

Analytical Report n17



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FROM REGULATION TO ADOPTION: THE DRIVERS OF DATA SHARING

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Executive Summary

Data sharing and re-use have been at the crux of European policy for more than two decades now. The European data market has been estimated in EUR 59.5 billion in 2016 and overall value growth from EUR 247 billion in 2013 to almost EUR 300 billion in 2016. As a result, it has been the protagonist of different European policy activities trying to deliver the promises of such a growing and increasingly valuable market where studies have predicted a compound annual growth rate of 15.7% since 2016.

A heterogeneous package of European policy measures that seek to generate a European data market and facilitate data flows within and across sectors in Europe have been pursued (European Commission, 2020). These measures can be divided into **open data** and **data sharing measures**; that is provisions for opening up data indiscriminately and thus promoting minimum restrictions and costs to access to data (open data); or provisions for ensuring access to specific entities to data (*data sharing*). As opposed to open data, data sharing is defined by the provision of restricted data to restricted entities (organisations or individuals). For both cases, regulatory and non-regulatory measures have been adopted, with different rates of success.

The overall results of such policy initiatives are uneven, and the implementation has proven challenging. Ultimately, what emerges from the uneven compliance and the different efficacy of the policy measures is that **regulation is not enough to induce data opening and sharing**.

To explore the factors behind governmental compliance towards data sharing and open data regulation, the present study implements a comparative analysis of:

1. The different commitment to **open data** at the sub-national level (i.e. local government) where similar municipalities in their region of Lombardia (Italy) diverge in their actions towards open data; and
2. The different commitment towards **data sharing** by two comparable public agencies in the Oil and Gas industry in two different countries: The Netherlands and Norway.

The results show that for the **open data** domain, economic incentives, coordination with business suppliers and policy leadership accompanied with technical guidance explained the decision of Italian municipalities in Lombardia - and in particular for the smallest ones in terms of population - to open up their data. Besides such regional programme support, which was instrumental, the case of Pavia also powerfully shows the virtuous cycle between civil servant enthusiasm for publishing data, the impact on the quality of data, services being developed, and thus the effect on data re-use.

Regarding **data sharing**, with the comparative analysis of data sharing approaches in the Oil and Gas sector in the Netherlands and Norway, we realise the significant weight of government role in incentivising and orchestrating data sharing in the country. In both countries, whether by making subsurface data available with the support of a public legal arm of government such as TNO, or whether as a founder and partner of a joint venture such as DISKOS with the oil and gas companies, the role of government is significant to make data sharing possible. The government role is crucial to mitigate such risks that companies fear to share valuable datasets and generate settings where organisations feel comfortable sharing with appropriate governance structures, contractual agreements and security standards that do not violate their legitimate private and commercial interests.

However, the Netherlands and Norway follow two different governmental approaches to incentivise data sharing. The Netherlands makes it openly available (almost open data after an embargo period of data); and Norway follows a more nuanced approach, legitimising closed data at some points within the DISKOS collaboration where the government takes part of a joint venture with the oil and gas companies to be closer to the operations and to be one party in the discussion about how to coordinate data flow across the organisations.

The analysis of the cases reflects that the willingness of the governments to make the data openly available is to give their territory a competitive advantage towards other areas with oil and gas worldwide. Yet, there is a trade-off between attracting potential investors and newcomers and protecting the competitive interests of the licensees. As a result, whether a more open data approach or a more restricted approach towards data sharing is taken, both need to find an **optimal period of data embargo**. This time dilation in the release of the data has the ability to give enough competitive advantage to the generators of the data. However, the government needs to manage this secrecy requirement with the timely necessity to release the data to attract new companies to explore and drill but also to provide transparency and monitor the national resource management.

In sum, the analysis of cases is inspirational to provide some mechanisms that can drive the implementation of regulatory measures at the EU level, fostering open data and data sharing by factoring in some incentive aspects that need to be overcome in the implementation phase of such measures at the different administrative levels. The delicate equilibrium of competing forces is orchestrated across the case analysis by heterogeneous governmental actions that together constitute some of the *conditions* to allow opening up or sharing data. While the mechanisms identified are embedded in their national and local contexts, they allow for some extrapolation at the EU level and are able to inform future implementations of INSPIRE and Open Data Directive.

Introduction

Data sharing and re-use have been at the crux of European policy for more than two decades now. The benefits of data sharing and re-use have been acknowledged for some time now and have been actively pursued in the context of the Digital Single Market and in policies encompassing different sectors such as government, academia and business. The European data market has been estimated in EUR 59.5 billion in 2016 and overall value growth from EUR 247 billion in 2013 to almost EUR 300 billion in 2016. As a result, it has been the protagonist of different European policy activities trying to deliver the promises of such a growing and increasingly valuable market where studies have predicted a compound annual growth rate of 15.7% since 2016.¹ The forecasts for the global volume of data generated are growing from 33 zettabytes² in 2018 to an expected 175 zettabytes in 2025, with an estimated growth of 100% every 18 months.

Besides the actual and predicted economic impact, data plays a crucial role in governmental policies as it helps to manage the current resource and address great societal challenges such as public health as we saw in COVID crisis and other epidemic outbreaks, but also climate change, and wellbeing, amongst others. Acknowledging the importance and benefits of data, the European strategy for data³ stresses the importance that a wide flow of data across organisations needs to be accompanied by high levels of privacy, security, safety and ethical standards.

A heterogeneous package of European policy measures that seek to generate a European data market and facilitate data flows within and across sectors in Europe have been pursued (European Commission, 2020). These measures can be divided into provisions for opening up data indiscriminately i.e. **open data**, that is promoting minimum restrictions and costs to access to data; or for ensuring access to specific entities i.e. **data sharing**. Regulatory and non-regulatory measures have been adopted with different rates of success (see summary table 1).

While most of the government initiatives focus on enabling open access to and sharing of public sector data – almost 65% according to OECD (2019) – only some (around 15% according to the same source) are devoted towards facilitating data sharing within the public sector. Open data is the most prominent approach to foster access to data, especially for governmental owned data. In this direction, in 2019 the **Open Data Directive**⁴ appears to provide a common framework for the European market for government-held data to foster publicly funded data re-usable – i.e. public sector information - and replaces **Public Sector Information Directive**.⁵ The Open Data Directive was born after some studies pointed out problems relating to lack of public data re-usability due to several problems including Market entry barriers, a lack of publicly funded data in a significant number of domains and distortion of competition due to exclusive agreement practices.⁶

When it comes to data sharing, there is an evident trend towards promoting data sharing within the public sector. One of the reasons behind this is that governments are increasingly becoming more data-driven and

¹ IDC (2017), SMART 2013/0063 European Data Market, <https://ec.europa.eu/digital-single-market/en/news/final-results-european-data-market-study-measuring-size-and-trends-eu-data-economy>

² A zettabyte is one sextillion (one [long scale](#) trillion) bytes

³ Communication from the Commission to the European Parliament, the Council, the European Economic, and Social Committee and the Committee of the Regions, A European strategy for data, 2020, https://ec.europa.eu/info/sites/info/files/communication-european-strategy-data-19feb2020_en.pdf

⁴ Directive (EU) 2019/1024 of the European Parliament and of the Council of 20 June 2019 on open data and the re-use of public sector information, <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1561563110433&uri=CELEX:32019L1024>

⁵ 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%3A32003L0098>

⁶ Deloitte, Open Evidence, Wik Consult, Timelex, Spark, The Lisbon Council (2018), Study to support the review of Directive 2003/98/EC on the re-use of public sector information, <https://ec.europa.eu/digital-single-market/en/news/impact-assessment-support-study-revision-public-sector-information-directive>

take advantage of technological trends exploiting the data analytical potential. Some examples include the UK's Data Ethics Framework and Centre for Data Ethics and innovation or further away In Australia DS&R legislation regarding data-sharing and release legislation. In the same direction, the **INSPIRE**⁷ directive came into force on 15 May 2007 with a roadmap and a set of implementation stages that span until 2021. INSPIRE seeks to generate a European spatial data infrastructure for European environmental policies. This infrastructure seeks to facilitate data sharing related to environmental information among public sector organisations, public access to spatial data across Europe and support the different policy-making activities across boundaries that rely on such data. INSPIRE is operated by the EU Member States and addresses 34 spatial data themes required for environmental applications.

Regarding governmental initiatives to foster data sharing within the business, they are the least present amongst all policy initiatives promoting data sharing. These data initiatives include policies fostering data sharing between business and government (B2G) with an emphasis on 'data of public interest'; and within network industries (e.g. transportation and energies) to guarantee interoperability of smart services. Table 1 below provides an overview of major European policy initiatives.

TABLE 1: EUROPEAN POLICY MEASURES TO FOSTER DATA SHARING AND OPEN DATA

	Data Sharing	Open data
Government	INSPIRE ⁸	PSI directive ⁹ Directive on open data and the re-use of public sector information June 2019 ¹⁰
Academia		OECD recommendations Communication on scientific data PSI revision ¹¹ Funding agencies open data mandate e.g. H2020 ¹²
Business	Communication February 2020: "Towards a common European data space" ¹³ B2G Data Sharing expert group ¹⁴ Guidance on sharing private sector data in B2B and B2G contexts ¹⁵ PSD2 directive ¹⁶	

⁷ About Inspire: <https://inspire.ec.europa.eu/>

⁸ About Inspire: <https://inspire.ec.europa.eu/>

⁹ PSI directive: <https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32003L0098>

¹⁰ Directive on open data and the re-use of public sector information June 2019: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L1024&from=EN>

¹¹ PSI revision: <https://ec.europa.eu/digital-single-market/en/public-sector-information-psi-directive-open-data-directive>

¹² Guidelines to the Rules on Open Access to Scientific Publications and Open Access to Research Data in Horizon 2020: https://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-pilot-guide_en.pdf

¹³ Communication February 2020 *Towards a common European data space*: <https://ec.europa.eu/digital-single-market/en/news/communication-towards-common-european-data-space>

¹⁴ B2G Data Sharing expert group: <https://ec.europa.eu/digital-single-market/en/news/meetings-expert-group-business-government-data-sharing>

¹⁵ Guidance on sharing private sector data in B2B and B2G contexts. <https://ec.europa.eu/digital-single-market/en/guidance-private-sector-data-sharing>

¹⁶ About PSD2 directive: https://ec.europa.eu/info/law/payment-services-psd-2-directive-eu-2015-2366_en

The overall results of such policy initiatives are uneven and the implementation has proven challenging. When it comes to government, the INSPIRE directive fell short of expectations in making government agencies share their data (Cetl et al., 2017). In terms of open data, in the implementation of the PSI Directive several EU Member States and regions have introduced local regulations that encounter unequal uptake (Moretti et al., 2018). In the scientific domain, surveys repeatedly show that scientist do not share data often (if they do they typically do not do it in the recommended FAIR¹⁷ data model) and that funding agencies regulation are not an effective driver (Berghmans et al., 2017). When it comes to the private sector, companies are reluctant to share data (Pujol et al., 2016) and the newly released PSD2 regulation encounters resistance from the point of view of banks in releasing their data (Tink, 2019). Moreover, the more detailed and cumbersome the data standard recommended, the less likely organisations are to share data.

Ultimately, what emerges from the uneven compliance and the different efficacy of the policy measures is that **regulation is not sufficient to induce data opening and sharing**. Why some regulations are fully implemented, and others do not achieve the same result? This context reveals other explanatory factors and mechanisms that come into play to foster data sharing and open data notably, such as incentives and community building. As such, the key question that remains is:

What are the current levers that can convince ‘data holders’ – that is the organisations or individuals that collect or generate the data – to share or open up their data? What are the actual and perceived benefits for data holders to share and open up their data? Ultimately, what are the factors that drive compliance with regulation, besides the regulation itself?

Considering the uneven patterns observed in terms of data openness across governmental bodies, despite a common data regulation, the present study seeks to shed light on the potential drivers present behind governmental bodies to comply with the regulatory mandate and effectively share and open up their data. While the focus of the analysis remains the governmental arena, the findings seek to be insightful for other sectors too. Essentially, analysing public undertakings can be of utility to understand how other conditions (e.g. an alternative to regulation) shapes data openness.

While reports exploring the motivations of opening up data are abundant, most of them focus on pioneers in data sharing and as such incorporate highly motivated data holders. These reports do not say much about how to foster data sharing in those less motivated even to comply with directives and regulations. In other words, we lack an understanding of how to scale up data sharing and open data by shedding light on **what drives adoption and compliance of regulation**.

Compliance has been treated as a *black box*, driven exclusively by enforcement mechanisms employing sanctions (*the stick*). But in reality, most regulations in this domain do not have effective sanctions, or at least they are not the main driver of compliance. In particular for data sharing, where the quality of data often matters more than the quantity, reluctant compliance is not sufficient. Hence: Which are the key factors that ensure full implementation of the regulation on data sharing and open data, on top of coercive measures? Why do some agencies comply, and some do not? What could be done to address this “implementation gap”?

This report aims at identifying the factors (*the carrots*) that drive or hinder adoption in the presence of overarching regulation, besides pure compliance. Based on our previous studies and conversations with stakeholders, we anticipate some hypothetical factors that the current study will explore:

- Reuse and adoption: Seeing results from data sharing and the opening is certainly an incentive.
- Leadership: The existence of a personal and political commitment by "enlightened" decision-makers.
- Alignment with overarching policy mandate: if the overarching institution and implementing institutions pertain to similar political party or orientation.
- Staff motivation: the existence of advocates for data sharing inside the institution.
- Monetary incentives to organisations.

¹⁷ FAIR Guiding Principles for scientific data management and stewardship:

<https://www.nature.com/articles/sdata201618>

- Monetary incentives to civil servants.
- Alignment with strategic priorities of the body.
- Demand from stakeholders, notable re-users.
- Virtuous competition with other entities in terms of recognition as a leader in “open government”.

To explore the factors behind governmental compliance towards data sharing and open data regulation, the present study will implement a comparative analysis of:

1. The different commitment to **open data** at the subnational level (i.e. local government) where similar municipalities diverge in their actions towards open data.
2. The different commitment to **data sharing** by two comparable public agencies. Section four will provide an explanation of the sampling strategy and research approach followed.

The remainder of the study is structured as follows: First, we provide a review of previous studies reveal about the governmental and public incentives towards open data and data sharing. Second, we describe the research approach to the present study. Section 5 describes the case studies selected and provides a cross-analysis of the cases and discuss the results from the comparative exercise. Finally, we conclude and provide some policy recommendations for future action.

Review of Incentives to Open Data and Data Sharing

Governments gather data on a daily basis when citizens and private organisations data conduct transactions with government agencies ([Alexopoulos et al., 2014](#); [Vieira and Alvaro, 2018](#)). Especially considering that governments are progressively transforming into e-governments delivering their services online with the support of Information and Communication Technologies (ICT) and increasing participation of organisations and citizens in online transactions with their governments generate more data every day. Other terms such as open government data or open public data or public sector information are drawing the landscape of public data. Making such data open means making “machine-readable data (which is) discoverable, available, and downloadable through dedicated internet portals without cost to potential data users” ([Dawes et al., 2016](#), p. 15).

A review of the literature suggests that the rationale behind the government's decisions to open up some of the different and heterogeneous datasets that they possess responds to the intention to create social value and foster innovation gains towards companies that can re-use the data for new products and services. Between such benefits, opening up governmental data is known to stimulate innovation through collaboration between the data potential users (i.e. businesses, citizens, or software developers) and the data holders, that is the government ([Verhulst and Young, 2016](#)). Besides an 'economic rationale,' there is also an intention to comply with transparency mandates, where governments use data to comply with accountability that they need to provide to society and industry about their resources management and the impact of their interventions and activities.

Finally beyond the self-motivations of public authorities to give access to public data to the society at large, governments themselves also play a major role in encouraging and facilitating data access and sharing through different policy actions and governance frameworks at different policy levels. As such, the present study plays special attention on how national and local policy levels incorporate European mandates and manage the complex system of incentives preventing organisations to share their data and make it available in a way that can be easily re-used by others.

Research approach

The research strategy was to identify cases for data-sharing and open data implementation that vary in behaviour in response to the same regulatory measure at the European level, whether PSI for open data or INSPIRE for data sharing but similar in a set of parameters. The goal was to isolate the key factors at play in determining the decision to implement the open data or data sharing regulation.

Sampling strategy

Regarding **open data**, the **Region of Lombardia (Italy)** was selected as a contextual setting to analyse the different behaviours of the municipalities towards opening-up their public data or not, meaning whether municipalities decide to make accessible their public data for re-use. Based on desk research and after an exploratory phase where the researchers carried some exploratory interviews and conversations with policymakers in charge of the open data agenda across Europe, this region was selected for being *revealing* as it offered **high variance** of local implementations and non-implementations of open data (i.e. adopters and non-adopters) despite regional policies transposing national priorities towards open data. Additionally, the region provided a unique and private dataset that allowed the research team to **assess open data policies of their 1,507 municipalities**.

The analysis sought to find patterns across municipalities with *similar* socio-economic characteristics (i.e. region, population, demographics, etc.), while their attitude towards opening up their data *differs*. More concretely, we sought to understand the enabling conditions and incentives to open up public data, while remaining constant a) the transposition of EU regulation towards open data (same country), b) size of the municipality, c) region, and d) demographic characteristics. The goal was to understand better the enabling conditions and the incentives to data sharing in order to complement hard regulation.

Regarding **data-sharing**, we selected **two public agencies approaches towards data-sharing in the Oil and Gas sector: Netherlands and Norway**. Following a purposeful sampling strategy, we sought that the following parameters remain constant: a) sector, and b) the type of data holder (public agencies). One varying-parameter was introduced: c) the country to assess *different national implementations and approaches* towards data sharing. The disparity of approaches allows investigating the different mechanisms that were put in place to incentivise data sharing in the oil and gas sector and how data flows were governed.

Data sources and analysis

The data sources employed for the analysis of cases were:

Desk research: A review of the literature on open data and data sharing across different sectors has been carried out. In addition, for the case study, background desk research has been implemented on both policy instruments, namely to analyse existing evaluations.

Field research: The field research focused on a set of exploratory semi-structured interviews focusing on the main factors behind the decision to comply or not with the regulation: the two proposed regulations are the INSPIRE directive and the Lombardy region open data strategy.

TABLE 2: DATA SOURCES

	Open Data	Data-Sharing
Primary data	Interview Region Lombardia (O1) Interview Municipality Pavia (O2)	Interview Netherlands agency (D1) Interview Expert Norway (D2)
Secondary data	Extensive background literature on Open Data policies in Italy. Database with participation details to the regional plan.	Extensive background literature on Norway and Netherlands subsurface data management policies and approaches.

Synthesis memos were generated after the interview and were compared with the existing literature on incentives towards opening up and sharing data. Discussions amongst the study team were held in an iterative manner to build a common understanding of the drivers in the different cases to share and mechanisms to put in place to make data-sharing or opening-up data possible. The study performed respondent validation by sharing with the interviewees the preliminary findings of the study in order to gather further feedback and refine the results.

Case studies description

Open data: local adoption of open data in Lombardia in Italy

In 2011, Italy launched dati.gov.it and became a member of the Open Government Partnership,¹⁸ to work with civil society and other public administrations in the generation of two-year action plans with concrete commitments in different application domains (e.g. more than 4000 commitments globally at present). Since 2011, relevant actions have been put in place in the open data arena by Italy, including the release of the guidelines for the semantic interoperability through linked open data in 2012; the modification of the article 52 in the Codice di Amministrazione Digitale (Code for the Digital Administration) introducing the principle of 'Open by default'; or the elaboration of the Italian National Open Data Agenda in 2013 led by the Agency for Digital Italy (AgID) and the introduction of the guidelines for the public sector information which were finally published in 2014. Also, later in June 2014, a new version of the portal dati.gov.it was released. Different Italian open data initiatives have been launched including e.g. OpenParlamento,¹⁹ OpenCoesione,²⁰ OpenBilanci,²¹ OpenExpo²² and Confiscati bene,²³ amongst others.

Background: PSI and the Open data directive

The European Public Sector Information (PSI) started thirty years ago when EC produced the Guidelines for improving the synergy between public and private sectors in the information market²⁴ in 1989. It described the "potential resulting from the combination of information from a variety of government sources in view of producing and distributing information products oriented to the needs of the market". Thirty years later, the same policy message still keeps being relevant and guides new policy activities to grasp the economic potential of public sector data for growth and competitiveness.²⁵ After different studies on the data economy, the role of PSI has been increasingly highlighted.

The first version of PSI was adopted in 2003²⁶ and sought to facilitate the re-use of PSI in Europe by harmonising the conditions under which PSI is made available to foster the emergence of new products and services based on public data. Several studies have tried to capture the economic impact of PSI (e.g. MICUS²⁷, Vickery²⁸ or POPSIS²⁹). In 2013, the EC launched a revised version of the PSI Directive³⁰ that extends the scope

¹⁸ <https://www.opengovpartnership.org/>

¹⁹ <https://parlamento17.openpolis.it/>

²⁰ <https://opencoessione.gov.it/it/>

²¹ <https://openbilanci.it/>

²² <http://dati.openexpo2015.it/it>

²³ <https://www.confiscatibene.it/>

²⁴ Guidelines for improving the synergy between public and private sectors in the information market, <https://ec.europa.eu/digital-single-market/en/news/guidelines-improving-synergy-between-public-and-private-sectors-information-market>

²⁵ Commission Staff Working Document Evaluation, Accompanying the document, Proposal for a Directive of the European Parliament and of the Council on the re-use of public sector information, {COM(2018) 234 final} - {SWD(2018) 129 final} <https://eur-lex.europa.eu/legal-content/EN/PIN/?uri=SWD:2018:129:FIN>

²⁶ 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>

²⁷ Assessment of the Re-use of Public Sector Information in the Geographical Information, Meteorological Information and Legal Information sectors, MICUS, December 2008.

²⁸ Graham Vickery, Review of recent studies on PSI reuse and related market developments, 2011, <https://ec.europa.eu/digital-single-market/en/news/review-recent-studies-psi-reuse-and-related-market-developments>

²⁹ Pricing of Public Sector Information Study (POPSIS) - Models of supply and charging for public sector information (ABC) - final report, 2011, <https://ec.europa.eu/digital-single-market/en/news/pricing-public-sector-information-study-popsis-models-supply-and-charging-public-sector>

³⁰ Directive 2013/37/EU of the European Parliament and of the Council and amending Directive 2003/98/EC on the re-use of public sector information, <https://eur-lex.europa.eu/legal-content/FR/ALL/?uri=CELEX:32013L0037>

of PSI for the cultural sector and introduces a set of practical measures to facilitate data discoverability and re-use, amongst others.

Due to the different technological developments that constantly affect such regulations on public data, EC undertook a new set of revisions, which led in April 2018 to the adoption of the Directive 2003/98/EC³¹, recently adopted by the Parliament and the Council.³² The main goal of the new revision was to lower barriers of data re-use and guide a transparent process for the setup of public-private agreements. Also, in this new revision, Article 14 empowers EC to implement activities on a list of identified **High-Value Datasets** (HVDs) that belong to 6 thematic data categories so that there are technical specifications at European level about their metadata, data formats, common arrangements for data dissemination and agreement on how to make them compatible with open standard licences, including terms for data re-use. The logic behind giving more centralisation and paramount role of the EC for releasing such high-value datasets across Europe is to try to make PSI a pivotal piece in unfreezing the value of data for innovation and economic growth.

The Lombardy regional programme

The Lombardy region is the wealthiest region in Italy. From its early stage, the regional government has been active in open data. In March 2012, it launched its own open data portal. In 2014, the regional government created the first set of recommended datasets for local authorities in the region. By 2017, 18 local authorities provided data. However, it was clear that the effort was not sufficient.

To combat this, in 2017 the regional government launched a funding programme to cover the costs for municipalities (Delibera 7256). Municipalities had to commit to publishing 10 or 25 datasets chosen in the shortlist of 50 datasets established by the regional government. The co-financing covered part of the costs and was typically below € 2000 per municipality to be used to cover real external costs for data preparation. Real costs included internal resources that vary across municipalities and datasets to prepare the data to be published following data standards, but also vendors' activity to make such data publicly available in a form and medium that could be potentially re-used. Clearly, it was not a major funding instrument – but potentially interesting because of the fragmented nature of the market. The IT providers of local authorities could find it interesting because of the possibility to do a joint intervention for tens of their clients, thereby reaching an interesting volume of contracts.

Perhaps the most interesting aspect of the regional plan was the requirement not only to publish the dataset but to also establish automated ways for updating the data so that no additional human intervention was needed for data to be updated regularly in the regional portal. Secondly, the funding instrument was accompanied by the creation of common publication standards aligned with national and European guidelines. This was a co-creation process aiming at improving data quality and improve its reusability. The results are remarkable. If 18 municipalities were involved until 2017, 136 committed in 2018-2019 to the new programme and 95 municipalities already reached the target of datasets published at the time of writing. There are now 1275 datasets from municipalities on the website that are updated regularly and follow the appropriate standards to guarantee datasets quality for potential re-use.

³¹ <https://ec.europa.eu/digital-single-market/en/public-sector-information-psi-directive-open-data-directive>

³² <https://ec.europa.eu/digital-single-market/en/european-legislation-reuse-public-sector-information>

When looking at the distribution, it is interesting to see that very small municipalities (below 5000 inches.) are well represented. While they make up 68,7 % of total municipalities, they are 63,4 of those who participated in the plan and 60,2 % of those who publish datasets. The plan was genuinely able to help those with fewer resources.

TABLE 3: DISTRIBUTION MUNICIPALITY BY SIZE

	Regional plan	Publish open	Total Lombardy
Large	6,50%	6,78%	0,92%
Medium	12,20%	15,25%	6,55%
Small	17,89%	17,80%	23,77%
Very small	63,41%	60,17%	68,70%

When looking at what data they publish, there is a wide coverage of topics. The most popular dataset is transparency followed by transport. However, as the table below shows, transport is favoured by larger municipalities while transparency is preferred by the smallest ones.

TABLE 4: DISTRIBUTION OF DATASETS TOPICS BY SIZE

Topic	Very small municipalities	Small	Medium	Large municipalities	Average
AMBIENTE	9%	11%	8%	9%	8,24%
COMMERCIO	6%	4%	2%	5%	8,78%
CULTURA	4%	2%	1%	2%	7,69%
ENERGIA	3%	4%	1%	0%	2,35%
MOBILITA' E TRASPORTI	11%	17%	13%	25%	14,82%
SICUREZZA	1%	4%	4%	7%	10,90%
STATISTICA	16%	11%	15%	9%	12,78%
TERRITORIO	19%	21%	24%	27%	10,67%
TRASPARENZA	28%	23%	30%	16%	17,88%
TURISMO	3%	4%	1%	0%	5,88%
Grand Total	100,00%	100,00%	100,00%	100,00%	100

As mentioned before, one of the success factors of the programme has been the capacity to involve technological suppliers. The table below shows the wide range of IT providers involved in the programme and the relative concentration for small municipalities: three providers cover 45 very small municipalities. The regional government did an extensive work of coordination and orchestration to make sure these companies were aware of the opportunity and willing to take part in it.

TABLE 5 DISTRIBUTION OF SUPPLIERS

IT provider	Very small municipalities	Small	Medium	Large municipalities	Grand Total
Maggioli Spa	13	2	4	2	21
Halley	16	3	1		20
Consorzio.It Srl - EasyGov	16	1			17
Supporto CIT Provincia BS	4	5	1		10
TeamQuality	3	2			5

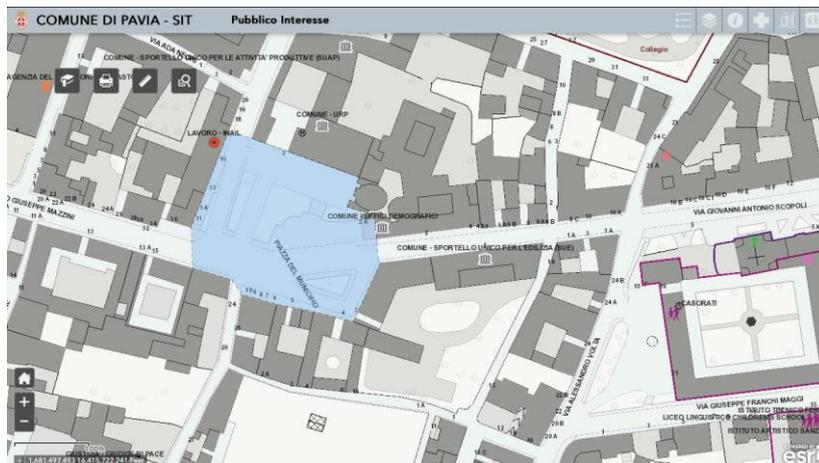
NSH		1	1	2	4
EasyGov Solutions S.r.l.	4				4
CSC Società Cooperativa Sociale	3				3
APKAPPA (Gruppo Maggioli)			1	1	2
A.C.R. Progetti				1	1
ADS spa			1		1
Ambito SRL		1			1
Dedagroup		1		1	2

The case of the municipality of Pavia

Pavia is a large municipality (73.000 in.) in Lombardy. It has been a leader in providing open data, namely in the geospatial domain. It has also taken part in the regional programme, mostly with the purpose of implementing the provision for the automatic update of the data. The municipality has its own open data portal,³³ while at the same time publishing the data on the regional portal.

So while the regional programme was relevant and useful, the municipality was already very active in publishing data beforehand. The area perhaps with the greatest visible impact refers to territorial data, where data have been available for several years in the “Sistema Informativo Territoriale”.³⁴

FIGURE 1: SCREENSHOT OF PAVIA GIS WEBSITE



When inquiring about the reasons for this enthusiastic embrace of open data, the first and foremost reason mentioned is the individual passion of the civil servant. Due to open-source solutions, a motivated individual can make a real difference, even in a small municipality. More specifically, Pavia started off as a sort of laboratory for OpenStreetMap by making geospatial data available back in 2010.

However, to deliver a GIS system such as the one above, individual motivations are not enough. There is the need to gain policy endorsement and, most importantly, to maintain it even when governments change. Pavia, in particular, has switched the governing party in every one of the last 5 elections (from the year 2000). How did these enthusiastic civil servants manage to continue the commitment of their political leaders?

The answer is straightforward: showing results. By participating actively in the open data community, the municipality was able to publish the data and obtain tangible benefits from it. Furthermore, this does not come only from the technical in-house capacity, but by the open-source contributions of the community and because the data were effectively re-used.

In particular, the existence of a mature open geospatial community around OpenStreetMap made accessible a wealth of additional services for free by simply providing data in a compatible format. The local CEO recalls the

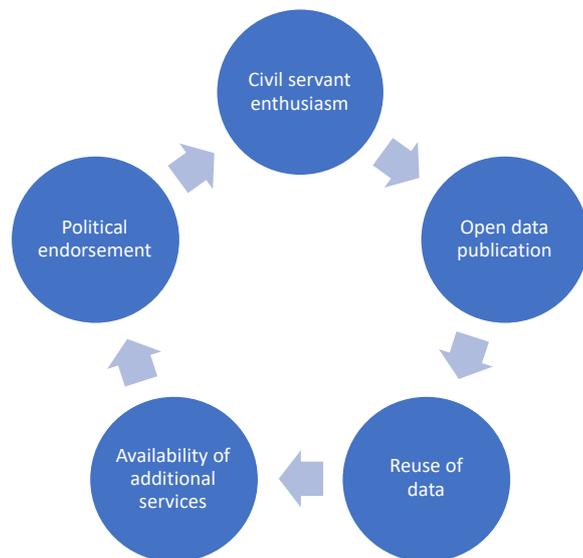
³³ <http://dati.comune.pv.it/site/home.html>

³⁴ <https://webgis.pv.comune.pv.it/>

surprise of finding not only their data on OpenStreetMap, but also the possibility to access free added value resources such as for printing brochures. This is a powerful small example: the production of a brochure with the main attraction of the city used to be a significant effort and cost. Due to the open ecosystem, this could be produced quickly, cheaply and with high quality. In another case, data on bike-sharing availability in Pavia had been incorporated in an EU-wide service for finding bike-sharing widely used by tourists. These small examples are instrumental in ensuring the endorsement of decision-makers.

Overall, open data went through a positive virtuous cycle kickstarted by the civil servants, which led to the publication of open data and an increase in open data re-use by the community that developed additional services useful to citizens, tourists and the public administration itself. This ultimately led to the continuous endorsement of political leaders. Of course, the same virtuous circle can become vicious when datasets are not published, if they are of poor quality, or they are not re-used. This is indeed one of the main barriers to open data: the concern that opening data would reveal the poor quality of the underlying data.

FIGURE 2: THE VIRTUOUS CYCLE OF DATA REUSE



This cycle also reflects a set of incentives for different stakeholders, as listed in the table below.

TABLE 6: INCENTIVES FOR DIFFERENT STAKEHOLDERS

Stakeholders type	Incentive
Civil servant (open data evangelist)	Personal satisfaction, recognition by the policymaker, additional resources
A civil servant in a specific department	Improved services that help their work
Developers	High quality, valuable and updated data to develop new services
Citizens	Useful services
Policymaker	Visible results in terms of services for citizens, tourists, departments of the administration
Companies (IT providers)	Additional revenues, customers satisfaction, new cust

Finally, the regional programme was instrumental in ensuring sustainability beyond individual enthusiasm. It is not rare to have an individual enthusiasm for publishing data, but for services to be developed the data must be high quality and be maintained over time. Therefore, the introduction of tools for automatic publishing is widely seen as a game-changer for regional open data.

Data sharing: A comparative analysis of two public agencies in the oil and gas sector

Background: the INSPIRE directive

Directive 2007/2/EC (INSPIRE) sets up a set of overarching principles that guides the tasks put in place to facilitate *geospatial* data-sharing. According to INSPIRE: a European Spatial Infrastructure has to be implemented to “enable the sharing of environmental spatial information among public sector organisations and facilitate public access to spatial information across Europe and assist in policy-making across boundaries”.

INSPIRE defines different implementing rules for data sharing. It includes non-binding technical guidance documents for **the Member States** that describe specific implementation issues and already existing data standards and practices that need to be considered across the different territories if the Member State chooses to conform to INSPIRE technical guidance.

Under INSPIRE, 34 data categories fall under **geological data**, which is the contextual focus of the present study cases on data sharing (see section 4). Geological data is essential and by definition, it is **cross-border** so it requires coordination of different entities working in different territories and gathering different types of geological data. For instance, geological data and knowledge of the subsurface are required to detect geohazards; providing information for environmental planning; or providing information for natural resources exploration; vulnerability of the underground to contamination; and for indicators for climatic change; for example. As such, under the INSPIRE directive, significant efforts have been put to try to harmonise and share data between different administrations.

Although different efforts have been destined to the implementation of INSPIRE and the Member States have started the development, it acknowledges the hard administrative and organisational challenges considering the heterogeneous norms and different national systems. Moreover, in many cases, the responsibilities of managing the data rely on different entities and organisations.

The Oil and Gas industry is one of national importance in both Norway and The Netherlands and makes a significant contribution to their economy, energy security and employment. In the case of Norway, it is among the global top seven exporters of crude oil and the industry constitutes to around 18% of their GDP and around 62% of the Norwegian exports in 2018. Furthermore, Norway is considered one of the most important sources of natural gas for Western Europe. Following Norway, the Netherlands is the second-largest producer and exporter of natural gas in Europe. Most of the Dutch natural gas fields are offshore in the North Sea, although some of them are onshore, including Groningen, is considered one of the ten largest natural gas fields in the world.

In both cases, the Oil and Gas sector has faced unprecedented challenges in different *exploration* and *production* environments. Exploration and production are considered the **early stages** of energy production, which includes the activities of searching, finding and extracting raw materials to be shipped to other oil companies within the production process and energy business. One potentially viable fields are identified, a well is drilled to collect samples and test the quality and quantity findings. If the testing is successful, then the oil and gas deposits are extracted, stored on a temporary basis and eventually shipped to refineries.

Governments provide **licences** in a numbered of licensing rounds to a group of organisations to engage in exploration and production activities under their territory. The transfer of a licence or of a share needs to be approved by the government. Licences are normally granted to a consortium of companies led by an operator. Grouping organisations under one licence makes it possible that less experienced companies learn from the others, but also allows companies to employ some control towards the operator by making collective decisions towards the exploration activities. The licence grants the group of companies the monopoly to perform the exploration and research activities in the petroleum deposits within the specific geographical area identified in the licence. The companies under the licence become the owners of the petroleum that they find and produce.

Governmental approaches towards data sharing in the Oil and Gas sector for the exploration and production phase depends on the maturity of the sector and changes with the phase resources recovery a country is in. Traditionally, the oil and gas industry has turned away from sharing data out of concerns around giving away valuable knowledge. However, current challenges and pressures towards increasing efficiency in exploration and production phases are attracting new investments and better resources for monitoring and management. This has led to heterogeneous governmental data approaches towards sharing (and opening up) valuable data. These approaches differ across countries depending on the phase resources a country is in. If there are still many resources to explore in the country, different regulations and approaches to data would apply compared if we are in a phase of slowly phasing out. For example, the Netherlands is currently in the phase of managing risks as a result of the extractions of resources (i.e. oil, gas, and coal). Thus, the relevance of opening up data for careful monitoring is crucial. Moreover, in the case of the Netherlands, the country is so densely populated that, besides the phase where the country is in, data is needed for monitoring. We can exemplify such argumentation with the case of the Groningen field: the government sought to cap annual natural gas production to encourage production from smaller fields and to extend the life of such field.

To understand governmental approaches towards data sharing in the Oil and Gas sector in the Netherlands and Norway, and extensively to any other European country, we need to understand the role of agencies in licensing, supervision and stewardship. Some background information is available below to understand the role of data and these countries governmental approach towards adopting European data sharing guidelines within their general efforts in monitoring and regulating the industry.

The Netherlands

Background

In 2009, the Dutch implemented the Act of the European Commission Directive on Infrastructure Spatial Information (the INSPIRE Decree) into Dutch law and regulations. The Netherlands, as other European countries, has been periodically estimating the costs and benefits (CBA) of introducing INSPIRE. The latest estimate in 2016 shows that INSPIRE has helped with data quality, data availability and data comparability. The Netherlands created an INSPIRE node³⁵ through which organisations can automatically retrieve metadata containing data services of INSPIRE datasets.

The Netherlands uses the principle that only the most appropriate datasets are labelled as INSPIRE data (i.e. only the best datasets, as opposed to all, are considered INSPIRE). For each INSPIRE theme, the government has determined who needs to supply the relevant geo-information for which feature. Those who need to 'provide' such data are designated to INSPIRE data providers. Such data providers need to guarantee that the

³⁵ Inspire node at nationalgeoregister.nl

data is made accessible following INSPIRE requirements. Also, the INSPIRE requirements for *metadata* have been integrated into the Dutch metadata profiles for data and services. Thus, in order to assess whether a dataset or service is re-usable by other individuals or organisations, datasets require metadata to make it or data service findable and re-usable. The Dutch metadata profile for datasets and services is the application of the INSPIRE core set.³⁶ Sectors in the Netherlands can develop their own extensions to the Dutch profile and need to be part of ISO 19115.

Data approach

The Dutch government's overarching goal was to increase closer monitoring of the impact, which the multiple uses of subsurface have on people and the environment. The subsurface was getting more crowded because of a growing intensive use; and while the government acknowledges that this generates opportunities, this intensive use also generates conflicts between multiple uses that need to be monitored and combined. An example is the production of geothermal energy and natural gas from the same reservoir. As a result, under the Mining Act and Mining Decree, the Dutch Minister of Economic Affairs established that **licensees/operators need to provide copies of all data obtained during the reconnaissance, exploration, production or storage of mineral resources or geothermal energy** (Article 123 of the Mining Act). Relative regulation consists of Mining Act: article 123, Mining Decree: article 9, article 10, article 108, articles 114-116 and article 177; Mining Regulation: article 11.1.1; Production and injection data.

All data provided by operators in the **Geological Survey of the Netherlands** (GDN) is stored together with the old drilling data of the country and other related information in the digital archive **DINO** (Data and information of the Dutch Subsurface) and released on the **NLOG Oil and Gas portal**. This portal releases data on deep geology, where data is treated according to article 10.1.c Wet Openbaarheid van Bestuur, as described in article 123.3 of the Mining Act. DINO contains all data previously stored (in a period of more than 100 years) in a series of independent archives – they have become digitised and standardised within DINO – and it is moving towards a key register of the subsurface so-called **BRO**. The Geological Survey has also developed models that transform the data into usable insights for re-users. One of the main tasks of the geological survey is to support the Dutch government on policies and tasks related to the management of the deep subsurface. The Geological Survey is managed by a **legal entity incorporated into public law: TNO**³⁷.

According to the Minister's prescriptions, the supply of the data needs to be provided to TNO with a proper description following the prescriptions on metadata. TNO also formulated a data standard for the delivery of seismic data. The geophysical data has to be supplied to TNO within one year after acquisition and it is established that eventually the data will be relinquished 10 years after the acquisition was completed.

Data archived in DINO, the so-called 'clearinghouse' of the geodata on the shallow and deep geology of the Netherlands, which contains data related to:

- The **shallow subsurface** (up to \pm 500 m deep), which is derived from drillings and cone penetration tests on-shore and off-shore the Dutch North Sea zone. The most relevant component of the drilling is the information that is provided about the sediments bored. Cone penetration tests provide insights about the physical characteristics of the subsurface (e.g. strength and compression). These data also include geophysical recordings such as geo-electrical measurements, seismic and side-scan sonar (NLOG, 2020).
- The **deep subsurface** (deeper than 500m), comes from petroleum, natural gas, mineral salt or terrestrial heat exploration activities performed by companies. These datasets need to be provided by companies according to the Mining Act to the GDN. The data provided by the companies has an **embargo period of five years** where such data remains confidential and no other organisation has access to it.

DINO is not a commercial or joint venture activity. Its mission is to provide access to data and foster its re-use by national, provincial and local authorities in the Netherlands and by companies and people. They are

³⁶ The INSPIRE metadata standard can be found on the website of the [Joint Research Center](#).

³⁷ About TNO: <https://www.tno.nl/en/>

currently transitioning to BRO, which is standardised public information on the subsurface that the Dutch government has put in place to improve accessibility to subsurface data. The use of subsurface data by both governments and companies have raised in recent years, being crucial at the operational level for several organisations but also for governments to manage societal issues such as resource management and climate change policies (e.g. related to rising sea levels and soil subsidence). BRO seeks to extend DINO functionalities to expand data re-use. Other re-uses include examples of geothermal energy, CO2 storage, amongst others. BRO seeks to further facilitate subsurface data –sharing within the government and across companies. The idea is to manage in one location all data on the subsurface and made it available for different re-uses.

Norway

Background

The collaboration between Oil and Gas industry and State has set up the playing field where the ecosystem cooperates: while the State regulates the sector by defining a clear and predictable policy framework, oil companies and other industry stakeholders are responsible for the operational activities. As commercial companies are responsible for exploration and production, it is important to provide the right incentives for companies to share their data so that they can effectively contribute to societal benefits. Thus, the regulatory framework seeks to balance companies and societal interests through taxation policy, regulation and oversight of resource management.

The Norwegian Petroleum Directorate (NPD) is the authority responsible for the data management on oil and gas on the Norwegian continental shelf and provides openly on a website (*Norwegian Petroleum Directorate, 2020*) information about discoveries, fields, wells, the company operators and the licensees. The data that is published in the portal can be used following the Norwegian Licence for Open Government Data (NLOD). According to such a licence, there are restricting uses of the data to third party rights.

All operators in Norway need to provide their data once per year (every autumn) together with their forecasts and estimates for the different fields, discoveries and transport systems. These forecasts relate to production, costs and estimated emissions to the environment. The data is forwarded to the Ministry of Petroleum and Energy and sequentially to the Ministry of Finance to inform the governmental budget and policy.

Data approach

The Norwegian government decided to set up a joint venture integrating the Norwegian Petroleum Directorate (NPD) and all oil and gas companies with activities in the Norwegian Continental Shelf in order to generate and operate a data infrastructure called **Diskos**. The Directorate manages the joint venture and the joint venture is **in charge of sharing and trading data between the companies** (the licensees) and **manages the access to public data**. Data is seismic data, well data and production data.

Governance of Diskos is composed of a Steering and a management committee where all participant companies are represented. The management committee is considered the operational body at the executive level in the joint venture. The management team consists of two people from the governmental authority and the administrator who coordinates all the tasks of Diskos. The day-to-day management of the data infrastructure is outsourced to a vendor that periodically renews the contract with Diskos. According to Norwegian legislation, it is mandatory that once per year licensees report their data and forecasts regarding exploration and production activities. Data is stored in Diskos. **After the embargo period over the data** – i.e. after the confidentiality period expires – Diskos can make the data available to the public.

The willingness of the public authorities to make the data public is to give the Norwegian Shelf a competitive advantage towards other areas with oil and gas. Yet, there is a trade-off between a) protecting competitive interests of the licensees and giving them exclusivity rights towards the data they have collected on the exploration, and b) to attract other potential investments towards the region by decreasing the costs of exploration activity and openly sharing such costly data. As a result, the equilibrium is found by agreeing on an optimum period of time to make such data available. Time needs to give enough competitive advantage of the generators of the data, yet it needs to be released quickly to attract new companies to explore and drill. Making data available becomes a governmental strategy to decrease companies' costs to explore the shelf,

compared to other regions where such data is not available. Diskos encourages different licences to **swap, trade and exchange the data** that companies gathered in the subsurface about drilling in the geological formation.

Regarding the Diskos business model, all companies reporting data need to pay a fee to the contractor of Diskos to upload the data. Companies have the right to retrieve the data and the fees are established by a contract. The price depends on the type of data, whether it is seismic or well data. Companies share their data through the so-called “Geodata Trade Operator” (GTO), which works in coordination with the subcontractor of Diskos –Kadme- who implements the transactions.

Members of DISKOS pay the same amount of approximately NOK 400 000 a year. Besides oil and gas companies, other associated members pay an annual membership around NOK 140 000, yet they pay the same fees as the oil and gas companies to upload or retrieve data from DISKOS. Relatedly, **access to data** differs for members and non-members of DISKOS: non-members cannot access to the same data. Non-members can only access ‘public’ data or non-confidential public documents available in DISKOS. Also, access to the data upon request for non-members is more labour-intensive. *“The idea behind Diskos is that the oil companies should all cooperate on storing exploration data and compete in the interpretation of this data. The more raw data is collected and shared, the greater the possibilities for the bright minds in each company,”* says the Diskos member (Diskos, 2016).

One of the major requirements of DISKOS was that software should allow watertight dividers between the data uploaded by the different companies. Once uploaded, it could be opened for exchange and sale fulfilling all the security standards. IBM won the software contract. The pre-condition negotiated by the company was that IBM would own the software and would have the possibility to export the concept to other countries. IBM also won the contract for the operations of the software and partnered with TapeTech and PGS. Together they form an operating company in 1994 named PetroData AS. Besides NPD and the four original oil companies, others joined over the course of the year: Shell, Norsk Agip, Hess, Conoco, Elf, Total, Phillips, Enterprise Oil, RWE-DEA and BP/Amoco.

Raw data in Diskos from seismic and wells from licence groups are protected from public access for **two years**. General seismic data is kept in **embargo** without allowing access to third parties for **five years**. Seismic data acquired by companies for sale is protected **for ten years**. However, the most valuable data is the **interpreted data**, which is under embargo and kept confidential for **20 years** before it is open up to other organisations to freely use the data. The logic behind this is that in order to preserve the incentives for companies to invest in such exploration activity as much as possible, they need to obtain exclusive rights over the data for a certain period of time before allowing others to reuse it. When the period of time expires, it is considered that the data holders or initial owners of the data have conducted as many activities as possible to gain a competitive advantage towards the rest of the companies after the period of exclusive rights to the data. Furthermore, it is important to highlight that the data re-use strategy has proven to be very successful for other companies and has effectively helped in several major discoveries (e.g. Johan Sverdrup discovery). As Hans Chr. Rønnevik, exploration manager in Lundin Norway, recognises: *“Much of the secret behind new discoveries in mature areas involves delving into old data with renewed enthusiasm and to putting the information into an updated context”*.

Soon companies started to employ Diskos to store all international seismic data, information that is not shared with Norwegian governmental authority or other companies. Thus, companies use Diskos also for their international operations also. In concrete terms companies integrated Diskos with their private databases sometimes with the support of an external supplier. The current discussion is that Diskos is based on a commercial agreement between the companies within Diskos and a supplier. This generates a vendor lock-in situation, as the system needs to be managed, updated and changed. When there is a change in supplier, as in Diskos, there is a lot of effort put in place in order to keep continuity and quality of services.

Cross-analysis of the cases

Firstly, regarding **open data**, the analysis of Italian municipalities behaviour in the region of Lombardia shows that behind the municipalities decision to open up their data there are **economic incentives** provided (in this case provided by the region) to support the small investment required, in particular for the small-size municipalities with less than 5000 habitants.

Additionally, the support of the regional level to **coordinate the collaboration of business providers** across the different municipalities facilitated and make it easier for the municipalities to engage in the activities of open up the data. Facilitating the technical aspects of how to release the data at the level of the vendor by centralising data standards, quality requirements, software specifications amongst others and by providing the right incentives for municipalities to accept releasing openly their public datasets is crucial. Considering the sometimes lack of technical skills to engage in such local activities, the coordination with providers at the regional level facilitated the task and also generated efficiencies with some economies of scale for the vendors.

Moreover, the existence of a regional policy to endorse, in other words, **policy lead** at the upper administrative level, explains the decision of the municipalities to open up their data. This is exemplified by the fact that most of the municipalities that agreed to open up their data did it under the regional plan Delibera of the Region of Lombardia. Economic incentives, coordination with business suppliers and policy leadership accompanied with technical guidance explains the decision of Italian municipalities in Lombardia, and for the smallest ones in terms of population, to open up their data. Besides the regional programme support, which was instrumental in ensuring sustainability, the case of Pavia also powerfully shows the virtuous cycle between civil servant enthusiasm for publishing data, the impact on the quality of data, services being developed and thus effect on data-reuse. The case reflects on the importance of the introduction of tools for automatic publishing, which is widely seen as a game-changer for regional open data.

Secondly, regarding **data sharing** and the comparative analysis of Norway and Netherlands, when researching data approaches to facilitating data sharing in the oil and gas industry, we realised the **significant weight of government role in incentivising and orchestrating** data sharing in the country. In both countries, whether by making subsurface data available with the support of a public legal arm of government such as TNO, or whether as a founder and partner of a joint venture such as DISKOS with the oil and gas companies, the role of government is significant to make data sharing possible.

In the case of Norway, the governmental role of NDP behaves as an **independent trusted third party** across the partnership with the other companies. In the Netherlands, through the geological survey, TNO captures the data required from the companies and establishes **bilateral** discussions with companies when data is required and for any eventual doubt. This governmental role is consistent with other cases from the literature for instance in the Data Integration Partnership for Australia, which was set up as "an investment to maximize the use and value of the Government's data assets" (Department of the Prime Minister and Cabinet (Australia), 2017).

Through the two cases, we learn that data access and sharing in such a sector where there are significant investments put in place in exploration activities, comes with **several risks** for organisations, basically in terms of their competitive position towards other companies. As such, the governmental role is crucial to **mitigate such risks** and generate settings where companies feel comfortable sharing with appropriate governance structures, contractual agreements and security standards that do not violate their legitimate private and commercial interests. DISKOS shows precisely that the government not only was a lever to facilitate data sharing but thanks to such type of organisational setting between companies, they can share and mutually enrich their data including via **cross-licensing agreements**. This is in line with an increasing trend in a number of governments where there are incentives put in place to generate data partnerships within the private sector and public sector to facilitate data exchanges but also to enable access and re-use to public sector data.

In both cases, we appreciate another important governmental role, which is **financial support for metadata and data maintenance** via the engagement of NDP in Diskos or through TNO a public legal- arm of the ministry in the Netherlands. Paramount to the incentives for companies to share is to have the net for keeping and updating all contextual descriptions about the data in the standards and quality required for them (or others)

to re-use. Complementary investments in metadata, data models, tech infrastructure for shared data storage, processing but also data access are required. Whether through TNO funding support in managing the geological survey or the financial contribution to NDP to the joint venture Diskos to operate the collaboration and curate and sustain the data.

However, in the case of the Oil and Gas sector, we find two different governmental approaches to incentivise data-sharing. The Netherlands invests in making it openly available (almost open data after an embargo period of data); and Norway follows a more nuanced approach, legitimising closed data at some points within the DISKOS collaboration where the government takes part of a joint venture with the oil-and-gas companies to be closed to the operations and be one party in the discussion about how to coordinate data flow across the organisations. These two different approaches also provide a different answer to the data demand problem. By making data openly available, the Netherlands solves the challenge of how to set up a data market for oil and gas data reflecting the value of such data. Additionally in a context-dependency of data is very challenging to establish ex-ante the economic value of a dataset. Within this situation, opening up all data as the Dutch decision reflects the intention to lower the costs of exploration activities for companies and attract foreign and additional investments in the Dutch shelf for research and exploration activities. A different alternative in Norway is to protect the economic interests of the companies in the area performing exploration activities and set up a framework that gives such licensees with some exclusivity rights towards the exploitation of the data and a favourable organisational context that facilitates the trade of data across licensees.

Conclusion and recommendations

What the present study uncovers is the intricate **web of private and public incentives** that open data and data sharing policies at *the local* and *national* level need to face when implementing European data policy guidelines. Within the context of the Italian municipalities in the region of Lombardia and the comparative analysis of two national approaches towards subsurface data-sharing, the study sheds light on the relevance of governmental role in facilitating opening up data or data sharing.

Regarding **open data**, exploring a private database of the region of Lombardia about the open data policies of their 1,507 municipalities, the study sheds light on the relevance of:

1. *economic incentives*,
2. *coordination with business suppliers* (vendor level) to facilitate open data, and
3. *policy leadership* that provides a technical framework for the local authorities for releasing the data.

These three actions capture the explanatory factors behind the decision of Italian municipalities in Lombardia – and especially for the smallest ones in terms of population – to open up their data.

Exploring the Oil and Gas industry at the national level, the study reflects that **governmental approaches towards data sharing** for the exploration and production depends on the maturity of the sector and it changes with the phase resources recovery a country is in. Basically, if there are still many resources to explore in the country, different approaches to data would apply compared to if we are in the phase of slowly phasing out. In other words, the willingness of the governments to make the data openly available is to give their territory a competitive advantage towards other areas. Making data available becomes a governmental strategy to decrease companies' costs to explore the shelf, compared to other regions where such data is not available. However, there is a trade-off between attracting potential investors and newcomers and protecting the competitive interests of the licensees. As a result, whether more open data approach (the Netherlands) run by a public agency or a more restricted approach towards data sharing (Norway) where companies set up a joint venture in collaboration with the government to execute some control over the data and the process for data release, both of them need to find an **optimal period of data embargo**. The time dilation in the release of the data has the ability to give enough competitive advantage to the generators of the data, yet government needs to manage this secrecy requirement with the need to release the data to attract new companies to explore and drill but also to provide transparency and to allow monitoring over the national resource management.

The analysis of cases is inspirational to provide some mechanisms that can drive the implementation of regulatory measures at the EU level fostering open data and data sharing, by factoring in some incentive issues

that need to be overcome in the implementation phase of such measures at the different administrative levels. While the mechanisms identified are embedded in their national and local contexts, they allow for some extrapolation at the EU level and are able to inform future implementations of INSPIRE and Open Data Directive.

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