatial data to the sector.

	Poland	Spain	Belgium	The Netherlands
The country uses the SDI in the deployment of cross-border eGovernment services.	The country is involved in many cross-border initiative but none of them goes as far as developing SDI based eGovernment services.	Spain is involved in many different cross-border projects for instance Ideotalex (jointly with Portugal) which is supported by the European Regional Development Fund and provides a cross-border/cross-region SDI with some additional services on top but does not make clear reference to SDI based services as an outcome	The country is very active cross-border and notably on knowledge exchange, setting up SDI components and data harmonisation, which may be interpreted as preliminary steps for further applications developments.	Netherlands is also very active cross-borders and on knowledge exchange, setting up SDI components and data harmonisation. The country is for instance involved with Belgium in the establishment of proximity maps, cross-border information services on commercial sites and property and cross-border crime fighting.
The use of SDI has delivered measurable benefits to public administration	Poland identified the following benefits for public administrations: Increased exchanges and interoperability at the European level which leads to better monitoring and policies (e.g. in the environmental domain). Reduced costs for data integration and improved data management leading to cost savings. Reduced time and costs for planning, analysing and preparing public interventions in many domains including urban planning and environmental protection. Better intra-institutional cooperation and increased awareness on the potential of spatial information at different levels of government	The interviewees have no doubt about the breadth of benefits although these are difficult to quantify. Overall benefits for public administrations linked in particular to increased efficiency, reduction of costs and increased effectiveness. In this respect, studies such as the analysis of socio-economic benefits of SDI in Catalonia, underlined the magnitude of these benefits. The example of the online Cadastre service provided by the INSPIRE Country Report and mentioned during the interviews can also serve as a more recent illustration of the benefits both for the public authorities and the citizens.	In Belgium, the key benefit at national level is the convergence of efforts across regions and the federal level in setting up and maintaining the different SDIs and in assuring different SDIs follow the same structure, quality and level of availability of data. Direct benefits of the SDI are mainly situated at the level of the specific regions and administrative levels. The Brussels administration for instance mainly reported benefits in terms increased awareness on and interest to sharing of spatial data, improvements in the quality and effectiveness of the work of public authorities and increased sharing of data. At the federal level, (potential) benefits are identified at three main levels: the level of the federal administration, the level of the federal users and the level of the European users.	Netherlands carried out several studies on benefits of SDI usage. The latest cost–benefit analysis (2016) demonstrated that three main types of benefits can be distinguished for this country: efficiency gains, quality and reliability gains and acceleration gains. Various efficiency gains are taken into consideration and further investigated: information can be shared, found, processed and reported in a more efficient way, data collection and provision processes can be harmonized and the INSPIRE- approach (including the standard) can be reused. The list of – potential – quality and reliability gains is even longer, and contains 9 different types of gains in total. Acceleration gains refer to gains that are realized faster because of the INSPIRE Directive. These include an acceleration in the Dutch open standards policy, the more rapid implementation of internationally recognized standards and societal benefits that are achieved sooner.
The use of SDI has delivered measurable benefits to businesses, citizens and society more broadly.	In terms of benefits for citizens, the INSPIRE Country Report suggests that they mainly consist in reduced costs and burden for accessing data. This applies to areas such as Cadastre but also to other domains which are less evident such as culture and cultural patrimony. In terms of benefits for businesses, the INSPIRE Country Report lists the following: Interoperability between portals and services;	The example of the online Cadastre service show the qualitative and quantitative benefits of developing SDI based applications in Spain. In the period 2013-2015 more than 33.000 users leveraged these services for a total of 2.782.000 files downloaded and 55 mio of hours spared over these three years. Another example comes from the Ministry of Industry which has developed a portal that allows citizens to find the most convenient petrol station in their area. This portal is visited around 20 million time every year and it allows	An in-depth investigation of the geo-sector in Flanders was undertaken in 2014, which strongly focused on the need for geo-ICT skills and knowledge and less on the impact of the SDI. Benefits to citizens are mainly achieved through the delivery of improved e-services using SDI data, such as the digital building permit or the provision of traffic data. The main benefit of the SDI to businesses is the availability of open geospatial data that can be used to develop new and innovative products	Several studies took place to investigate and measure the benefits of open spatial data, focusing on particular data datasets, such as topographic data and elevation data. Both studies demonstrated that the main impacts of open spatial data were external impacts, with an increased use of the data by companies to develop new applications, products and services.

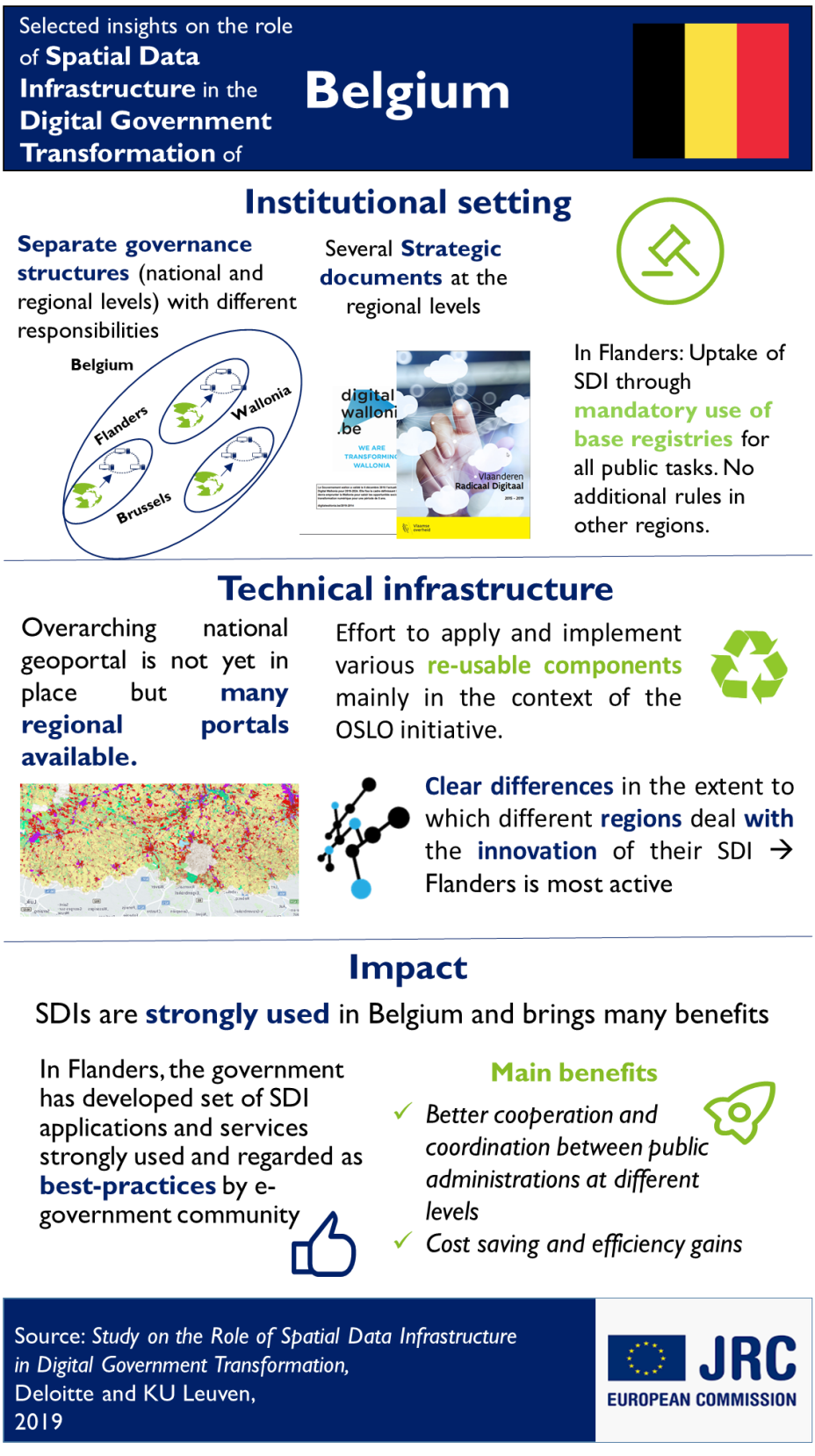
	Poland	Spain	Belgium	The Netherlands
	Increased analytical capacity; Lowered costs of accessing and gathering data.	citizens to spare a total of 60 million euro. Other benefits for non-public stakeholders emerged indirectly from the interviews, such as the possibility for companies to build better quality hiking and cycling apps covering rural areas (see section on usage) or the possibility to create new products and services based on new SDI services (e.g. ortho-mapping of Spain).	and services.	

Annex 3. Selected insights on the four countries analysed in-depth

This annex includes some selected insights on the role of SDI in Digital Government Transformation for the four countries analysed in depth.

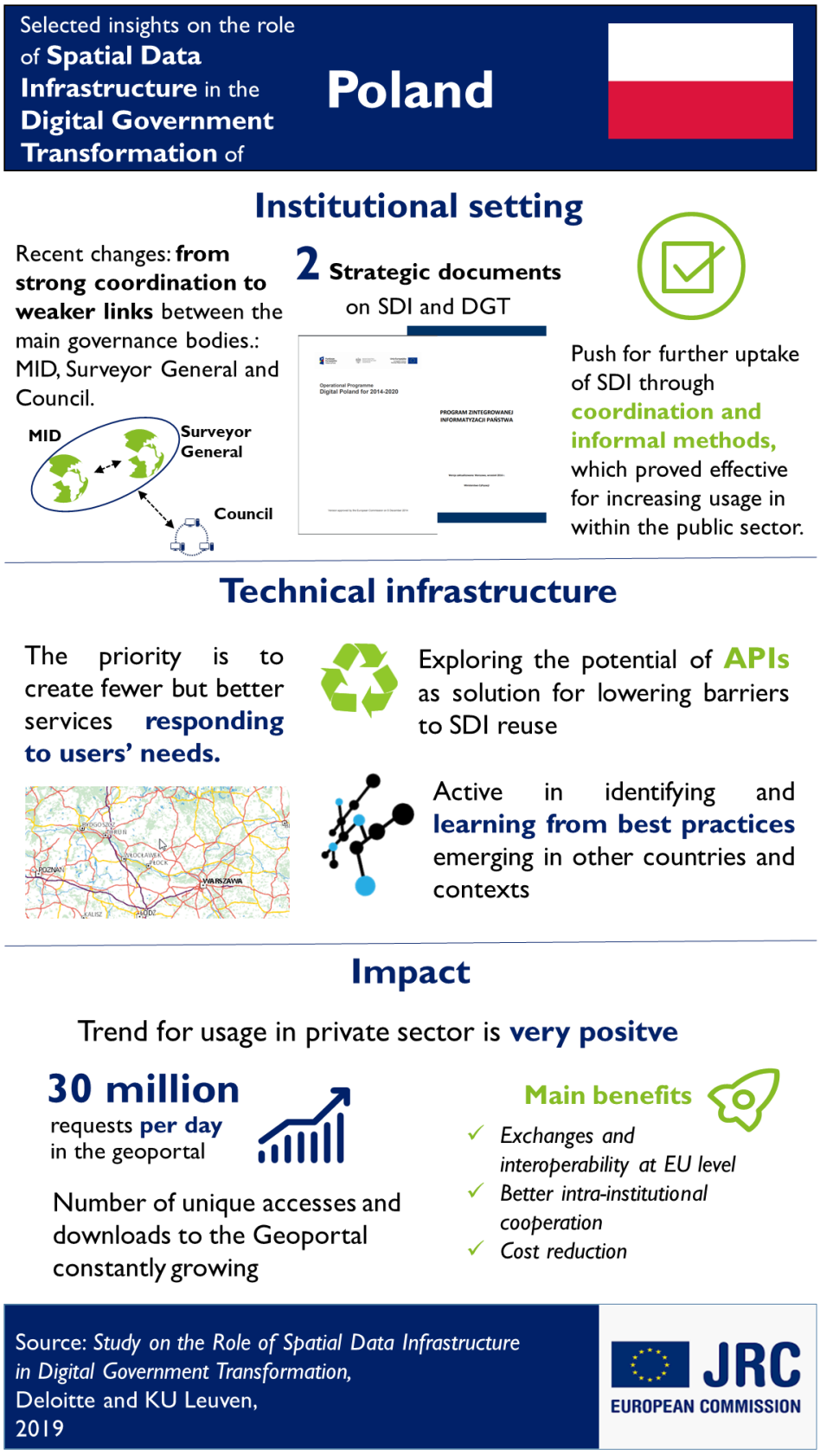
Belgium

Figure 14 – Belgium – selected insights



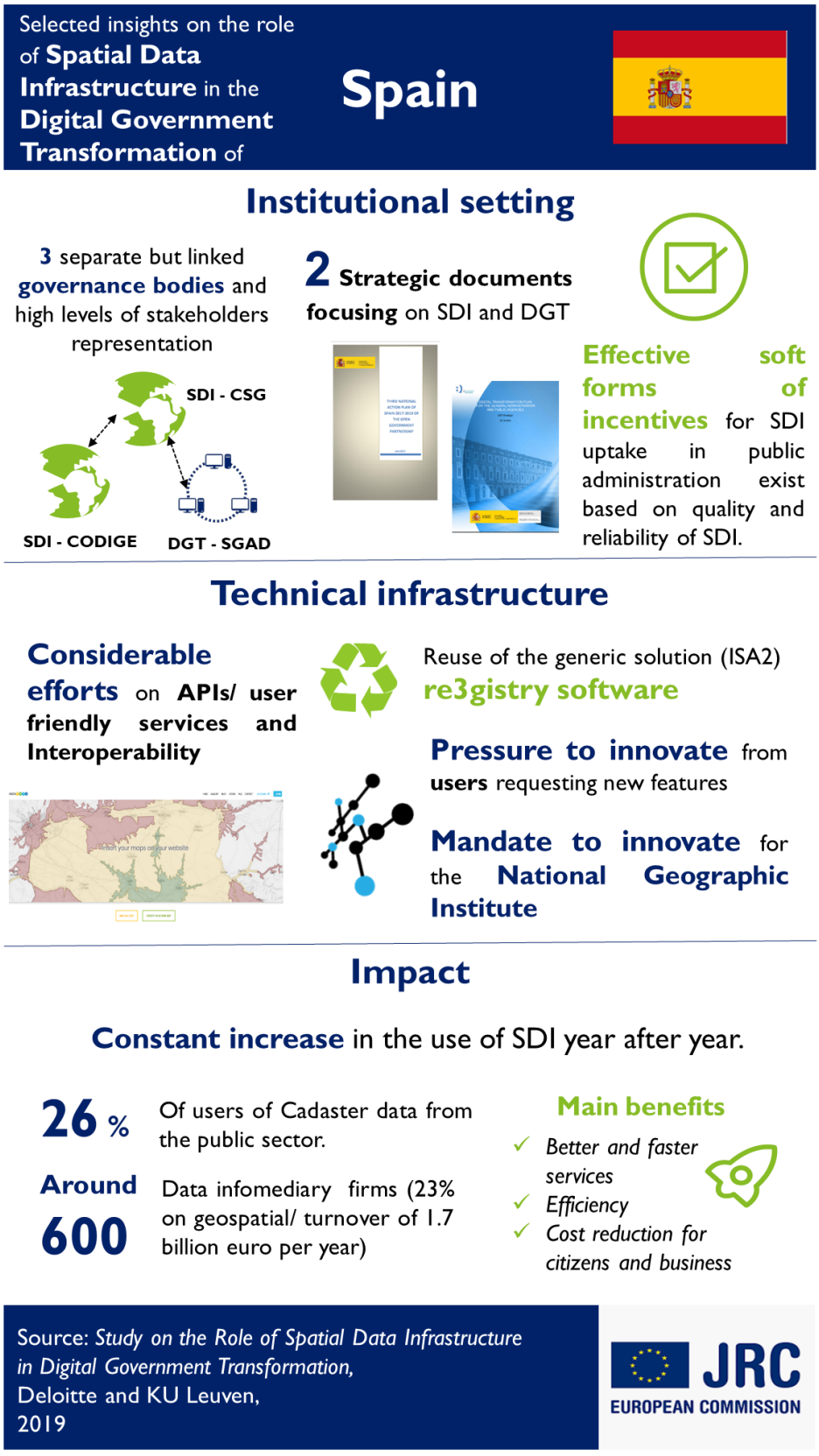
Poland

Figure 15 - Poland – selected insights



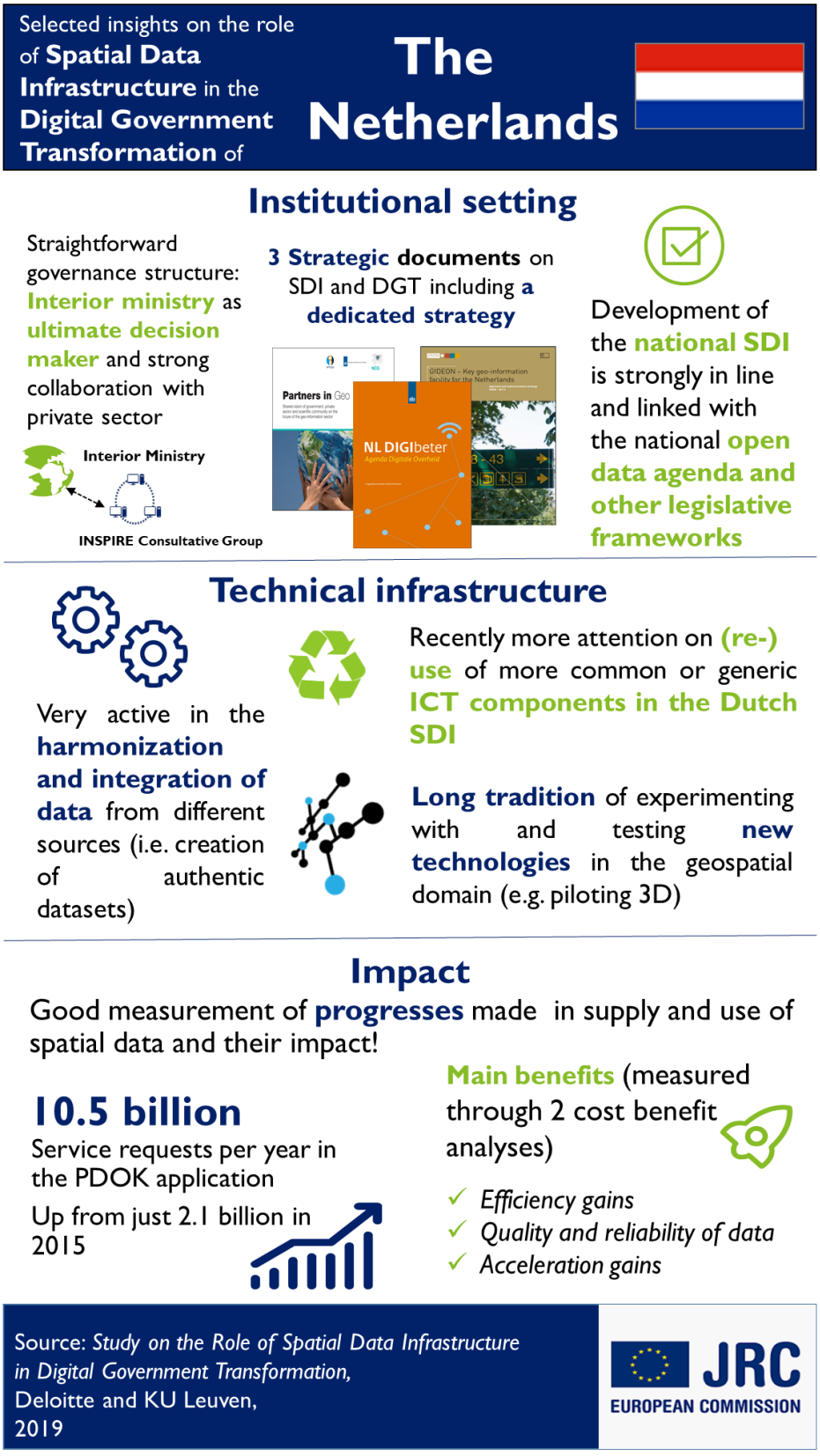
Spain

Figure 16 – Spain – selected insights



The Netherlands

Figure 17 - The Netherlands country factsheets



Annex 4. Analytical framework

This annex further illustrates the analytical framework used for this assignment and provides indications on key aspects for each indicator and scoring guidance.

Table 14 - Indicators on institutional setting (key aspects and scoring guidance)

Group of indicators	Sub-category	Number	Indicator	Key aspects	Scoring guidance
Institutional setting	Governance	1	A governance structure or mechanism is in place in which different communities, domains, administrative levels and sectors, are involved in decision making on the role of SDI in Digital Transformation.	Existence of a joint decision making body Scope and mandate of decision making body Participation in decision making body (different sectors, domains, levels) Existence of other governance and decision making mechanisms (e.g. public consultation)	Low: No or very little joint decision making on SDI in Digital Transformation Medium: Some joint decision making on SDI in Digital Transformation, but not all stakeholders involved High: Strong joint decision making on SDI in Digital Transformation, with involvement of all stakeholders and communities
	Governance	2	There is a central organisation responsible for leading and coordinating the implementation of policies on the role of SDI in Digital Transformation.	Existence of central organisation responsible for SDI coordination Tasks and responsibilities of SDI coordinating organisation (with regard to Digital Transformation Tasks and responsibilities of eGovernment coordination organisation (with regard to geospatial) Collaboration between SDI and eGovernment coordinating organisations	Low: No or very weak central leadership and coordination on actions and policies related to SDI in Digital Transformation Medium: Some central leadership and coordination on actions and policies related to SDI in Digital Transformation High: Strong central leadership and coordination on actions and policies related to SDI in Digital Transformation
	Strategy	3	A strategy exists on the role of spatial data and the SDI in Digital Transformation.	Existence of a national GI/SDI strategy Extent to which national GI/SDI strategy deals with digital transformation Extent to which national eGovernment strategy deals with geospatial	Low: No strategy on SDI and spatial data in Digital Transformation Medium: Some recognition of and attention to the role of SDI and spatial data in Digital Transformation in government strategies High: Overall strategy exist on SDI and spatial data in Digital Transformation
	Strategy	4	A strategic approach exists on	Existence of national strategy on digital skills,	Low: No or very little training and awareness

Group of indicators	Sub-category	Number	Indicator	Key aspects	Scoring guidance
			skills and training related to innovative geospatial solutions.	and geospatial skills in particular Number of training and awareness raising initiatives on geospatial Scope and content of training and awareness raising on geospatial Target audience of training and awareness raising on geospatial	raising on geospatial skills Medium: Some training and awareness raising on geospatial skills exist, but rather ad hoc and with limited scope High: Strong training and awareness raising with particular focus on SDI and geospatial data and its role in Digital Government Transformation
	Legal framework	5	The use of SDI for eGovernment services is mandated/defined by law.	Existence of legislation mandating the use of geospatial data and services Number of geospatial datasets and services for which the use is mandated	Low: No mandatory use of SDI data or services Medium: Mandatory use of some data and services for public tasks and services High: Mandatory use of all key data and services for public tasks and services within a common legal framework
	Legal framework	6	A well-defined government-wide policy on open data is in place and also applies to geospatial data.	Number of geospatial data sets available as open data Recognition of and focus on geospatial data in national open data strategy Level of alignment between geospatial strategy and open data strategy Existence of an 'open by default' approach Use of standard open data licenses	Low: No policy on open geospatial data Medium: Most geospatial data are open, but no overall government-wide policy in place High: Geospatial data 'open by default', as part of government-wide policy on open data

Table 15 - Indicators on technical infrastructure (key aspects and scoring guidance)-

Group of indicators	Sub-category	Number	Indicator	Key aspects	Scoring guidance
Technical infrastructure	Extended infrastructure	1	The SDI goes beyond what a traditional SDI or INSPIRE requires by developing additional components in the infrastructure	Number and types of additional web services beyond the services required by INSPIRE Number and types of registries Existence of other additional components Existence of overall strategy on developing additional components to the SDI	Low: No additional SDI components planned or in place Medium: Some additional SDI components already in place High: Several additional SDI components in place, as part of overall strategy to develop new components
	Extended infrastructure	2	API's have been developed on top of INSPIRE/SDI	Number of APIs on top of SDI/INSPIRE Type of APIs on top of SDI/INSPIRE Existence of strategic approach to the development of APIs Mechanisms to support and coordinate the development of APIs	Low: No APIs planned or in place Medium: Implementation of APIs is planned and/or at least 1 APIs is already in place High: Overall strategy on APIs exist and several APIs are in place
	Interoperability	3	Joint efforts have been made to improve the interoperability of reference/core thematic data and/or integrate different data collection flows.	Efforts to improve interoperability between geospatial and non-geospatial data Efforts to improve interoperability between different thematic data sets Cross-border and cross-regional efforts to improve interoperability of data Efforts to integrate different data collection flows	Low: No efforts to improve interoperability of data Medium: Some efforts to improve interoperability of data High: Strong efforts to improve interoperability of data, between different thematic communities, regions and countries
	Interoperability	4	There are different platforms, portals and catalogues operational that link to each	Existence of approach for harvesting of metadata between different portals/platform	Low: Different portals/platforms exists that are not linked to each other

Group of indicators	Sub-category	Number	Indicator	Key aspects	Scoring guidance
			other and exchange information and other components for stimulating the reuse and uptake of geospatial data.	and catalogues Inclusion of geospatial data in the national open data portal Existence of thematic user-oriented portals/platforms	Medium: Some harvesting of metadata between different portals/platforms, but no overall approach High: Logic and user-oriented approach of harvesting and publishing metadata and data via different portals and platforms
	Innovation	5	Generic ICT solutions, such as those designed by the ISA/ISA^2 programme, are (re-)used in the SDI.	Active involvement and contribution to ISA/ISA^2 activities Number and types of generic ICT solutions re-used in the SDI Status of implementation (exploring, testing, planning, operational, …)	Low: No awareness on or interest in generic solutions under ISA/ISA^2 Medium: Possibility of reusing IS/ISA^2 solutions is investigated, discussed and/or planned High: One or more generic solutions under ISA/ISA^2 have been implemented
	Innovation	6	A procedure is in place to discover, explore and incorporate new technological features or emerging technologies.	Existence of approach for monitoring and discovering new relevant technologies Existence of approach for testing and experimenting with new relevant technologies Number and types of stakeholders involved in these testing and experimenting initiatives Scope of the approach (i.e. which technologies addressed)	Low: No awareness on or interest in new technological developments Medium: More ad-hoc approach to monitoring now developments, with very little testing High: Clear approach to monitoring, testing and upscaling of new technological developments, in collaboration with different stakeholders

Table 16 – Indicators on impacts (key aspects and scoring guidance)

Group of indicators	Sub-category	Number	Indicator	Key aspects	Scoring guidance
Impacts	Usage	1	Public administrations use consistently SDI to in decision-making and service delivery processes.	Awareness about SDI and geospatial data among public officials Number of users of SDI data and services Number of public sector processes and services using SDI data and services Level of integration of SDI data and services in public sector processes (decision making and service delivery)	Low: Geospatial data and services hardly used in government processes Medium: Use of geospatial data and services in some government processes High: Strong use and integration of geospatial data and services in most government decision making and service delivery processes
	Usage	2	There is a considerable take up of the SDI by private sector and other organisations (e.g. NGOs) for delivery of – new and innovative – applications, products and services.	Number of non-government users of SDI data and services Number and types of non-government applications built on top of SDI data and services Number and types of non-government processes and services using SDI data and services Level of integration of SDI data and services in non-government processes	Low: Geospatial data and services hardly used by non-government actors and organisations Medium: Some use of geospatial data by non-government actors and organisations High: Strong use of geospatial data by various types of non-government actors and organisations
	Usage	3	The country uses the SDI in the deployment of cross-border eGovernment services.	Number and types of cross-border eGovernment services using SDI data and services Level of integration of SDI data and services in cross-border processes and services	Low: No use of geospatial data and services in cross-border e-government services Medium: Some use of geospatial data and services in cross-border e-government services

Group of indicators	Sub-category	Number	Indicator	Key aspects	Scoring guidance
					High: Use of geospatial data and services in multiple cross-border e-government services
	Benefits	4	The use of SDI has delivered measurable benefits to public administration	Benefits of SDIs to decision making in the public sector Benefits of SDIs to service delivery in the public sector Benefits of SDIs to overall functioning of the public sector	Low: No evidence of benefits of SDIs to public administration Medium: Some evidence – mainly qualitative - of benefits of SDIs to public administration High: Strong evidence – qualitative and quantitative - of benefits of SDIs to public administration, both in terms of decision making and service delivery
	Benefits	5	The use of SDI has delivered measurable benefits to businesses, citizens and society more broadly.	Benefits of SDIs to businesses (productivity gains, efficiency gains, growth, innovation, etc.) Benefits of SDIs to citizens Overall socio-economic benefits of SDIs	Low: No evidence of benefits of SDIs to non-government actors and organisations Medium: Some evidence – mainly qualitative - of benefits of SDIs to non-government actors and organisations High: Strong evidence – qualitative and quantitative - of benefits of SDIs to non-government actors and organisations

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