

The logo graphic features a central orange circle with a white flower-like pattern. This is surrounded by three smaller circles: a blue one at the top, and two green ones at the bottom left and right. These are connected by curved lines. The background includes a large light blue circle at the top right, a large light yellow circle with a white flower pattern on the right, and a large light green circle at the bottom left.

ODECO

Towards a sustainable Open Data ECOSystem

D4.3

An approach to steer the behaviour of non-government data holders towards open data through a governance strategy



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D4.3 An approach to steer the behaviour of non-government data holders towards open data through a governance strategy

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Abbreviations

AND	Automotive Navigation Data
B2G	Business to Government
CGA	Children's General Assembly
C2G	Citizens-to Government
D	Deliverable
ESR	Early Stage Researcher
G2G	Government-to-Government
G2B	Government-to Business
G2C	Government-to Community or Citizen
M	Managerial
MS	Milestone
NGD	Non-Government Data
NPO	Non-Profit Organizations
OD	Open Data
ODECO	Open Data ECOsystem
OKB	Open Knowledge Belgium
OKF	Open Knowledge Foundation
OKFG	Open Knowledge Foundation Germany
OSM	OpenStreetMap
OSMF	OpenStreetMap Foundation
S	Structural
WP	Work Package

Nr	Partner	Partner short name	Country
Beneficiary			
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2	Katholieke Universiteit Leuven	KUL	Belgium
3	Centre National de la Recherche Scientifique	CNRS	France
4	Universidad de Zaragoza	UNIZAR	Spain
5	Panepistimio Aigaiou	UAEGEAN	Greece
6	Aalborg Universitet	AAU	Denmark
7	Università degli Studi di Camerino	UNICAM	Italy
8	Farosnet S.A.	FAROSNET S.A.	Greece
Partner organisations			
1	7eData	7EDATA	Spain
2	Digitaal Vlaanderen	DV	Belgium
3	City of Copenhagen	COP	Denmark
4	City of Rotterdam	RDAM	Netherlands
5	CoC Playful Minds	CoC	Denmark
6	Derilinx	DERI	Ireland
7	ESRI	ESRI	Netherlands
8	Maggioli S.p.A	MAG	Italy
9	National Centre of Geographic Information	CNIG	Spain
10	Open Knowledge Belgium	OKB	Belgium
11	SWECO	SWECO	Netherlands
12	The government lab	GLAB	United States of America
13	Agency for Data Supply and Infrastructure	ADSI	Denmark
14	GFOSS Open Technologies Alliance	GFOSS	Greece
15	Inno3 Consulting	IC	France
16	Regione Marche	RM	Italy
17	Open Data Institute	OCI	United Kingdom

Executive summary

In this research document, we explore governance stimuli that can enhance non-governmental open data sharing. Previous investigations have shown that many non-governmental actors are not sharing open data, which is problematic as the open data ecosystem depends on the participation of diverse contributors. The lack of inclusion of different perspectives in open data ecosystems restricts the possibilities of capturing the full potential of such ecosystems, and it is suspected to add to existing power imbalances at the expenses of vulnerable groups.

For our analysis, we build on earlier findings that identified key enablers that can promote non-governmental open data sharing. These enablers include training in data skills and literacy, access to suitable technical tools, alignment of private interests with open data sharing, adequate resources (financial, time, personnel), the presence of data-sharing communities, awareness of the social impact of open data, and the availability of engagement or enjoyment activities.

To understand how governance mechanisms can foster open data sharing, we apply the hierarchy, market and network governance framework. We employed a multi-stepped research strategy, analysing perspectives from diverse actors such as non-specialists, elementary schools, non-profit organizations, journalists, commercial entities, and intermediaries through various methodologies including case studies, literature reviews, action research, and design-based research. This approach allowed us to identify governance instruments that are currently 1) enhancing non-governmental data sharing, to which we refer as the 'as is' situation or 2) have the potential to foster non-governmental data sharing, to which we refer as the 'to be' situation.

Our findings reveal that a wide range of governance instruments—from hierarchical measures like legal frameworks to grassroots network initiatives such as collaborative partnerships—can effectively stimulate open data sharing. Notable strategies include coordination through permanent bodies and the creation of consortia, which offer substantial benefits for various non-governmental actors. However, market-oriented instruments, such as financial incentives, are currently underutilized, likely due to the non-commercial nature of many non-governmental actors we analysed in this study. Our results go beyond non-governmental open data sharing and highlight also how some governance instruments can facilitate other forms of participation from non-governmental actors, such as open data use in combination with open data sharing.

This study establishes a solid foundation for understanding governance mechanisms in non-governmental open data sharing and highlights areas for further research. While the study primarily focuses on specific actors and regions within the EU, extending these findings to a broader range of contexts could provide a more comprehensive view of the open data ecosystem. Additionally, further research could focus specifically on how to include the perspectives of vulnerable groups through non-governmental open data sharing.

Highlights

- ⇒ **Different governance instruments can lead to further open data sharing by non-governmental actors.** Some instruments are already adopted and require further uptake, while others are not yet adopted and can improve open data sharing.
- ⇒ There is consensus among different actor groups on the **potential of coordination** through the creation of permanent bodies organizing, for instance, recurrent hackathons with long-lasting effects or through the establishment of national or supra-national consortium for open data sharing by non-governmental organisations.
- ⇒ **Legal Frameworks for Non-Governmental Open Data Sharing:** The study suggests adopting or extending existing legal frameworks for stimulating non-governmental open data sharing.
- ⇒ **Underutilized and under conceptualized Market Incentives:** Financial incentives, such as tax credits, are underused and under conceptualized as viable strategies in stimulating non-governmental data sharing, especially among non-profit and non-commercial actors, signaling the need for alternative or supplementary governance strategies.
- ⇒ Some governance instruments can also be used to stimulate **other kinds of value** to the open data ecosystem, such as the inclusion of actors by facilitating open data use along open data sharing.
- ⇒ **Further research is needed to confirm and expand the results of our analysis to other perspectives** within the same actor group, across different sub-fields (e.g., commercial organizations operating in various industries), scales (e.g., non-profit organizations of different sizes), and contexts (e.g., including those lacking the capabilities to engage with technology).

1 Introduction

1.1 Problem definition

Open data ecosystems are characterized by different flows of open data from and to a broad range of actors and users (Pollock, 2011). Traditionally, governments have played a dominant role as open data providers (Van Loenen et al., 2021). Various factors drive the sharing of open government data, including legal obligations, demands for greater transparency (Weerakkody et al., 2017), societal value, and the promotion of economic value through open data reuse (Valli Buttow & Weerts, 2022). In contrast, non-governmental actors, such as the business sector, non-profit organizations (NPOs), citizens, journalists, are lagging behind, with a more limited role in open data sharing compared to governments (Runeson et al., 2021; Van Loenen et al., 2021). The lack of participation from non-governmental actors in open data ecosystems has two major consequences.

First, we observe a dynamic of **exclusion**, where certain actors' perspectives are overlooked. A healthy open data ecosystem depends on the active participation of a diverse range of actors, including private, public, and non-profit organizations, each fulfilling roles that span from data provision to data use (Reggi & Dawes, 2022). However, the current landscape is dominated by the perspectives and interests of those with the capacity to provide open data and the influence on framing policy issues and propose solutions to them (Van Loenen et al., 2021). As such, only a limited number of actors currently share open data, shaping the structure of the open data ecosystem. This is problematic, as the participation through non-governmental open data sharing of different types of actors, such as citizens, can produce significant benefits in terms of both giving attention to an issue faced by them or tackling it (Meijer & Potjer, 2018).

Second, open data ecosystems in which only a few participate reflects and reinforces dynamics of **injustice**. In his critique of open data, Johnson (2014) points out that open data can be exclusionary, thus, not reflecting the interests and values of individuals who do not engage in it at different stages, such as data collection, dissemination, or operation. The lack of participation can also mirror imbalances of power by benefitting those already in power (Gurnstein, 2011). Information pluralism, in which different actors actively participate to the design and practices of the information system, is an important step towards information justice (Davies & Perini, 2016; Johnson, 2014; Ruijter et al., 2024). The consequences of this potential injustice might be heavier for vulnerable groups who face challenges in participation (in this case data sharing) due to lack of power, resources, knowledge, capability to engage effectively (Ruijter et al., 2024).

Against this background, there is a lack of studies on the contribution of different types of actors in open data ecosystems (Reggi & Dawes, 2022) and that explore how we can achieve inclusiveness in open data ecosystems (Walker & Perini, 2024). To fill this gap, in this deliverable, we investigate the potential solutions to enhance open data sharing by non-governmental actors and answer the following research question:

What governance mechanisms have the potential to foster open data sharing from non-governmental actors (or data holders)?

In the context of this deliverable, governance is considered to be a process by which authority is exercised (World Bank Group, 1991). It also refers to the structures, policies, actors and institutions by which the open data ecosystem is managed through decisions (OECD, 2015). Section 2 of this report further expands on the concept and definition of governance adopted in this deliverable. The research methodology applied consisted of a multi-step process aimed at identifying governance instruments to encourage non-governmental open data sharing. It began with recognizing enablers from prior work (Deliverable 4.1), such as data skills training, access to technical tools, and alignment of private interests with open data sharing. Two online workshops

were then conducted: the first workshop focused on discussing governance frameworks (hierarchy, network, market) and mapping governance instruments to each enabler, resulting in a matrix. Researchers analysed perspectives from various actors (e.g., elementary schools, journalists, commercial organizations) using a variety of research methodologies (i.e., case studies, literature reviews, action research, and design-based research) and discussed preliminary results in a second workshop. The results were then reviewed and analysed, leading to the identification of a comprehensive list of governance instruments that currently enable (as-is) or are expected to enable (to-be) non-governmental open data sharing. This process is broken down in detail in Section 3 of this document.

1.2 Role of this deliverable in the ODECO project

The ODECO deliverable 4.3 is part of Working Package 4, “From an Exclusive to an Inclusive Open Data Ecosystem”. The objective of ODECO Deliverable D4.3 is to explore the use of different governance approaches for influencing and controlling the behaviour of non-government data holders in the open data ecosystem. The relation to the other deliverables of WP4 is as follows:

- Deliverable 4.1 investigated the **motivations** of non-government actors and data holders to become active contributors to the open data ecosystem. Besides the key motivations, key barriers for sharing non-government data were identified. The main outcome of the report was a list of seven key enablers for stimulating non-government data holders to share their data: (1) Availability of training in data skills and literacy, (2) Availability of appropriate technical tools, (3) Alignment of private value and interests with open data sharing, (4) Availability of resources (financial, time, people/workforce), (5) Existence of data sharing communities (6) Awareness about the social impact of open data sharing, and (7) Presence of engagement or enjoyment activities. More details about these enablers can be found in the *Report on the motivations of NGD holders, and on barriers and enablers to sharing non-government data (ODECO Deliverable D4.1)*. Deliverable 4.3 builds on the results of Deliverable 4.1 and complements them.
- D4.2 explores **technical strategies** to steer the behaviour of non-government data holders towards open data. It will report on technological ways to promote the inclusion of non-government data holders in the open data ecosystem. Technical mechanisms include, but are not limited to, user interfaces, data integrators from a semantic perspective, and quality validation tools.

As such, the findings of this deliverable complement the ones of ODECO Deliverables D4.1 and D4.2. The overall outcomes of both deliverables result in a comprehensive list of insights to promote non-government data holders to sharing open data.

1.3 Outline

This report is structured as follows. Chapter 2 presents the theoretical framework. Chapter 3 describes the research methodology, followed by Chapters 4 to 9, which present the results of the analysis of governance mechanisms for each non-governmental actor. Chapter 10 provides a summary of the results, followed by Chapter 11, which presents the discussions and conclusions, along with the limitations.

2 Theoretical framework

Different definitions of governance exist (Pollitt, 2017), and they often vary in the emphasis they place on the mechanisms through which society is 'governed' (Chantillon et al., 2020). Amid different conceptualizations, we define governance as a process by which authority is exercised (World Bank Group, 1991). It also refers to the structures, policies, actors and institutions by which open data ecosystems are managed through decisions (OECD, 2015, 2017). We adopt this definition, as it does not normatively assume that any way of steering and managing society is to be preferred (e.g., network over hierarchy). In other words, the goals of the open data ecosystem can be achieved through different configurations of top-down decision making, bottom-up participation, and involvement of the markets (Cromptvoets & Ho, 2019).

In line with the definition, three mechanisms underpinning governance in the open data ecosystem – with an emphasis on coordination – can be distinguished: hierarchies, markets and networks. Each of these mechanisms has something to contribute to understanding the causes of problems experienced in governance, the gains to be achieved through governance, and the mechanisms through which better governance can be achieved. The distinction between hierarchies, markets and networks of governance in social life is widely accepted (Thompson, 1991).

Bouckaert et al., (2010) unpack the characteristics of the different governance modes as follows. In hierarchy-based governance, patterns of interaction have two main drivers: authority, operationalized in administrative orders, rules and planning on the one hand, and dominance and authority as the basic control system on the other. Market-based governance is based on competition, bargaining and exchange between actors. The price mechanism, incentives and self-interest steer activities of different actors. Network-based governance takes the form of cooperation between actors, where inter-organizational relations are ruled by the acknowledgement of mutual interdependencies, trust and the responsibilities of each actor (Bouckaert et al., 2010).

Each of these mechanisms illuminate different aspects of governance, but each also has some important explanatory deficiencies. Although these mechanisms are introduced as alternatives to one another, in reality many attempts to enhance governance will involve more than one of these forms. Under certain circumstances, attempts to impose direct hierarchical control over an actor or set of actors will work better if the governance can build a more cooperative network among the actors involved or among lower-level employees within those actors.

The three governance mechanisms are of a more general and abstract level. They refer to the basic processes which may underpin governance (authority, price and competition or trust and solidarity) in a sustainability context. In turn, governance rely on certain instruments, i.e. specific activities or structures, which may themselves refer to specific operational mechanisms.

Instruments can be either structural or managerial. Governance may be realized by creating new or changing existing structures or management forms. Managerial instruments refer to procedures, incentives and values which plan, monitor and evaluate the use of resources (HRM, finance) or the implementation of policies. Relevant structural instruments are: S1. Establishment of coordinating functions and entities, S2. Reshuffling of competencies, S3. Establishment of a legal framework, S4. Regulated markets, S5. Systems for information exchange and sharing, S6. Entities for collective decision-making, and S7. Partnerships. Relevant managerial instruments are: M1, Strategic planning, M2. Financial management: input-oriented, M3. Financial management: performance-oriented, M4. Financial management fostering joined up working and cooperation between public organizations, M5. Inter-organizational culture, knowledge management, and M6.

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Capacity building. Table 1 presents the classification of governance instruments into structural and managerial instrument types.

Table 1: Classification of governance instruments into structural and managerial instruments

Structural	Managerial
S1. Establishment of coordinating functions or entities	M1. Strategic planning
S2. Reshuffling division of competences	M2. Financial management: input-oriented
S3. Establishment of a legal framework	M3. Financial management: performance-oriented
S4. Regulated markets	M4. Financial management: joined up working and cooperation
S5. Systems for information exchange and sharing	M5. Inter-organizational culture and knowledge management
S6. Entities for collective decision-making	M6. Capacity building
S7. Partnerships	

Each of these listed instruments are briefly introduced below. Important sources for the introductions of the different instruments are:

- Bouckaert, G., Peters, B.G., Verhoest, K. (2010). Resources, Mechanisms and Instruments for Coordination. In: The Coordination of Public Sector Organizations. Public Sector Organizations. Palgrave Macmillan, London.
- Cromptvoets, J., & Ho, S. (2019). Developing a framework for national institutional arrangements in geospatial information management. In Sustainable Development Goals Connectivity Dilemma (pp. 141-161). CRC Press.

S1. Establishment of coordinating functions or entities. This structural governance instrument refers to the creation of influencing lines of control with the establishment of new functions or entities (e.g. coordination body) with clearly allocated roles, or responsibility tasks. In this context, a coordinator, respectively an individual or unit whose only or main function is to coordinate the open data activities of the different actors in an ecosystem, and a lead organization which has besides its coordinating function, some operational line functions.

S2. Reshuffling of competencies. This structural governance instrument contributes to new or changing structures and institutional forms in the context of open data. A well-known example is the reshuffling of open data competencies between ministries or departments in response to changing contextual pressures. Governance is enhanced by bringing related activities together by merging actors or by separating them from other actors with completely different activities. In addition, this instrument also takes into account the issue of (de)centralizing activities.

S3. Establishment of a legal framework. This structural governance instrument refers to the construction and adoption of a regulatory framework(s) for open data management at different levels and the associated legal conditions. Such a legal framework consists of a broad set of rules and regulations, aiming to organize a particular element in society (in this case the management of open data). These rules and regulations are not necessarily developed specifically for a particular subject but may have been created for other purposes in society and are now applied to the management of open datasets.

S4. Regulated markets. Another set of structural governance instruments relates to the creation of regulated markets in order to create stimuli and sanctions that induce appropriate behaviour by public organizations. The governance of tasks and activities by different organizations is done

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through mechanisms of price and competition, offer and demand. Money and incentives are crucial. Providers of open data apply different financing models. Such markets are generally created by government and, depending on the kind and number of users and providers, the kind and level of competition and the level of regulation, the market can be internal or external.

S5. Systems for information exchange and sharing. Applying the creation and maintenance of this structural governance instrument may induce actors to take into account the actions of other actors through processes of mutual adjustment. Through new or re-oriented flows and systems of information, decision-makers can be better informed about the latest developments and activities in line with those of actors (Pollitt, 2003). Through systems and arrangements for information exchange, information flows and exchange can be better organized. For example, the development of open data geoportals as a key element of open data ecosystems are a good example of this instrument in the context of open data management. Information from various actors can also be integrated in a wide information system, giving a strategic overview of government activities. The focus would be on both technical ICT systems as a basis for making information accessible as well as on the content of the information systems.

S6. Entities for collective decision-making. This structural governance instrument refers to entities that can make binding decisions affecting multiple actors. Strategic decision-making boards are established consisting of senior officials of different actors belonging to the policy domain of open data management in order to collectively set out strategy and control the implementation of it. Such joint decision-making bodies enable joint planning and joint working more easily than weaker forms of cooperation.

S7. Partnerships. The most extreme form of cooperation is the creation of a partnership between two or more actors leading to a common entity controlled by the different 'parent' actors. This enables the achievement of which these actors are collectively responsible for, or simply perform joint tasks. Applying this structural governance instrument obviously stimulates ownership and creativity, but also assumes substantial autonomy, a common vision, and sufficient goodwill and capacity to make collaboration possible. Partnerships can take myriad forms but can be broadly categorised into government-to-government partnerships (G2G); government to business (G2B); and government to community or citizen (G2C).

M1. Strategic planning. This management governance instrument refers to the existence, implementation status and political support of strategy plans regarding open data management in which activities of actor(s) are aligned to a system of interconnected levels of plans, objectives and targets. Governance is fostered by giving actor(s) clear objectives and targets. These different levels of plans are linked to one another to avoid duplication, gaps and to enhance the pursuit of overarching goals. These plans are monitored and evaluated, after which plans can be adjusted and fine-tuned.

M2. Financial management: input-oriented. This is the first governance instrument related to financial management system encompassing processes and instruments of budgeting, accounting and auditing. The set of instruments may entail budgetary guidelines, framework letters. Expenditure review committees, bilateral negotiations and conflict resolution processes, budgetary advice at the centre, formats, systems and provisions for accounting and audits. The hierarchical, input-oriented budget process defines clearly what resources related to open data management should be spent on, and in great detail.

M3. Financial management: performance-oriented. This second financial management governance instrument is result-oriented, with a heavy emphasis on actor incentives for performance. The focus of the management system is on providing incentives to improve their

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performance. The budget is linked to the expected or past performance, and financial sanctions in case of underperformance are possible.

M4. Financial management fostering joined up working and cooperation. This third financial managerial instrument aims to join-up working and cooperation between actors. In such a perspective, the focus of the financial management system is on the consolidation of financial and performance information across actors and policy fields. The emphasis is on information consolidation and exchange, new budget formats, geared towards horizontal policies (for example, outcome- or program-based budgets related to open data management), as well as joined and exchangeable budgets in order to achieve cross-cutting objectives.

M5. Inter-organizational culture and knowledge management. Another governance instrument relates more to human resources as an important resource. This managerial instrument aims to enhance governance by fostering shared visions, values, norms and knowledge between actors. As such, this set of governance instruments fosters the creation and growth of inter-organizational networks (Klijn and Koppenjan, 2000) and hence is predominantly linked to the network mechanism. This could be achieved by means of the development of cross-cutting skills among staff; common education or common training; management development; mobility of staff between organizations; and the creation of systems for inter-organizational career management (Pollitt, 2003). The introduction of behavioural and ethical codes for relevant staff members may be another vehicle for creating and cultivating such common values and norms.

M6. Capacity building. Capacity building or development is defined as the process by which individuals, organizations, institutions and societies develop abilities to perform functions, solve problems and set and achieve objectives (United Nations Development Program, 2009). Applied to the open data management context, this means establishing effective strategies for capacity assessment, development, and promoting open data advocacy and awareness. For example, the development of a competency framework to articulate the skillsets and knowledge required to function in the open data ecosystem could serve as a basis for capacity assessment and development. Facilitating education and skills training at all levels, from building basic awareness to the development of specialist skills could help to ensure a sustainable pipeline of talent for the open data workforce.

The structural and managerial governance instruments can be clustered into the underlying mechanisms allowing to guide the application of the key instruments for strengthening a specific governance mechanism (see Table 2). The instruments clustered can be considered as complementary to each other and it is up to the decision-maker (and policy makers) which one and/or how to apply.

Table 2: Clusters of governance instruments strongly based on work of Verhoest and Bouckaert (2005)

Instruments	Hierarchy	Market	Network
Structural	S1. Establishment of coordinating functions or entities S2. Reshuffling division of competencies S3. Legal framework	S4. Regulated markets	S5. Systems for information exchange and sharing S6. Entities for collective decision-making S7. Partnerships
Managerial	M1. Strategic planning	M3. Financial management:	M4. Financial management: joined

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Instruments	Hierarchy	Market	Network
	M2. Financial management: input-oriented	performance-oriented	up working and cooperation M5. Inter-organizational culture and knowledge management M6. Capacity building

3 Research methodology

In the previous section, we reviewed the theoretical background on governance instruments and their application in the open government context. To better understand how to encourage non-governmental data holders to share open data, it is essential to assess the current use of governance instruments (the as-is situation) and their potential for promoting further open data sharing (the to-be situation). Ideally, implementing governance instruments in the to-be scenario would enhance non-governmental data holders' willingness to share data.

To derive a comprehensive list of relevant governance instruments, we applied a multi-step research methodology summarized at the end of this section (Figure 1). We began by identifying enablers of non-governmental open data sharing from our previous work (Deliverable 4.1). These enablers include training in data skills and literacy, access to appropriate technical tools, alignment of private value and interests with open data sharing, sufficient resources (financial, time, people), the existence of data-sharing communities, awareness of the social impact of open data sharing, and the presence of engagement or enjoyment activities.

Next, we conducted two online workshops attended by two researchers whose main expertise was in governance, and six researchers who have been studying different actors' perspectives (i.e., non-specialist actors, elementary schools, NPOs, commercial organisations, and intermediaries) for more than one year. In the first online workshop (Workshop 1), we discussed the theoretical framework (i.e., hierarchy, network, and market governance through structural and managerial instruments) and collectively reflected on how different governance instruments can stimulate non-governmental open data sharing in both the as-is and to-be situations, achieving the goals set by the enablers. As a result of the first workshop, we developed a matrix of enablers and governance instruments (see Table 3), and we assessed the feasibility of analysing the different actors' perspectives through a governance lens. Following the workshop, each researcher identified relevant governance instruments from various actor perspectives, including non-specialists, elementary schools, not-for-profit organizations, journalists, commercial organizations, and open data intermediaries.

Table 3: Matrix Enablers – Governance instruments

Enablers	S1	S2	S3	S4	S5	S6	S7	M1	M2	M3	M4	M5	M6
Availability of training in data skills and literacy													
Availability of appropriate technical tools													
Alignment of private value and interests with open data sharing													
Availability of resources (financial, time, people)													
Existence of data-sharing communities													
Awareness about the social impact of open data sharing													
Presence of engagement or enjoyment activities													

Below, we outline the research methodology employed for each actor's perspective to develop our analysis. At the end of this section, we explain how these perspectives have been integrated into the results (Figure 1).

Research methodology applied for non-specialist actors

The section on non-specialist actors is based on a review of existing literature on open data events, conducted in Di Staso, Mulder, et al (In press). We systematically searched for articles describing open data events on major academic databases (Scopus, Web of Science, ACM). The search terms included "open data" combined with "hackathon," "game jam," "design jam," as well as synonyms for these terms. We only included English language journal and conference papers, describing in person open data hackathons or open data game jams, of least one day and no more than three days in duration (Di Staso, Mulder, et al., In press). We consolidated the search results into a single list of unique records, then filtered based on scanning the abstract or full text, and finally filtered based on the full text (Di Staso, Mulder, et al., In press). After all these steps, we obtained 20 unique articles. This section is also based on the following sources:

- participant observation of open data hackathons in Europe, and one of its final reports (Rambøll Management Consulting, 2022). These include: the Nordic AI and Open Data Hackathon, which took place in March 2022 in Denmark, Sweden, and online, aimed at reusing open datasets of Nordic countries with AI; and the 3rd CASSINI Hackathon, which took place in May 2022 in several European countries, and was aimed at reusing space data (Copernicus, Galileo, etc.) to address challenges related to tourism and travel
- lessons learnt from organizing three open data game jams with non-specialist participants, such as Master's students, and non-specialist civil servants. A total of 101 participants attended the jams, which lasted approximately 8 hours. Participants were asked to express societal issues with open data and game-making tools. The events are described in (Di Staso, Christiansen, et al., In press).

Research methodology applied for elementary schools

A design-based research (DBR) methodological framework has been applied in the case of elementary schools. DBR is defined as a theoretical and practical approach for the development of new educational approaches (Bakker, 2018). Iterative cycles are developed, aiming at producing actionable knowledge that can be used to achieve some educational goal through design (Anderson & Shattuck, 2012). Each DBR cycle is a design experiment that develops in four phases: problem definition, design, intervention, and analysis (Anderson & Shattuck, 2012). This iterative process aims at having better and more concrete outcomes after each iteration.

Three cycles including five interventions in Danish schools were conducted with the total participation of 117 pupils aged 14 to 16 years and nine teachers in 7th to 9th grade. The first cycle included a systematic mapping review of the skills associated to using open data in education and the learning approaches (Celis Vargas et al., 2023), semi-structured interviews with five teachers and an open data activity with 39 9th grade students to understand their current practices (Vargas et al., 2024). This first cycle was essential to define the as-is situation by exploring the current state of open data initiatives in education and the current practices of teachers and students to teach and learn open data competencies such as the analysis of data and the creation of data arguments to solve a real-world problem (Celis Vargas et al., 2023; Vargas et al., 2024). The second and third cycles focused on the systematic development of an authentic game called The Open Data Newsroom (Celis Vargas et al., 2024). The game is based on authentic open data practices to develop Data Literacy and Real-world problem-solving competencies (Celis Vargas et al., 2024). The Open Data Newsroom is a role-playing game where students play as data journalists to unravel an environmental mystery using and analysing open data. Four interventions in Danish schools were conducted with the participation of 78 students in 7th to 9th grade. The discoveries and outcomes of the second and third cycles help to define the to-be situation.

Research methodology applied for journalists

The analysis of the governance of journalists as potential contributors consisted of three main components: First, a systematic literature review was conducted to identify key areas of focus regarding open data and journalism. Second, three semi-structured interviews were carried out with journalists and data analysts from small media organizations in the European Union that emphasize data journalism. Expert sampling was employed to select participants who are actively using data in their journalistic work, thus ensuring their expertise in the domain of data journalism. Specifically, one journalist from Eurologus in Belgium was interviewed online, along with one journalist and one data analyst from Divergent in Portugal, also interviewed online, and finally, the chief editor and a data analyst from Farosnet in Greece were interviewed in person. These interviews aimed to explore how journalists utilize open data and the challenges they face, guided by insights from the literature review. Lastly, ongoing action research is being conducted at Farosnet, where the researcher is embedded through the ODECO project, employing iterative cycles of planning, action, and reflection to identify and address specific needs and challenges in integrating open data into reporting. The collected data from the interviews and action research are being analysed through a qualitative content analysis approach, where audio recordings were reviewed to extract key concepts and themes using an inductive coding process, allowing for a comprehensive understanding of journalists' experiences and challenges in utilizing open data.

Research methodology applied for NPOs

The case studies of four NPOs were conducted: Open Knowledge Belgium (OKB), Open Knowledge Foundation Germany (OKFG), Open Knowledge Foundation (OKF) and CityLAB Berlin. These organisations are focused on openness of knowledge and data, and on innovation and digitalisation of public services. The selection criteria for the case studies were: 1) Non-profit organisations should have different missions/focuses/aims, 2) Each case should have more than one type of open data project, 3) The cases work on different levels, i.e., municipal/regional/national/international, and 4) The cases involve organisations and people willing and ready to cooperate in the research and share information required to conduct this research. Semi-structured one hour interviews were conducted online and in-person with employees of these four organisations. We interviewed thirteen employees who work on open data-related projects within these NPOs. Additionally, we collected information from public web pages describing the open data projects of these NPOs. The deductive approach was used as collected data was analysed by using the codes based on the existing governance mechanisms theory, such as, instruments and enablers groups of codes.

Research methodology applied for commercial organisations

The analysis of commercial organisations focused on the case study of OpenStreetMap, a global crowdsourcing project for contributing and reusing open geospatial data where individual and organisational actors interact. Commercial organisations have willingly contributed value and data to the project since the early days of it, with a dynamic ecosystem flourishing around it. Hence it is a prime example to demonstrate the as-is and to-be governance instruments for commercial organisations. Data was collected through semi-structured interviews with employees of 25 companies (7 big corporations and 18 SMEs) who use and contribute to OpenStreetMap and through analysis of the OpenStreetMap Wiki and OpenStreetMap Foundation webpages. The companies in the Organised Editing Activities and Foundation Corporate members lists were contacted, and the final list was completed with companies met through OSM community events, and those proposed by the interviewees. Data analysis of the interviews was made with inductive reasoning, by extracting keywords, to find the common motivations and barriers to contribute open data.

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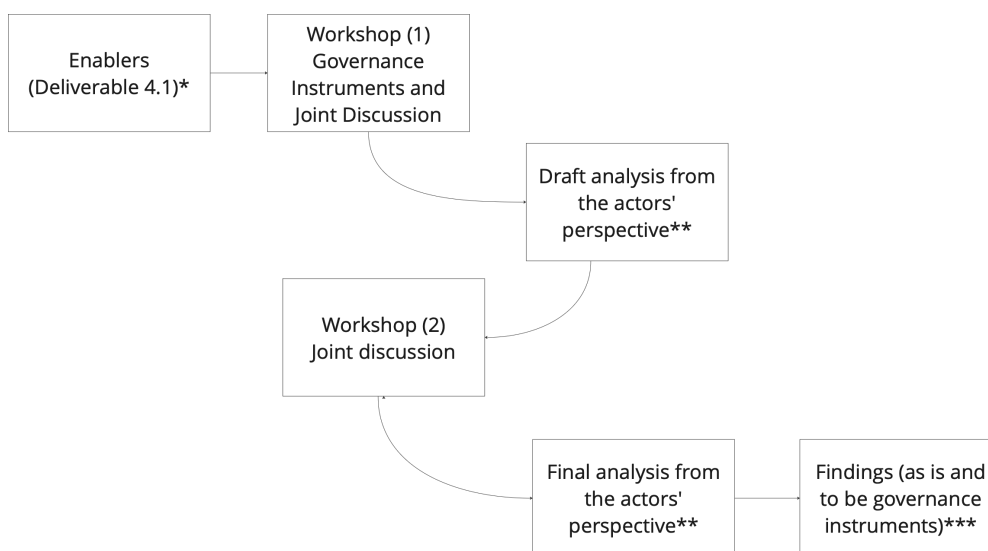
Research methodology applied for intermediaries

Insights on the existing (as-is) and potential (to-be) governance instruments to stimulate open data intermediaries to share open data are based on the case studies of Esri and OpenStreetMap (OSM). We conducted 53 in-depth interviews with representatives from these two organizations and other relevant stakeholders, such as open geospatial data providers and end-users. The interviewees are in charge in the managerial or technical aspects of open data. These two organizations were selected due to their significant contributions to the open geospatial data ecosystem in the last decade. We analysed the interviews through abductive approach, following the governance instruments in Table 1. Esri is a multinational geospatial software company that has long been an open data intermediary. It serves such a role in multiple ways, such as by collecting and pre-processing open data from various sources and offering the ready-to-use data in its software (called ArcGIS), providing consultation services to open data providers and users, and developing applications and visualizations based on open data. OSM is a geospatial data crowdsource platform. While the OSM Foundation (OSMF) provides leadership, OSM is run by the community who contribute, reuse, and build applications based on the open data on the platform.

From the analysis of the different actors' perspectives to the results

After conducting an initial analysis from the perspectives of the various actors using the research methodology outlined in the previous sections (Draft analysis), we discussed the preliminary results in a second workshop (Workshop 2). The aim of the second workshop was to resolve any theoretical ambiguity that might have arisen from the application of the theoretical framework. In some cases, for instance, researchers were aware of the existence of mechanisms that could enhance non-governmental open data sharing; yet they could not clearly associate them with one of the governance strategies. Following this, the analysis from the actors' perspectives was finalized (Final analysis), leading to the derivation of key findings—namely, a list of governance instruments that currently enable or could potentially enable non-governmental open data sharing. These instruments are presented in Section 10 of this document. The following figure (Figure 1) summarizes the multi-step research approach adopted in this deliverable.

Figure 1: The overall research methodology



*Enablers identified in deliverable 4.1. Namely: Training in data skills and literacy, Access to appropriate technical tools, Alignment of private value with open data sharing, Sufficient resources (financial, time, people), Existence of data-sharing communities, Awareness of the social impact of open data sharing, Engagement or enjoyment activities

**Analysis based on: Literature Review, Case Studies, Design-Based Research, and Action Research

*** Findings presented in Section 10 of this document

4 As-is / to-be non-specialist actors

4.1 Introduction

Non-specialist actors are those who do not possess specialised skills for data analysis, but who can still benefit from the reuse of open data. In recent years, governments and private entities have started engaging with non-specialist actors through open data hackathons (Purwanto et al., 2018), and other “accelerated design events” (Falk, 2022). At an open data hackathon, participants - including non-specialist actors - come together over a short period of time (usually 1-2 days) to create together solutions that make use of open datasets. As such, it is relevant to study how open data hackathons, as a system, can become more circular and inclusive. Different stakeholders come together to support the event, and new datasets are made available as open data both in the “pre-hack” and “post-hack” phases (Concilio et al., 2017). Throughout hackathons (and similar accelerated design events) participants can form new networks and learn to work together with open data. Non-specialist users can make an important contribution at these events, by sharing their contextual knowledge, and their “thick” (i.e. qualitative) data regarding issues that can be solved with open data. In this section, we go over the current (as-is) and desired (to-be) governance instruments that can stimulate non-specialist users (in the context of open data hackathons) to share their knowledge (data).

4.2 As-is: Non-specialist actors

We summarised the current governance instruments stimulating non-specialist actors to participate in the open data hackathon ecosystem in table 4. They are based on a variety of mechanisms, which we discuss in this section. In the context of open data hackathons, the establishment of coordinating functions or entities (S1) is leveraged, as these events tend to form at least a temporary organising committee, dedicated to bringing together multiple stakeholders, from local organisations to local government and institutions, as well as private companies. Each stakeholder can contribute to the event by making technical tools available to participants (e.g. APIs offered by tech companies), open data (e.g. local government opening previously closed datasets), or with funding for the event in exchange for sponsorships. Open data hackathons also leverage systems for information exchange and sharing (S5). For example, IT companies often provide APIs and other technical tools for free to participants, in order to promote their product and introduce more people to their ecosystem. In terms of *partnerships* (S7), open data hackathons leverage this instrument by forging new relations among stakeholders both in their “pre-hack” and “post-hack” phases (Concilio et al., 2017). The “financial management: joined up working and cooperation” (M4) mechanism, is also leveraged in open data hackathons, as they commonly offer monetary rewards and post-event incubation (including facilitating business connections, offering shared workspaces and mentoring) to selected teams. Finally, the capacity building mechanism (M6) is adopted in two ways: (1) previous research has found that open data hackathons can do “community capacity building”, and (2) teambuilding activities and the overall “pressure-cooker” (Mulder & Kun, 2019) environment of these events creates an engaging atmosphere for participants. For example, as highlighted in the final report of the Nordic AI and Data Hackathon (Rambøll Management Consulting, 2022): “Participants demonstrated high levels of engagement across the three venues”. However, organisers also noted that in-person hackathons were more successful than online ones at “dynamic, interesting event.”

Table 4: Current governance instruments stimulating non-specialist actors to participate in open data hackathon ecosystems

Instruments Enablers	S1	S5	S7	M4	M6
Availability of training in data skills and literacy					
Availability of appropriate technical tools		Provision of APIs and technical tools by organising partners			
Alignment of private value and interests with open data sharing			New partnerships between stakeholders during the “pre-hack” and “post-hack” phases		
Availability of resources (financial, time, people/ workforce)				Award funding and incubation resources to promising teams and products	Community capacity building
Existence of data sharing communities	Living labs and hackathon organisational committees				
Awareness about the social impact of open data sharing					
Presence of engagement or enjoyment activities					Teambuilding activities and “pressure-cooker” environment

4.3 To-be: Non-specialist actors

We identified five structural governance instruments and one managerial instrument in an ideal, “to-be” scenario, which we summarized in table 4. Starting with the establishment of coordinating functions or entities (S1), governmental bodies at the EU level should consider establishing permanent hackathon organisation committees for open data hackathon. The EU Publications Office already maintains a public calendar of open data events (including hackathons), and, up until 2022, used to organise an annual EU Datathon. Given the benefits in terms of community building and skills development offered by hackathons, these efforts should continue and be further strengthened. Our second recommendation concerns the reshuffling division of competences (S2). Organisers should adopt specific group formation strategies at the hackathon event, in order to ensure the cooperation of expert and non-specialist actors. A more flexible division of competences is needed to include non-specialist actors in decision-making processes concerning open data utilization, ensuring their insights and contextual knowledge are integrated into the final output. Our third recommendation is related to the establishment of a legal framework (S3). Open data hackathon participants should be invited to share their contribution and output under an open license. In the current state, hackathon contributions often have unspecified or proprietary licensing. Our fourth recommendation is on the systems for information exchange and sharing (S5). To facilitate the collaboration between expert and non-specialist actors, all participants should be invited to use the same beginner friendly tools. In the current state, the use of advanced tools often excludes non-specialist actors’ contributions. Our final recommendation is about the financial management (M2). Organisers should aim at lowering financial barriers for non-specialist participants, such as offering grants or stipends to cover participation costs. Additionally, allocating funds to develop resources that specifically support non-specialist engagement, like educational materials or beginner-friendly datasets, can further stimulate their participation.

Table 5: Desirable governance instruments stimulating open data non-specialists actors to participate in the open data hackathon ecosystem

Instruments Enablers	S1	S2	S3	S5	M2
Availability of training in data skills and literacy					
Availability of appropriate technical tools				Invite both expert and non-specialist participants to use the same beginner friendly tools	
Alignment of private value and interests with open data sharing			Inviting hackathon participants to make their solutions available under an open license		
Availability of resources (financial, time, people/workforce)	Establishing a permanent coordination body for hackathon events, in connection to open data initiatives				Lowering financial barriers for non-specialist participants
Existence of data sharing communities					
Awareness about the social impact of open data sharing					

Instruments Enablers	S1	S2	S3	S5	M2
Presence of engagement or enjoyment activities		Use appropriate group formation strategies at open data hackathons			

4.4 Conclusion

Open data hackathons are moving away from meetups of exclusively specialist actors and are starting to include a broader audience. While they already leverage governance instruments such as the establishment of coordinating entities, as well as systems for information exchange, further steps should be taken to incentivize non-government data holders to share open data. This includes the creation of permanent open data hackathon organisation committees, the adoption of group formation strategies tailored for non-specialist actors, as well as lowering financial barriers for non-specialist participants.

5 As-is/to-be elementary schools

5.1 Introduction

Elementary school students are children and young people engaged in formal learning environments in basic school education from 1st to 9th grade aged 7 to 16 years old. In the open data context, they have been seen as part of the large percentage of citizens without technical backgrounds, often referred to as non-specialists, non-data experts or lay audiences (Boyles, 2020; Concilio & Mulder, 2018). Integration of open data in school education has not just been claimed as an important strategy to increase inclusiveness and fairness in open data ecosystems (International Open Data charter, 2015), but also, as a way to foster in elementary school students essential skillsets for data management and for engagement with real-world environments and communities (Celis Vargas et al., 2023).

Elementary school students can be seen as non-governmental actors in open data ecosystems when using open data during learning activities. Although elementary school students are currently users of open data rather than contributors, in ODECO deliverable 3.1 we have under covered their potential contributions such as the creation of local datasets, and their motivations to share the data created in learning activities (Ktistakis et al., 2023). In this section, we explore how to incentive governance instruments building on the motivations of elementary school students as non-governmental open data users to open their data. The following analysis provides insights on the existing (as-is) and potential (to-be) governance instruments to stimulate elementary school students to share open data.

5.2 As-is: elementary school students

Although the research importance of open data in elementary education has been increasing, current open data initiatives in school have been focused on elementary school students as users of open data rather than contributors in open data ecosystems. According to Van Loenen et al. (2021) current open data systems in education are mainly exclusive and mostly linear. In elementary school, the exploration of open data rather than the students' creation of it has been prioritised (Pellegrino & Antelmi, 2023) to teach subjects such as geography, history, or statistics (Atenas et al., 2015; Coughlan, 2020). The as-is situation could be seen as a reflection of the barriers identified in previous studies for students to open their data in open data ecosystems. The main barriers found in the ODECO deliverable 4.1 are (i) the lack of technical skills from teachers and significant training, (ii) updating classroom technology, (iii) the concept of open data being highly abstract, (iii) low awareness about what is open data, and (iv) the risk of disclosing personal data from young pupils (Re et al., 2024).

The as-is situation presented in Table 6 shows few current governance instruments regarding elementary school students as providers of open data. The findings are not specific for the context of sharing or using open data, but these show the context of elementary schools and relate to the use of open data or to the development of competencies for engaging in open data ecosystems. Three structural governance instruments related to several enablers were identified. Firstly, a qualitative study in a Danish school helped to identify the establishment of legal frameworks (S3) from the Ministry of education but also from municipalities, for example, the municipality of Billund in Denmark has made compulsory the adoption of project-based and playful learning in elementary school education. Previous research has identified that these learning elements are relevant in learning designs for developing open data competencies (Vargas et al., 2024). Secondly, interviews with teachers provided insights on the current technical tools used by teachers for finding and sharing data for learning activities such as open educational tools and resources, school platforms and government statistics portals. These technical tools are not specific for open data, however, could be seen as structural instruments and systems for information exchange and

sharing (S5). Finally, a literature review highlighted the presence of partnerships (S7) as a recurrent cooperations between schools and other organisations to create extracurricular learning activities or support learning activities in the classroom. Partnerships are made with several purposes which relate to different enablers. Regarding the training in data skills and literacy, the Coding Pirates^[OEI] partnership focuses on building computational and IoT thinking, and programming languages practice for children. Concerning the availability of resources (financial, time, people/ workforce), the Children's General Assembly (CGA) partnership, a public, private and non-profit partnership, joins for rising the voice of children from different countries to world leaders of the United Nations about their perspectives and solutions to current world issues. In relation to the awareness about the social impact of open data sharing, the Green Schools^[OEI] partnership promotes sustainability education in Danish school. These examples of partnerships in the elementary school context show the importance of contextualising open data practices and initiatives.

Table 6: Existing governance instruments stimulating elementary school students to participate in the open data ecosystem and share open data

Instruments Enablers	S3	S5	S7
Availability of training in data skills and literacy	Project based and playful learning regulation by the Municipality of Billund		Coding pirates
Availability of appropriate technical tools		Open educational tools and resources School platforms Government statistics portals	
Alignment of private value and interests with open data sharing			
Availability of resources (financial, time, people/ workforce)			Children's general assembly
Existence of data-sharing communities			
Awareness about the social impact of open data sharing			Green schools
Presence of engagement or enjoyment activities			

5.3 To-be: elementary school students

Considering youngsters as future active citizens in a fast changing and data-driven society, elementary school students aged 14 to 16 years old have been at the centre of long-term Open Data Literacy initiatives (Pellegrino & Antelmi, 2023). Research in learning designs for open data competencies in elementary school has stressed the importance of authenticity for building Data Literacy and Real-world problem-solving competencies fostering students as active citizens and local experts (Vargas et al., 2024). Learning designs for open data competencies in elementary school enable young citizens as active contributors in open data ecosystems. Open Data learning designs drive the creation and sharing of open data created by elementary school students. The new role of elementary school students as contributors might involve different interactions or collaborations with other actors or systems which requires the development of governance

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instruments. Potential governance instruments might support them in their new role as contributors. Learning activities might include several approaches for the creation and sharing of open data. In data collection activities, students could create and contribute with local datasets about their environment or associated to local issues. As the outcome of data exploration learning activities, students could create new dataset(s) from the analysis of current Open Government Data or Open Research Data in citizen science projects.

Considering the potential situation where elementary school students create and share open data to the ecosystem, table 7 summarises the potential governance instruments needed. By systematically developing an open data learning design with students and teachers from 7th to 9th grade to develop competencies for participating in open data ecosystems, six structural governance instruments, four structural instruments and two managerial instruments, related to several enablers were identified. First, the establishment of coordination functions and entities (S1) such as projects for schools led by the Danish Digitalization Agency and the promotion of awareness about open data from local municipalities. These structural instruments connect to three enablers: availability of training in data skills and literacy, the availability of appropriate technical tools, and the awareness about the social impact of open data sharing. Second, the development of systems for information exchange and sharing (S5) supporting the existence of data-sharing communities. The ministry of education might develop systems to support school data-sharing communities, and the Digitalization Agency might support the creation an interactive interface for teachers and students in the Danish open data portal. Third, the establishment of entities for collective decision-making (S6) could be related to two enablers: the alignment of private value and interests with open data sharing, when initiatives are from research centres or urban development companies, and the presence of engagement or enjoyment activities when bridging the community and the school around the creation of open data in the real context. A final structural instrument might enhance current partnerships (S7) such as Coding Pirates, CCA and Green Schools by focusing on providing tools and methods for using, creating and sharing open data. On the other hand, two more managerial instruments were identified. First, applying strategic planning (M1) in schools as relevant actors to drive data-sharing communities. Second, financial management: input-oriented (M2) might be related to three enablers. The investment for increasing the availability of training in data skills and literacy and the availability of appropriate technical tools for schools, teachers and elementary school students. Funding for increasing the availability of resources (financial, time, people/ workforce), for example as an initiative of the Ministry of education for allocating resources and workflow.

Table 7: Potential governance instruments stimulating elementary school students to participate in the open data ecosystem and share open data

Instruments	S1	S5	S6	S7	M1	M2
Enablers						
Availability of training in data skills and literacy	Projects for schools led by the Digitalization Agency			Support current partnerships		Investment
Availability of appropriate technical tools						
Alignment of private value and interests with open data sharing			When initiatives are from research centres or urban development companies			
Availability of resources (financial, time, people/ workforce)						Ministry of education allocating resources and workflow
Existence of data-sharing communities		Ministry of education developing systems to support school data-sharing communities The Digitalization Agency creating an interactive interface for teachers and students			School as a relevant actor	

Instruments Enablers	S1	S5	S6	S7	M1	M2
Awareness about the social impact of open data sharing	Local Municipalities promote awareness					
Presence of engagement or enjoyment activities			Bridging the community and the school around Open Data			

5.4 Conclusion

The as-is and to-be situations show a gap between the ongoing approaches of open data in education that focus on the exploration of open data, and the potential development of learning designs for open data competencies. Although the use of open data in the classroom has shown to increase civic awareness, the potential is unexploited due to the current lack of governance mechanisms. The to-be situation outlines a richer development of governance mechanisms to support a wider spectrum of abilities that enable elementary school students not just as contributors in open data ecosystems, but also, as active actors in local communities and experts of their daily life environment. Although this study provides an overview of the governance mechanisms that might contribute to position elementary school students as active citizens and contributors in open data ecosystems, a bottom-up perspective to enhance current practices might drive further research and contribute to the sustainability of open data learning designs in schools. The insights presented in this study are based on empirical research based in Denmark and take into consideration the Danish educational system and Open Data ecosystem, further research might explore the perspective of elementary school students in different contexts.

6 As-is / to-be Non-Profit Organisations (NPO)

6.1 Introduction

Non-Profit Organisations (NPOs) in this section, are intermediaries in the open data ecosystem who bridge the gap between data providers and users (González-Zapata & Heeks, 2015). Historically, NPOs pushed for data openness, developed the open data research field (Enaholo, 2017), and contributed to open data being back in the open data ecosystem in many ways. For example, they can produce or aggregate open data and re-share it with the users. They also often enhance the data, for example, by improving its quality or dealing with missing values. NPOs can also lobby for or request the data the users need on their behalf from the data providers and republish it.

In this section, we describe the insights on the existing (as-is) and potential (to-be) governance instruments to stimulate NPOs to share open data based on the case studies of four NPOs: Open Knowledge Belgium (OKB), Open Knowledge Foundation Germany (OKFG), Open Knowledge Foundation (OKF) and CityLAB Berlin. These organisations are focused on openness of knowledge and data, and on innovation and digitalisation of public services. The selection criteria for the case studies were: 1) Non-profit organisations should have different missions/focuses/aims, 2) Each case should have more than one type of open data project, 3) The cases work on different levels, i.e., municipal/regional/national, and 4) The cases involve organisations and people willing and ready to cooperate in the research and share information required to conduct this research. Semi-structured one hour interviews were conducted online and in-person with employees of these four organisations. We interviewed thirteen employees who work on open data-related projects within these NPOs. Additionally, we collected information from public web pages describing the open data projects of these NPOs. Collected data was analysed by coding it using the codes based on the existing governance mechanisms theory i.e. with the deductive approach.

6.2 As-is: non-governmental intermediaries

Table 8 shows the existing governance instruments that encourage non-profit intermediaries to share open data. The instruments are mainly based on the network mechanism, with one hierarchical instrument and without any market-based instruments. The hierarchy-based instrument is the *establishment of the legal framework (S3)* that supports the availability of training in data skills and literacy. NPOs can help create an open data legal framework, which would ease open data publishing and use by different stakeholders, including NPOs. For example, OKF, together with other stakeholders, created Open Data Commons and Open Definition. Open Definition is a set of legal tools and licenses to help publish and use open data, while Open Definition sets our principles to define the “openness” of data.

Similarly, supporting the availability of training in data skills and literacy is the network-based instrument of *systems for information exchange and sharing (S5)*. As an example, OKF is working on a tool called Open Data Editor that will allow users to work with data in a more simplified way and publish their data easily so that NPOs who may not have all the needed data skills can be helped with publishing their data. The next network instrument is *partnerships (S7)*. OKFG works together with the “Code for ...” community of volunteers. Volunteers provide technical expertise, as many of them have substantial data skills. That supports the availability of training in data skills and literacy, enabling the execution of technical projects for which NPO might not have had technical resources. Additionally, OKFG helps open up data for the “Code for...” volunteering community, sometimes taking the lead on talking to public organisations to open up the data needed. This relationship supports the enabler of the existence of data-sharing communities. Another example is that OKFG is part of the F5 alliance of five NPOs that seeks to have a dialogue with policymakers on the topics of digital policy, open data, and digital security. CityLAB Berlin is

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also working together with other organisations under the non-profit foundation umbrella of Technology Foundation Berlin. This supports alignment of private value and interests with open data sharing.

Another network instrument is *financial management: joined up working and cooperation (M4)*. OKB is an umbrella organisation which supports open-data grassroots projects/communities by providing a legal structure and financial support. Thus, those communities can share the open data under the organisational umbrella while not having bureaucratic hurdles, which supports the availability of resources enabler.

Inter-organisational culture and knowledge management (M5) is another network instrument. Openness is one of the values shared within the open data NPOs as part of the cultivated and shared organisational culture of these organisations, which supports the alignment of private value and interests with open data sharing. NPOs aim to create a social impact as part of the cultivated and shared organisational culture, which means they have an awareness about the social impact of open data sharing. Additionally, the organisational culture of NPOs is often less hierarchical, and employees can propose and take part in projects they enjoy, which means they have a presence of engagement or enjoyment activities to motivate open data sharing.

The last network-based instrument is *capacity building (M6)*. OKF and OKFG support other NPOs in gaining skills to publish or work with open data, for example, through providing training and advice. That helps with *the availability of training in data skills and literacy* to help NPOs publish the open data.

Table 8: Existing governance instruments stimulating NPOs to participate in the open data ecosystem and share open data

Instruments Enablers	S3	S5	S7	M4	M5	M6
Availability of training in data skills and literacy	OKF created Open Data Commons and Open Definition	OKF is working on a tool Open Data Editor that will allow users to work with data in a simplified way and publish their data easily	OKFG works together with the "Code for ..." community of volunteers. Volunteers provide technical expertise.			OKF and OKFG support other NPOs in gaining skills to publish or work with open data
Availability of appropriate technical tools						
Alignment of private value and interests with open data sharing			OKFG is part of the F5 alliance of five NPOs around digital policy; CityLAB Berlin is working together with other organisations under the non-profit foundation umbrella		Openness is one of the values shared within the NPOs as part of the cultivated organisational culture	
Availability of resources (financial, time, people/ workforce)				OKB is an umbrella organisation which supports open data grassroots projects/communities		

Instruments Enablers	S3	S5	S7	M4	M5	M6
				by providing a legal structure and financial support		
Existence of data-sharing communities			OKFG helps open the data for the "Code for..." volunteering community			
Awareness about the social impact of open data sharing					NPOs aim to create a social impact as part of the cultivated organisational culture and aims	
Presence of engagement or enjoyment activities					The organisational culture of NPOs is less hierarchical, and employees can propose and take part in projects they enjoy	

6.3 To-be: non-governmental intermediaries

Table 9 shows the potential governance instruments to stimulate non-profit intermediaries to contribute open data. The network-based instrument of *systems for information exchange and sharing (S5)* can be used to create a common platform for NPOs to share open data, similar to open data government portals, and some NPOs voice interest in having such a portal. The existence of such a portal could help with the availability of appropriate technical tools and availability of resources that many NPOs lack and, thus, are unable to share their data as open data.

Another network instrument is *financial management: joined up working and cooperation (M4)*. Financial resources are often scarce, so to tackle the availability of resources to support the projects' execution and their long-term support, more financial cooperation is needed. There are existing examples of such cooperation, such as the OKF network, that can help other open knowledge organisations financially. Such a solution should be promoted, especially across the countries, to help distribute the resources to the NPOs with less support.

The *capacity building (M6)* network instrument can also be used to ensure the availability of training in data skills and literacy and the awareness about the social impact of open data sharing of the NPOs. Some non-profit intermediaries that have valuable data do not have the needed technical skills to publish open data or are not aware of open data's potential impact. To help deal with that, NPOs or governmental organisations can promote training or workshops.

Table 9: Potential governance instruments stimulating NPOs to participate in the open data ecosystem and share open data

Instruments Enablers	S5	M4	M6
Availability of training in data skills and literacy			Promote training to improve technical skills for NPOs that lack them
Availability of appropriate technical tools	NPOs voice interest in having a common platform for open data sharing		
Alignment of private value and interests with open data sharing			
Availability of resources (financial, time, people/ workforce)	NPOs voice interest in having a common platform for open data sharing	Financial resources are often scarce, so to support projects long-term, more financial cooperation is needed	
Existence of data-sharing communities			

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Instruments Enablers	S5	M4	M6
Awareness about the social impact of open data sharing			Promote training to improve open data awareness for NPOs that lack it
Presence of engagement or enjoyment activities			

6.4 Conclusion

As-is situation shows that NPOs' are motivated to share due to mainly network governance mechanisms, with one hierarchical instrument and without any market-based instruments. There's mutual support between/within this type of organisations, together with similar mission or focus on openness, which motivates them and provides the space for them to share open data. The definition of being a non-profit or non-governmental organisation explains why network mechanisms are preferred, and no market-based ones are utilised, as the motivations do not lie in the profit-making lane but focused on the societal issues. To-be potential for open data sharing, similarly, shows that NPOs will benefit from network mechanisms as in as-is situation. Specifically, building an infrastructure in the form of NPOs shared open data portal together with receiving financial resources for projects like that, would improve the organisations' ability to share their data even more effectively. It is important to note, this research' case studies are with smaller sized non-profit organisations, which might present a limited set of results. Further research might explore NPOs of a bigger size as different results might be achieved due to bigger organisations having more resources, mainly financial ones.

7 As-is / to-be Journalists

7.1 Introduction

Journalists investigate, collect, and present information as news stories to the public through various channels and formats. They play a crucial role in keeping the public informed and holding power to account (Kovach & Rosenstiel, 2007).

The use of open data in journalism, or data journalism, involves using data to uncover, analyse, and craft compelling stories by merging traditional journalism techniques with data analysis and visualization. Although data journalism has been practiced since the 19th century, its popularity has increased in recent years due to the abundance of information available to journalists (Gray et al., 2012). In the past, the main struggle was to collect and compile data sets; now, the focus has shifted to data analysis due to the plethora of data available from various sources (Rogers, 2013).

While open data has played a role in this shift and can be a valuable resource for journalists, the openness of the data is not their primary concern. Journalists are mostly focused on the accuracy, relevance, and usefulness of the data, and the impact they can achieve by using it in their stories, regardless of whether the data is publicly accessible or obtained through other means (Bradshaw & Rohumaa, 2013).

Journalists are mostly users of open data. The most common use is republishing existing visualizations of data to inform their audience. However, they also use raw open data, analysing it and publishing their findings to the audience through various types of visualizations (tables, figures, maps, etc.) to support their stories. There are also cases where media organizations release datasets as open data, but these are exceptions and more common in large media organizations (Coddington, 2015)

The research methodology consists of three main components: First, a systematic literature review was conducted to identify key areas of focus regarding open data and journalism. Second, three semi-structured interviews were carried out with journalists and data analysts from small media organizations in the European Union that emphasize data journalism. Specifically, one journalist from Eurologus in Belgium was interviewed online, along with one journalist and one data analyst from Divergent in Portugal, also interviewed online, and finally, the chief editor and a data analyst from Farosnet in Greece were interviewed in person. These interviews aimed to explore how journalists utilize open data and the challenges they face, guided by insights from the literature review. Lastly, ongoing action research is being conducted at Farosnet, where the researcher is embedded through the ODECO project, employing iterative cycles of planning, action, and reflection to identify and address specific needs and challenges in integrating open data into reporting. The collected data from the interviews and action research are being analysed through a qualitative content analysis approach, where audio recordings were reviewed to extract key concepts and themes using an inductive coding process, allowing for a comprehensive understanding of journalists' experiences and challenges in utilizing open data. Through the interviews and action research in the HuffPost Greece branch, it has been continuously revealed that journalists are reluctant to share their data without monetary compensation.

7.2 As-is: Journalists

The current state of governance instruments that encourage media organisations to share data in the open data ecosystem is depicted in table 10. There is a lot of training available for journalists in the use of data, and some is provided by media organizations (Establishment of coordinating functions or entities, S1), indicating an interest in developing these skills in the community.

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However, this training is not specifically focused on open data. The focus is mostly on the analysis of data and the outcomes that can be extracted rather than whether the data is open or from other sources. There is an increase in data-specialized teams in large news media and small data journalism organizations (Reshuffling division of competences, S2). This leads to new specialized roles that have to focus on the use of technology and combine it with traditional storytelling journalistic practices. Sophisticated tools for data collection, analysis, and presentation have also been developed, but there are no specialized tools for open data sharing (Systems for information exchange and sharing, S5). In the case of The Guardian, they are sharing some of the datasets they have compiled through Google Sheets so anyone interested can download and use them. It has been observed in academic publications that collaboration occurs between journalists and other specialists inside organizations. Some noteworthy examples are Boyles (Boyles, 2020), which examines journalism hackathons as spaces for collaboration between journalists and technologists, and Baack (Baack, 2018), who highlights the shared practices between journalists and civic hackers and their goals in using open data to inform and engage the public. There have also been academic publications (Handler & Ferrer Conill, 2016; Palomo et al., 2019) presenting cases where journalists reached out and collaborated with their audience to collect and analyse data, as well as to extract expertise to understand specialized topics or help them with the analysis of large amounts of data. In particular, La Nación Data (Palomo et al., 2019), an Argentinian news organization, has reached out to their active audience to help them collect and open data through their Vozdata platform, and subsequently released the collected data as open data. Another interesting publication is the presentation of the Guardian's analysis (Daniel & Flew, 2010) of MPs' expenses, where the public was invited to help in the data analysis (Partnerships, S7).

From a managerial perspective, although the formation of data journalism teams is not a common occurrence in media organizations, the hiring and training of specialists to use data is a cornerstone of strategic planning towards a new direction (Strategic planning, M1, Inter-organizational culture and knowledge management, M5). Capacity building initiatives such as workshops and hackathons help journalists not only improve their networks, locate and potentially recruit tech-skilled individuals like programmers and civic hackers but also help to align their goals with those of other actors in the open data ecosystem (Capacity building, M6).

Table 10: Current governance instruments stimulating journalists users to participate in open data hackathon ecosystems

Instruments Enablers	S1	S2	S5	S7	M1	M5	M6
Availability of training in data skills and literacy	News organizations provide training in data skills to their journalists. Through workshops and online courses				News organizations provide training in data skills to their journalists. Through workshops and online courses		
Availability of appropriate technical tools			Using tools for data analysis and sharing			The use of tools for the publication and popularisation of their work aligns with managerial goals	
Alignment of private value and interests with open data sharing							Promotion of transparency and accountability is key for journalists
Availability of resources (financial, time, people/ workforce)		Hiring data analysts and researchers					

Instruments Enablers	S1	S2	S5	S7	M1	M5	M6
Existence of data-sharing communities			Collaborative projects and tools are promoted from international originations	Partnerships between media organizations, tech specialist or academics help align interests towards the effective use of open data			
Awareness about the social impact of open data sharing							
Presence of engagement or enjoyment activities				Hackathons and workshops for innovation			Hackathons and workshops for innovation

7.3 To-be: Journalists

The to-be state of governance instruments that can encourage media organisations to share data as open data in the open data ecosystem is depicted in table 11.

As it has been mentioned above, in chapter 7.1, although there are available resources online, the training of journalists in open data is not considered a priority in many newsrooms. Most of the training programs are focusing on general data analysis and they are using open data as datasets for training, an important function. However, to enhance the importance of open data as a pillar of journalism, more focused training that covers the principles of openness and transparency is of vital importance (Establishment of coordinating functions or entities). Although there are many tools available, the main issue is not the lack of specialized tools for journalists to share open data. Instead, the real problem is the willingness of media organizations to prioritize and commit to sharing open data initiatives.

Although the design of specialized tools could boost the limited endeavours that exist at the moment, it is mainly a conceptual impediment as media organizations often perceive data as a valuable resource that they are not willing to share. To alter this perception, the importance of increased transparency that they can achieve with the use of open data and the impact that can have on their audience and their engagement must be highlighted (Systems for information exchange and sharing, Capacity building).

Furthermore, although there are cases where journalists are trained in open data or collaborating with experts, this is not a popular approach in media organizations. The importance of data incorporation into new articles must be highlighted through various means, including enhancing credibility, engaging the audience, facilitating transparency and providing improved storytelling. Management needs to recognize the commercial and business value of these benefits to justify allocating more resources to the use of open data (financial, time, personnel) (Strategic planning, Inter-organizational culture and knowledge management)

Table 11: Potential governance instruments stimulating journalists to participate in the open data ecosystem and share open data

Instruments Enablers	S1	S5	M1	M5	M6
Availability of training in data skills and literacy	Develop and offer training programs on open data				
Availability of appropriate technical tools		Specialized tools for open data sharing			
Alignment of private value and interests with open data sharing		Encourage the use of existing platforms and tools that support open data sharing			
Availability of resources (financial, time, people/workforce)			Allocate dedicated resources (financial, time, personnel) to support open data initiatives within media organizations.	Allocate dedicated resources (financial, time, personnel) to support open data initiatives within media organizations.	
Existence of data-sharing communities					
Awareness about the social impact of open data sharing					Successful case studies and examples where open data sharing has led to significant public benefits

Instruments Enablers	S1	S5	M1	M5	M6
Presence of engagement or enjoyment activities					Create interactive and engaging content using open data to demonstrate its value and potential to the audience

7.4 Conclusion

The use of open data by media organizations has high importance as it can provide them with an extra tool to enhance transparency and audience engagement. There are several governance instruments that can support them in this direction. The existence of a plethora of training options in data usage for journalists, although not specifically covering the domain of open data, can provide the basis for that. On the other hand, the majority of organizations are not utilizing these training options due to lack of willingness and inability to see their usefulness and advantages. Another significant impediment is that media organizations frequently perceive data as assets, which hinders their willingness to share their raw data, although they share their analyses and infographics. Therefore, it is essential to present to them the possible benefits they can have in terms of audience engagement. Finally, the formation of partnerships and collaborations between journalists and data specialists can help optimize the use of open data in media and enhance journalistic practices and storytelling through capacity building.

8 As-is / to-be commercial organisations

8.1 Introduction

Commercial organisations are defined as those whose goal is to make an economic profit. Depending on their field and necessities, commercial organisations may have different motivations to contribute data to open data ecosystems. To give a clear picture of commercial organisations' role in contributing to open data ecosystems, we used a case study where they actively contribute. OpenStreetMap (OSM), a geospatial open data ecosystem, is a case where this has happened since the project's early days (Maron, 2020). OpenStreetMap is a community-led (Park et al., 2020) platform where stakeholders of different types contribute and use its data. It can be classified as a successful initiative where a large number of diverse commercial organisations are contributing value to and taking a producer role as part of the broader community (Anderson et al., 2019; OpenstreetMap Foundation, 2024; OpenStreetMap Wiki, 2024). By studying OSM, we answer what governance instruments enable commercial organisations to contribute data to a collaborative open data project.

We interviewed employees who work with OSM in 25 commercial organisations (7 big corporations and 18 SMEs) to figure out how and why do they contribute open data to the project. We contacted companies listed in the OSMF Corporate Members list, and the Organised Editing OSM Wiki page, as well as companies met in OSM events and conferences attended by the ESR, and those proposed by the interviewees at the end of their interview. The interviews were semi-structured and conducted by a video call of 30 to 60 minutes long. Afterwards, keywords were extracted to create a list of barriers and motivations. As well, we analysed the OpenStreetMap Wiki and OpenStreetMap Foundation webpages, which serve as the official documentation for the project and its supporting body, respectively. With this methodology we aim to explore what is the current situation of commercial organisations contributing to the OSM project.

8.2 As-is: Commercial organisations

In this section we explain the as-is, the current situation for commercial organisations to contribute data to the open data ecosystem, in the use case of the OpenStreetMap (OSM) ecosystem.

The OpenStreetMap Foundation (OSMF), a non-profit organisation, has the role of supporting OSM, with its functions comprising legal representation, maintenance of the computer services that run the project, fundraising, conference organization, and supporting other tasks through dedicated Working Groups (communications, data/vandalism, engineering, communities, etc.). The OSMF has several Corporate Members (OpenstreetMap Foundation, 2024), who donate a yearly amount of money to help financially sustain the project and, in return, get a seat on the advisory board. These relate with the governance instruments of (S1) Establishment of coordinating functions or entities, and (M4) Financial management: joined up working and cooperation.

The advisory board has no direct voting on the OSMF decisions, but the OSMF board may consult them for important decisions, therefore, having an indirect say in the foundation's policymaking. On top of that, individuals affiliated with commercial organisations can take part in the Working Groups. As an example, in the Engineering Working Group, which coordinates software development efforts across the ecosystem, 3 out of the 9 members are directly related to and/or employed by commercial organisations which are part of the OSM Ecosystem. These relate with the governance instrument of (S1) Establishment of coordinating functions or entities.

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OpenStreetMap acts as a data-sharing platform, relating to the instrument (S5) Systems for information exchange and sharing, where commercial users can both use its data and contribute value to the ecosystem in the way of data, software, resources, and partnerships. Communities of Practice in the realm of software in the OSM Ecosystem, with MapLibre (<https://maplibre.org/sponsors/>) being an example of this, with several companies sponsoring the project and allocating resources to it. However, this software uses OSM data, but does not contribute data to it, but it can be seen as a role-model for interorganizational cooperation for private value. Rapid (<https://rapideditor.org/>) is an example of a software created by a commercial organisation (Meta Platforms) to add data to OSM, in partnership with other organisations (humanitarian non-profit: HOT, commercial: Esri), and which uses data sources generated also by commercial organisations (Meta's Facebook Roads and Microsoft's Building Footprints). Rapid editor is being used for the social good to rapidly map areas in need in humanitarian projects. This group encompasses the governance instruments of (S7) Partnerships, and (M4) Financial management: joined up working and cooperation.

In ODECO deliverable D4.1 (Re et al., 2024), we reported that enriching the data, by improving its quality, is a big motivation for commercial organisations to participate in open data contribution to OSM. This is due to the project's open licensing, which allows commercial use with few limitations. This relates to the instrument (S3) Licensing framework. Commercial organisations contribute data by employing paid editors, releasing data for imports, and empowering and supporting data improvement communities (Anderson et al., 2019; Papadimitriou, 2023; Re et al., 2024).

In deliverable D4.1, we also reported four barriers to share open data reported by commercial organisations: Technical/tools, license compatibility, insufficient resources (reported by SMEs), and resistance by other community members (reported by big corporations). These barriers found in the OSM Ecosystem have been some core reasons to establish the Overture Maps Foundation, by companies such as Microsoft, TomTom, Amazon Web Services, and Meta. The Overture Maps project is centered around corporate and developer needs, in contrast to OSM community focus, and allows commercial organisations to tackle technical (lack of appropriate data merging tools, license incompatibilities) and governance (resistance by community members¹) barriers in the OSM Ecosystem, to contribute geospatial data by commercial organisations. The emergence of Overture Maps encompasses the following governance instruments: (S1) Establishment of coordinating functions or entities, (S7) Partnerships, and (M4) Financial management: joined up working and cooperation. And the mentioned guidelines cover the instruments (S3) Legal framework, and (S4) Regulated markets.

Another example is Maproulette, a micro tasking tool used by other commercial organisations such as TomTom and Meta to contribute their data to OSM, circumventing the governance barriers previously mentioned. By allowing individual citizens to add and merge data in a micro tasking way, it does not count as an import and, therefore, it does not need to go through the community discussion and buy-in phase. This relates with the governance instrument of (S6) Entities for collective decision-making.

Regarding other cases of commercial organisations' open data sharing in the geospatial data domain, beyond OpenStreetMap, Papadimitriou (2023) reports on strategic, technical, legal, economic, and cultural barriers to open data sharing by private companies. The company Automotive Navigation Data (AND) shared in 2007 its entire street map of the Netherlands to OSM. Fugro shared in 2017 its bathymetry data to the GEBCO Ocean Map and Microsoft provided in 2018 their building

¹ Import Guidelines: <https://wiki.openstreetmap.org/wiki/Import/Guidelines>, and Organised Editing Guidelines: https://wiki.openstreetmap.org/wiki/Organised_Editing_Guidelines

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footprints data as open data. Regarding motivations of these organisations to share their data as open data, marketing the companies' expertise, products and services appears as a motivation. In the specific instance of Fugro, Papadimitriou (2023) notes that "as Fugro is a publicly traded company that also has to maintain a sustainable image, the Seabed 2030 project was a way to show that they are also contributing to their sustainability goals for a "better liveable world." This relates with the instrument (M1) Strategic planning.

Table 12: Existing governance instruments stimulating commercial organisations to participate in the open data ecosystem and share open data

Instruments Enablers	S1	S3	S4	S5	S6	S7	M1	M4	M5
Availability of training in data skills and literacy									
Availability of appropriate technical tools	Establishment of the OSM Foundation Engineering Working Group			Existence of the OpenStreetMap database	Creation of projects by commercial organisations in the micro tasking tool Maproulette, for individuals to merge their data using gamification techniques, circumventing import barriers	Communities of Practice, to develop shared tools (e.g. MapLibre, Rapid)		Communities of Practice, to develop shared tools (e.g. MapLibre, Rapid)	

Instruments Enablers	S1	S3	S4	S5	S6	S7	M1	M4	M5
Alignment of private value and interests with open data sharing	Different for-profit companies established Overture Maps Foundation to pool resources to produce fit-for-purpose open geospatial data. Corporations donate to the OpenStreetMap Foundation which, in turn, gives them access to a seat in the Advisory board.	Open Licensing, which allows commercial reuse, so companies can add data, and reuse the merged product				Different for-profit companies established Overture Maps Foundation to pool resources to produce fit-for-purpose open geospatial data	Fugro is a publicly traded company that also has to maintain a sustainable image	Different for-profit companies established Overture Maps Foundation to pool resources to produce fit-for-purpose open geospatial data. Corporations donate to the OpenStreetMap Foundation which, in turn, gives them access to a seat in the Advisory board.	
Availability of resources (financial,	Establishment of the OpenStreetMap and							Different for-profit companies established	

Instruments Enablers	S1	S3	S4	S5	S6	S7	M1	M4	M5
time, people/workforce)	Overture Maps Foundations							Overture Maps Foundation to pool resources to produce fit-for-purpose open geospatial data	
Existence of data sharing communities	Establishment of the OpenStreetMap and Overture Maps Foundations	Existence of Importing and Organised Editing Guidelines for data insertion in OpenStreetMap	Existence of Importing and Organised Editing Guidelines for data insertion in OpenStreetMap						
Awareness about the social impact of open data sharing	Establishment of the Humanitarian OpenStreetMap Team and Missing Maps		Existence of Importing and Organised Editing Guidelines for data insertion in			Establishment of the Humanitarian OpenStreetMap Team and Missing Maps			Establishment of the Humanitarian OpenStreetMap Team and Missing Maps

Instruments Enablers	S1	S3	S4	S5	S6	S7	M1	M4	M5
			OpenStreetMap						
Presence of engagement or enjoyment activities					Creation of projects by commercial organisations in the micro tasking tool Maproulette, for individuals to merge their data using gamification techniques, circumventing import barriers				

8.3 To-be: Commercial organisations

In this section we explain the to-be, the desired situation for commercial organisations to contribute data to the open data ecosystem, in the use case of the OpenStreetMap (OSM) ecosystem.

The barriers reported in ODECO deliverable D4.1 (Re et al., 2024) have to, in the desired situation, be lowered, with the establishment of governance mechanisms. As explained before, there is a pressing demand from community members to commercial organisations, especially big corporations, to provide accountability when contributing to the project. This is due to bad experience with imports in the early years of the project (Atakua, 2019; OpenStreetMap Wiki, 2023), paired with a fear of commercial organisations getting a dominant position and breaking the balance in the OSM governance. This situation, on the other hand, makes data imports, even if desired by commercial organisations, difficult to do and not worth it in several cases.

While understanding the OSM Community position, the OSM project is also losing potential value in the missing contributions. A balance needs to be created, that makes companies feel more welcome to contribute, while still ensuring data quality, correctness, and correct integration. For the specific case of OSM, we propose the creation of a Working Group in the foundation, to serve as a single point of contact to help data producers, providers, and intermediaries to align their data and procedures to the Import Guidelines, and to ensure proper sustainability mechanisms for this data. This Working Group would have close collaboration with the existing Data, Licensing and Engineering WGs. An attempt to create such a group existed already back in 2010 but was ultimately never finalised². This group encompasses the following governance instruments: (S1) Establishment of coordinating functions or entities, (S2) Reshuffling division of competences (with the aforementioned WGs), (S7) Partnerships, (M5) Inter-organizational culture and knowledge management.

We also suggest that the Engineering Working Group supports the creation and maintenance of more Communities of Practice around tools, such as the one mentioned in the as-is, with MapLibre, to tackle the technical barriers to open data sharing, as well as to utilize the technical motivations. This relates to the instruments (S7) Partnerships, and (M5) Inter-organizational culture and knowledge management. The creation of more tools should also be accompanied by the ease of use of some of them. Commercial organisations interviewed did not complain about such issue, but this is because all of the interviewed organisations are tech-savvy. Looking as well at the existing lists of OSM commercial contributors, there is a technical gap that we are not addressing. Non-technical organisations may not be contributing as much as they could, but lack of tools, resources, and expertise may be keeping them away.

In addition to it, mechanisms to improve motivations have to be considered. As seen as well with the interviewed organisations, and the lists of contributing organisations, more work is needed in aligning private value to the interests of open data sharing, with business models that work for commercial organisations. Most of the contributing companies are tech-savvy, and are in the information technologies (IT), social networks, transportation, or geographic information systems (GIS) businesses. There is a gap to be reduced by creating sustainable business models both using and contributing to OSM, that align to private values in domains outside those mentioned. We propose that the currently non-existent Import Support Working Group mentioned before, and which relates to the (S1), (S2), (S7), and (M5) instruments, also promotes OSM as a place where commercial organisations can keep up-to-date data of their business locations, similarly to how companies keep their business profiles in platforms such Google Maps. This would also help lower the gap in Point of Interest data quality (Klinkhardt et al., 2023; OpenStreetMap Community Forum, 2023).

² https://wiki.openstreetmap.org/wiki/Foundation/Import_Support_Working_Group

Table 13: Potential governance instruments stimulating commercial organisations to participate in the open data ecosystem and share open data

Instruments Enablers	S1	S2	S7	M5
Availability of training in data skills and literacy	Creation of an Import Support Working Group			
Availability of appropriate technical tools	Creation of an Import Support Working Group	Creation of an Import Support Working Group	Creation of an Import Support Working Group. Improvement of the Engineering Working Group.	Creation of an Import Support Working Group. Improvement of the Engineering Working Group.
Alignment of private value and interests with open data sharing	Creation of an Import Support Working Group			
Availability of resources (financial, time, people/ workforce)			Creation of an Import Support Working Group	Creation of an Import Support Working Group
Existence of data sharing communities	Creation of an Import Support Working Group		Creation of an Import Support Working Group	Creation of an Import Support Working Group
Awareness about the social impact of open data sharing	Creation of an Import Support Working Group		Creation of an Import Support Working Group	Creation of an Import Support Working Group
Presence of engagement or enjoyment activities	Creation of an Import Support Working Group			

8.4 Conclusion

In conclusion, the OSM ecosystem has demonstrated that commercial organisations can take an important role in contributing to Open Data Ecosystems, including data contributions. Their

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participation is motivated by a mixture of own-private values and social values. However, barriers exist in the technical and governance domains, including a great resistance by community members towards data imports and corporations' role in the ecosystem, hindering their potential in contributing to the project.

To overcome these barriers and encourage greater participation, we propose the creation of a dedicated working group in the OSMF to streamline and help with data imports, as well as to enhance collaboration between stakeholders. Furthermore, aligning business models with the goals of open data sharing can attract a wider range of commercial organizations beyond the currently dominating contributors: the tech-savvy industries, creating a more inclusive and robust ecosystem. This can be paired by fostering communities of practice and developing user-friendly tools that can address technical barriers and make it easier for non-technical organizations to contribute.

9 As-is/to-be open data intermediaries

9.1 Introduction

Open data intermediaries are defined as “third-party actors who provide specialized resources and capabilities to (i) enhance the supply, flow, and/or use of open data and/or (ii) strengthen the relationships among various open data stakeholders” (Shaharudin et al., 2023). Examples of open data intermediaries are software providers that pre-process open data and include the ready-to-use data in the software, platform providers that facilitate the sharing and reuse of open data, and app providers that integrate open data in the app functionalities. In most scenarios, open data intermediaries are not the original³ open data providers or end-users. However, they often pre-process open data (making it more readily usable), improve it (e.g., by rectifying errors), or augment it (by combining it with non-open data). Therefore, open data intermediaries could potentially share the pre-processed, improved, or augmented data back to the open data ecosystem for others to use.

In this deliverable, insights on the existing (as-is) and potential (to-be) governance instruments to stimulate open data intermediaries to share open data are based on the case studies of Esri and OpenStreetMap (OSM). We conducted 53 in-depth interviews with representatives from these two organizations and other relevant stakeholders, such as open geospatial data providers and end-users. The interviewees are in charge in the managerial or technical aspects of open data. These two organizations were selected due to their significant contributions to the open geospatial data ecosystem in the last decade. We analysed the interviews through abductive approach, following the governance instruments in Table 1. Esri is a multinational geospatial software company that has long been an open data intermediary. It serves such a role in multiple ways, such as by collecting and pre-processing open data from various sources and offering the ready-to-use data in its software (called ArcGIS), providing consultation services to open data providers and users, and developing applications and visualizations based on open data. OSM is a geospatial data crowdsource platform. While the OSM Foundation (OSMF) provides leadership, OSM is run by the community who contribute, reuse, and build applications based on the open data on the platform.

9.2 As-is: Open data intermediaries

Table 14 shows the existing governance instruments that stimulate open data intermediaries to share open data. Most of them are based on the network mechanism. On the other hand, only one hierarchy-based instrument and no market-based instrument to stimulate open data sharing were identified from Esri and OSM cases. The hierarchy-based instrument referred to is the *establishing of coordinating functions or entities (S1)*. This instrument supported the alignment of private values and interests with open data sharing and was observed through the case of the CEO of Esri Netherlands leading the Breakthrough Project Open Geodata from 2013 to 2017. This project was initiated by the Netherlands’ Ministry of Economic Affairs to identify and address issues around open geodata in the Netherlands. However, while this project exemplifies the potential form of coordination that could take place to stimulate the alignment of private (and public) interests to increase open data sharing, it had limited impacts in making the non-public sector share open data. The project’s primary outcomes were the release of the actual elevation map of the Netherlands and satellite data from the Dutch Space Office, both from public agencies. Hence, moving forward, similar types of coordination could be leveraged to stimulate open data sharing from non-public sector organizations.

³ “Original” here is used loosely to refer to organisations whose one of the core or expected responsibilities or activities is to provide open data.

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Esri leveraged the network-based instrument of *systems for information exchange and sharing (S5)* to stimulate open data sharing through the availability of appropriate technical tools. Esri provides the technical infrastructure for open data dissemination and reuse. This infrastructure makes it easier for data holders to share their data as open data instead of developing the open data sharing platforms themselves and from scratch. It also allows Esri itself to share some of the data it pre-processed and produced as open data, which is useable even by non-ArcGIS users. Having said that, a more significant proportion of data pre-processed and produced by Esri is usable only to ArcGIS users. This is because Esri essentially wants geospatial data users to subscribe to its software in order to be able to use all of the data it offers. Therefore, the availability of more options of technical tools for open data dissemination and reuse, especially non-proprietary ones, may help further stimulate organizations to share open data.

OSM represents an *entity for collective decision-making (S6)* that stimulates open data contribution by spurring the existence of data sharing communities. OSM provides the infrastructure and community support for open data sharing and reuse. OSM is governed by the OSMF, which coordinates collective decision-making on how OSM data should be provided and used, not only regarding the technical aspects but also the licensing. Beyond offering a platform for anyone to contribute open data, OSM is intrinsically communal. OSM community members (consisting of OSM data providers, users, and developers) often organize events and conferences, such as the annual State of the Map conferences. These events and conferences help expand OSM community members (not only among geospatial professionals but also students and hobbyists) and facilitate discussions on the development around OSM technologies and organization. OSM communities are diverse and multi-scale instead of a single community; for example, there are OSMF-registered local chapters, informal (or non-OSMF-registered) national and regional communities, and university-based OSM associations (e.g., YouthMappers). OSM presents an example of an entity for collective decision-making that could be emulated in other domains to stimulate the contribution of open data.

The *partnerships (S7)* and *financial management: joined up working and cooperation (M4)* instruments are leveraged by Esri to stimulate open data sharing by mediating the alignment of private value and interests with open data sharing. Esri strengthens its position in geographic information ecosystems by partnering with various organizations to facilitate the availability and reuse of open data. A notable example is its partnership with other companies, including Microsoft, TomTom, Amazon Web Services, and Meta, to establish Overture Maps Foundation. Overture aims to provide high-quality and fit-for-purpose open geospatial data that anyone could use, especially developers within Esri's and other Overture partners' ecosystems. Overture's partners collectively contribute human resources and infrastructure support to generate and disseminate open data.

Esri also leverages the *partnerships (S7)* instrument to share open data based on its awareness about the social impact of open data sharing. For example, Esri works with Microsoft and Impact Observatory to produce a high-resolution global land cover map based on the European Space Agency (ESA) Sentinel-2 satellite imagery and offers it as open data. This data is helpful for conservation efforts and sustainability projects. As the executive from Esri Inc. (the parent company of Esri headquartered in California) interviewed noted, environmental sustainability is a cause that Esri is historically passionate about, befitting its original name, Environmental Systems Research Institute (E.S.R.I). Hence, Esri sees the value of offering open data that could be used for sustainability purposes. Additionally, the Humanitarian OpenStreetMap Team (HOT), an organization that uses the OSM platform to coordinate the contribution of open data for humanitarian responses and community development initiatives, also leverages the partnerships instrument. HOT works with various international and local organizations, including the United Nations and Red Cross, and mobilizes a community of volunteers to help provide open data for

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specific projects/purposes, such as to be used by save and rescue teams during the earthquake in Turkey and Syria in February 2023 and the tropical storm in Malawi in 2022.

Table 14: Existing governance instruments stimulating open data intermediaries to participate in the open data ecosystem and share open data

Instruments Enablers	S1	S5	S6	S7	M4
Availability of training in data skills and literacy					
Availability of appropriate technical tools		Esri provides the infrastructure for open data dissemination and reuse			
Alignment of private value and interests with open data sharing	Esri Netherlands' CEO led the multi-stakeholder project initiated by the government aimed at improving (open) geodata in the country			Esri, together with other for-profit companies, established Overture Maps Foundation to pool resources to produce fit-for-purpose open geospatial data	Esri, together with other for-profit companies, established Overture Maps Foundation to pool resources to produce fit-for-purpose open geospatial data
Availability of resources (financial, time, people/workforce)					Esri, together with other for-profit companies, established Overture Maps Foundation to pool resources to produce fit-for-purpose open geospatial data

Instruments Enablers	S1	S5	S6	S7	M4
Existence of data sharing communities			OSM provides the infrastructure and community support for open data sharing and reuse		
Awareness about the social impact of open data sharing				Esri works with Microsoft and Impact Observatory to offer high-resolution a global land cover map as open data Humanitarian OpenStreetMap Team (HOT) facilitates open data sharing for humanitarian response	
Presence of engagement or enjoyment activities					

9.3 To-be: Open data intermediaries

Table 15 presents the potential governance instruments to stimulate open data intermediaries to contribute open data. The hierarchy-based instruments of the *establishment of coordinating functions or entities (S1)* and *systems for information exchange and sharing (S5)* can be leveraged in combination with network-based instruments of having *entities for collective decision-making (S6)* and the *financial management: joined up working and cooperation (M4)* to establish a national or supra-national consortium for open data sharing by non-public organizations. Among other things, this consortium could develop and maintain non-proprietary technical infrastructure for open data sharing. The consortium may be governed by a committee composed of public, private, and civil sector stakeholders that facilitate collective decision-making on various technical and non-technical aspects. The consortium and its infrastructure may be supported by joint multi-stakeholder financial cooperation based on agreed terms. This undertaking, based on a collection of governance instruments, may stimulate open data sharing through the availability of appropriate technical tools, alignment of private value and interests with open data sharing, availability of resources (financial, time, people/workforce), and the existence of data sharing communities.

Moreover, the hierarchy-based instrument of the *legal framework (S3)* may be considered by extending the open data legislative framework to for-profit companies (especially large ones), including open data intermediaries. Currently, most open data laws stipulate the responsibilities of public sector bodies to publish and facilitate the reuse of open data, but such responsibilities are not extended widely to non-public sector organizations. For example, beyond public sector bodies, the EU Directive on open data and the re-use of public sector information (Open Data Directive) only applies to public undertakings (in which public authorities directly or indirectly exercise dominant influence) and research performing and funding organizations. Hence, such legislation does not cover many for-profit companies that may hold valuable data that could be made open, including open data intermediaries like Esri. Certainly, extending the open data legislation to for-profit companies will require extensive deliberation and negotiation. However, it is still worth considering as a form of governance instrument for the alignment of private value and interests with open data sharing.

In addition to the 'stick' type of instrument to stimulate open data sharing through legislation, a 'carrot' type of instrument, namely *regulated markets (S4)*, could also be explored. For instance, governments may consider offering financial incentives (such as tax discounts) to companies or civil organizations (including open data intermediaries) that share open data. This may help them compensate for the cost they might incur to prepare and disseminate open data, especially to small and medium-sized enterprises and non-profit organizations. This may ensure the alignment of private value and interests with open data sharing. However, given that governments have already spent substantial money to prepare and disseminate open government data, the cost-benefit comparison of offering financial incentives to non-public sector organizations to share their open data must be first carefully studied.

Lastly, the *capacity building (M6)* instrument can be leveraged to ensure the availability of training in data skills and literacy and the *awareness about the social impact of open data sharing*. Certain open data intermediaries that hold valuable data that could be made open may not have the technical skills to publish open data or even the awareness of open data value. The capacity-building efforts (such as training and workshops) may be undertaken not only by public organizations but also by others, including other for-profit companies (like Esri) and non-profit organizations (like OSM).

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Table 15: Potential governance instruments stimulating open data intermediaries to participate in the open data ecosystem and share open data (in addition to existing instruments)

Instruments Enablers	S1	S3	S4	S5	S6	S7	M4	M6
Availability of training in data skills and literacy								Promote open data publishing training
Availability of appropriate technical tools				Establish non-proprietary technical infrastructure for open data sharing by non-public organisations*				

Instruments Enablers	S1	S3	S4	S5	S6	S7	M4	M6
Alignment of private value and interests with open data sharing		Extend open data legislative framework to for-profit (especially large) companies including open data intermediaries	Offer financial incentives to (especially small/medium-sized) companies or civil organizations that share open data			Governments initiate targeted partnerships with organisations who hold large amount of data that could be made open	Establish financial cooperation to develop & maintain infrastructure for open data sharing by non-public organisations*	
Availability of resources (financial, time, people/ workforce)							Establish financial cooperation to develop & maintain infrastructure for open data sharing by non-public organisations*	

Instruments Enablers	S1	S3	S4	S5	S6	S7	M4	M6
Existence of data sharing communities	Establish national or supra-national consortium for open data sharing by non-public organisations*				Establish national or supra-national consortium for open data sharing by non-public organisations*			
Awareness about the social impact of open data sharing								Promote open data literacy training
Presence of engagement or enjoyment activities								

* Indicates inter-related instruments

9.4 Conclusion

Overall, even though hierarchy (S1 and S3) and market (S4) based instruments are limited in the as-is scenario, they have potential to be leveraged to stimulate open data intermediaries to contribute open data. The potential instruments identified can also be used to stimulate open data intermediaries to contribute other types of value to the open data ecosystem, apart from contributing open data. For instance, the instrument of *capacity building* (M6) can also be used to provide training on using open data apart from training on publishing open data.

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10 Summary of the results

In the previous sections, we examined the various governance instruments that currently promote open data sharing by non-governmental actors and explored potential instruments that could be developed or modified in the future to address the challenge of creating an inclusive open data ecosystem. In this section, we summarize the results of the current (as is) and desirable (to be) scenario. Table 16 summarizes the applicability of governance instruments across open data actors based on as-is and to-be scenarios.

Table 16: Summary of the results

	S1	S2	S3	S4	S5	S6	S7	M1	M2	M3	M4	M5	M6
Non-specialists	A, T	T	T		A, T		A		T		A		A
Elementary schools	T		A		A, T	T	A, T	T	T				
Non-profit organisations			A		A, T		A				A, T	A	A, T
Journalists	A, T	A			A, T		A	A, T				A, T	A, T
Commercial organisations	A, T	T	A, T	A	A	A	A, T	A			A	A, T	
Open data intermediaries	A, T		T	T	A, T	A, T	A, T				A, T		T

Note:

A: As-is instruments

T: To-be instruments

If A and T are in the same box (A, T), it means that there could be potential new or additional ways of leveraging the referred governance instrument.

10.1 As-is situation in the open data ecosystem

Summarizing the results of the previous sections, we see that the current (as is) situation is characterized by the presence of different governance instruments.

Open data sharing has been enabled through the **establishment of a coordination function (S1)** in the case of non-specialist users, journalists, commercial organizations, and open data intermediaries. This instrument assumes the configuration of the temporary structures created for hackathons, training in data skills by news organizations, fit-for-purpose working groups, and ad hoc coordinating initiatives steered by governments that address issues around open data.

In the case of journalists, we observe a **reshuffling of the division of competencies (S2)** with the rise of data-specialized teams in both large news organizations and small data journalism outlets. This shift results in the emergence of new specialized roles that prioritize the integration of technology with traditional storytelling practices in journalism.

Legal frameworks (S3) supported open data sharing in elementary schools, non-profit organizations, and commercial organizations. Legal frameworks take the shape of the compulsory adoption of 'project-based and playful learning' in elementary school, or the creation of legal tools and licenses to help publish and use open data.

An example of the creation of **regulated markets (S4)** that led to non-governmental open data sharing is illustrated by the Overture Maps project, which is tailored to the needs of commercial organizations and developers, in contrast to the community focus of OpenStreetMap (OSM).

Systems of information exchange (S5) fostered non-governmental open data sharing in the case across all actors. Non-specialist users were introduced to the (open) data ecosystem through the provision of APIs, while teachers in elementary schools used and shared data for learning activities through open education tools. The provision of a technical infrastructure, as a simplified open data editor tool for publishing data created by NPOs, or the ones created for facilitating open data sharing by intermediaries. The existence of a platform for open data sharing influences data sharing practices of commercial users, as in the case of the OpenStreetMap database.

The presence of **entities for collective decision-making (S6)** facilitated open data sharing for commercial users, and open data intermediaries. One critical example is the one of OSM that represents an entity for collective decision-making (S6) that stimulates open data contribution by spurring the existence of open data sharing communities.

The creation of new relationships in the form of **partnership (S7)** increased the potential for open data sharing across all actors. In the case of non-specialist users, we see lasting changes in connections to pre-hack and post-hack phases. For elementary schools, we observe recurrent cooperation between schools and organizations to create extra-curricular activities. For NPOs, we see collaborations with community of volunteers that supports the availability of training in data skills and literacy, enabling the execution of technical projects for which NPO might not have had technical resources. Communities of practices and commercial organizations develop shared tools and to produce and share fit-for-purpose open geospatial data. Open data intermediaries partner with various organizations and companies to facilitate the availability and reuse of open data.

Strategic planning (M1) initiatives are undertaken by news organizations to provide training in data skills to journalists and, thus, facilitate open data sharing.

Financial management fostering joined up working and cooperation (M4) mechanism is considered as important for non-specialist users, NPOs, commercial organizations, and intermediaries. In open data hackathons, as they commonly offer monetary rewards and post-event incubation (including facilitating business connections, offering shared workspaces and mentoring) to selected teams. For NPOs, support is provided through the provision of a legal structure and financial support. Thus, those communities can share the data as open data under the organisational umbrella while not having bureaucratic hurdles, which supports the availability of resources enabler. For commercial users, we see the development of pooled resources to produce fit-for-purpose open geospatial data. For open data intermediaries, we see partnerships with that result in the contribution of human resources and infrastructure to support to generate and disseminate open data. In the case of commercial organizations, we see the example of rapid editor being used for the social good to rapidly map areas in need in humanitarian projects.

Inter-organizational culture and knowledge management (M5) foster open data sharing in journalists, NPOs, and commercial organizations. Journalists utilize tools for publishing and promoting their work, while NPOs prioritize openness as a core value, fostering a culture that aligns private interests with open data sharing. NPOs aim for social impact and are aware of the implications of their data sharing practices. Their organizational culture is typically less hierarchical, encouraging employees to engage in projects they are passionate about, which enhances motivation for open data sharing.

Community capacity building (M6) enhances open data sharing across non-specialist users, journalists, and commercial users. Indeed, promotion of transparency and accountability, as well as hackathons for innovations, and the establishment of teams that enhance fit-for-purpose open data sharing (e.g., the establishment of the Humanitarian OpenStreetMap Team and Missing Maps), as well as the provision of trainings, are considered important instruments to favour open data sharing.

We observe that two market instruments—namely, **Financial Management (input-oriented, M2)** and **Financial Management (performance-oriented, M3)**—were not identified among the different actors.

10.2 To be situation in the open data ecosystem

Moving from the current (as is) scenario to the desirable scenario (to be), in this document we tried to identify the governance instruments that have the potential to further open data sharing.

The **establishment of coordinating functions or entities (S1)** is considered as a relevant strategy to increase open data sharing of non-specialist users, elementary schools, journalists, and commercial organizations. A strong coordination function can take the form of Permanent Hackathons Governmental bodies at different levels, such as at the EU level. For elementary schools' coordination can be achieved through ad hoc projects of digitalization agencies and local municipalities, among other institutions. The establishment of a support working group for open data sharing is expected to increase open data sharing from commercial users. Coordination strategies can also be combined with other governance instruments to maximize impact.

The analysis of the practices of intermediaries leads to a call for a mix of governance instruments that combine **coordination (S1)** with **information exchange and sharing (S5)** in combination with network-based instruments of having **entities for collective decision-making (S6)** and the financial **management: joined up working and cooperation (M4)** resulting in the establishment of a national or supra-national consortium for open data sharing by non-public organizations. This consortium could create and manage a non-proprietary technical infrastructure for open data sharing, governed by a committee of public, private, and civil sector stakeholders to facilitate collective decision-making. It would be supported by joint financial cooperation from multiple stakeholders. By utilizing various governance instruments, the consortium will aim at promoting open data sharing through technical tools, alignment of private interests, availability of resources, and active data sharing communities.

It is important to target actions that enable open data sharing of non-specialist users and commercial organizations through **reshuffling division of competences (S2)**. More specifically, those who organize hackathons events and intermediaries need to acknowledge mismatches between competences and Favor the establishment of specific groups that support open data sharing. This strategy will most likely result also in the hiring of data analysts, researchers, or more generally, open data enablers.

The **establishment of a legal framework (S3)** is expected to enable non-governmental open data sharing of non-specialist users, intermediaries, and commercial organisations. Open data hackathon participants can be invited to share their contribution and output under an open license. Also, new and bolder legislative frameworks can extend the responsibilities and obligations for open data sharing to non-public sector organizations. For example, beyond public sector bodies, the EU Directive on open data and the re-use of public sector information (Open Data Directive) only applies to some non-governmental actors such as public undertakings and does not extend to companies and non-governmental organizations.

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Moving from hierarchical instruments to **market instruments (S4)**, governments can explore the adoption of financial incentives (such as tax discounts) to companies or civil organizations (including open data intermediaries) that share open data. The use of market instruments can counterweight the costs borne for open data sharing that heavily impact less resourceful organizations. Yet, the financial sustainability of such an approach needs to be carefully assessed, as open government data already require sizeable investments.

Systems for information exchange and sharing (S5) can facilitate open data sharing from intermediaries (as seen in the previous paragraphs), non-specialist users, elementary schools, NPOs, and journalists. Common beginner friendly tools can support the existence of data-sharing communities. Such systems can also mirror governmental open data portals or have additional features that guide a diverse range of users to overcome technical issues encountered in open data sharing. These systems can also embed data analysis tools and features for collaborative projects to meet the needs of journalists.

The **establishment of entities for collective decision-making (S6)** is expected to foster open data sharing by elementary schools by helping to align private values and interests with open data sharing. For instance, collective decision-making can find a balance between research-led initiatives and the interests of urban development companies. This governance instrument has been identified as promising also in the case of intermediaries, as seen in previous paragraphs.

Lasting **partnerships (S7)** in elementary schools might enhance current open data sharing practices (e.g., through Coding Pirates, CCA and Green Schools) for the integration of open data providing tools and methods for using, creating and sharing it. Partnerships are also envisaged by commercial organizations and intermediaries as viable instruments to favour non-governmental open data sharing.

The adoption of **strategic planning (M1)** can drive elementary schools and journalists to catalyse open data sharing through the creation of data-sharing communities and the provision of data skills.

Financial management (M2): input-oriented aimed at lowering financial barriers for non-specialist participants in the form of grants or stipends to cover participation costs is expected to favour the contribution of non-specialist users to the open data ecosystem. In elementary schools, investments are presumed to increase the availability of training in data skills and literacy and the availability of appropriate technical tools for schools, teachers and elementary school students.

Another network instrument in the form of **financial management: joined up working and cooperation (M4)** can tackle the availability of resources to support the projects' execution and their long-term support in NPOs, especially across geographies. The same instrument is considered as promising by intermediaries, as seen in the combination of instruments described in relation with this actor in the previous paragraphs.

Inter-organizational culture and knowledge management (M5) through the establishment or improvement of data sharing supporting groups can foster open data sharing by commercial organizations. This instrument is considered as promising also in the case of journalists, in the shape of allocating dedicated resources (financial, time, personnel) to support open data initiatives within media organizations.

The **capacity building (M6)** network instrument can also be used to ensure the availability of training in data skills and literacy and the awareness about the social impact of open data sharing of the NPOs. Some non-profit intermediaries that have valuable data do not have the needed

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technical skills to publish open data or are not aware of open data's potential impact. To help deal with that, NPOs or governmental organisations can promote training or workshops. The capacity-building efforts (such as training and workshops) may be undertaken not only by public organizations and NPOs but also by others, including other for-profit companies. Journalists can be stimulated to share open data through showcasing successful case studies and examples where open data sharing has led to significant public benefits. The showcase can take of interactive and engaging content using open data to demonstrate its value and potential to the audience.

In the analysis of the 'to-be' results, we observe that **Financial Management (performance-oriented, M3)** is not mentioned as a viable governance instrument to stimulate non-governmental open data sharing.

11 Discussion and Conclusion

In this contribution we researched the potential instruments to enhance open data sharing by non-governmental actors by answering to the following research question: *What governance mechanisms have the potential to foster open data sharing from non-governmental actors (or data holders)?* In this section, we reflect on the key findings that emerge from this study and how they relate to the major challenges supporting the creation of an inclusive open data ecosystem. It is important to note that the theoretical framework applied in this study is not normative, meaning we do not express a preference for any particular governance mode (hierarchy, market, or network) or instrument. Instead, based on our findings, we suggest that a combination of governance modes and instruments can stimulate non-governmental open data sharing. Thus, while one governance mode or instrument may already enhance or have the potential to foster data sharing, this does not imply it should be preferred or applied in isolation. In other words, we do not rank governance modes or instruments.

It can be noted that the variety of governance instruments capable of promoting open data sharing from non-governmental actors is extensive. These instruments range from hierarchical approaches, such as robust coordination and legal frameworks, to grassroots measures, including systems for information exchange and collaborative partnerships. Notably, the role of market-related instruments remains underrecognized in the current context. Therefore, from the observations in this report, there seems to be limited steering of the behaviour of open data actors through financial incentives. One possible explanation is that the sample of non-governmental actors in this study is driven by the democratic benefits of open data, rather than business-like goals, although they are not mutually exclusive. This would likely be the case for non-profit organizations, elementary schools, and non-specialist actors. Yet, further research is needed to understand if the effects of market governance are invisible to some actors but do contribute to non-governmental open data sharing indirectly.

Despite the presence of various governance instruments that already support non-governmental open data sharing, we have also identified key elements that are currently lacking for both enhancing and establishing the conditions necessary for effective open data sharing.

Some instruments, more than others, are considered as popular strategies for enhancing open data sharing. For instance, there is consensus among different actor groups on the potential of **coordination** for through the creation of permanent bodies organizing, for instance, recurrent hackathons with long-lasting effects or through the establishment of national or supra-national consortium for open data sharing by non-public organisations. Hence, open data sharing from hackathon events may be part of this consortium. The presence of such organizations can have positive spillovers on a range on other user groups, such as non-specialists, (elementary) schools, and commercial organizations. A further development of this research might consider mapping the existence of consortia for open data sharing across other domains (e.g., academia) and understand if they led to any improvements in open data sharing practices.

Another **top-down** approach that is also suggested from the actors' perspective is the adoption of new **legal frameworks** or the extension of existing legal frameworks to non-governmental actors. Yet, legislation tend to have a territorial focus. An interesting extension of these considerations requires an analysis of how and if such legal frameworks are in place across different geographies and where on the spectrum from openness to closeness. For instance, what are the main barriers to legal frameworks that mandate non-governmental open data sharing? At which level of openness is feasible to share data more openly than in current practice? What is currently preventing the adoption of business-to-government (B2G) or citizens-to-government (C2G) legislations in the EU and other countries?

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From a **market-oriented** perspective, while we see tangible evidence of investments for governmental open data sharing, there is no uptake of financial incentives in the forms of tax credits or tax incentives more generally. While it is clear that such instruments need substantial budgeting, it is also clear that there is the tendency, among most of the observations in this report, to disregard this option or to consider it relevant only in the case of for-profit users including open data intermediaries and commercial organizations.

On the contrary, **network governance** instruments are widely popular across different actor groups, as in the case of systems for data exchange and open data sharing. Such instruments are expected to meet the need for appropriate technical tool for open data sharing and use among NPOs, elementary schools, non-specialist users, and journalists.

Also, both NPOs and open data intermediaries highlight **capacity building** tool to improve (open) data skills, literacy and awareness among their actor groups, thus overcoming serious barriers to open data sharing in user communities.

Furthermore, we observed that some of the to-be instruments to stimulate non-government data holders to share open data can also be used to stimulate them in providing **other kinds of value** to the open data ecosystem. For example, the instrument of *capacity building* can also be used to provide training on using open data apart from training on publishing open data. This expands the results of our study to embrace also other contributions to the open data ecosystem, such as data literacy. This is a relevant result that calls for additional research on how governance instruments both enhance non-governmental open data sharing and other contributions to the open data ecosystem.

In conclusion, different governance instruments can lead to further open data sharing by non-governmental actors. Some instruments are already adopted and require further uptake, while others are not yet adopted and can significantly improve open data sharing.

It is important to acknowledge several limitations of our study. These limitations can form the basis for further research. First, the research approach applied in the study, which relied on a combination of methodologies, did not cover the entire spectrum of actors in an actor group and often focused on a narrow geographical scope (the EU or specific EU countries). Further research is needed to confirm and expand the results of our analysis to other perspectives within the same actor group, across different sub-fields (e.g., commercial organizations operating in various industries), scales (e.g., NPOs of different sizes), and contexts (e.g., including those lacking the capabilities to engage with technology). Yet, it must be acknowledged that investigations on open data ecosystems that look at the range of actors presented in the study are scarce and our results offer a basis for further research. Second, while we tried to address information justice, we could not derive any findings that clearly connect inclusion of non-governmental data with vulnerable groups. As such, we call for further research to explore how the inclusion of diverse users reflects and amplifies the voices of most vulnerable groups. Finally, our research did not explore the effectiveness of the identified governance instruments in promoting non-governmental open data sharing, nor did it evaluate the probability of success for those governance instruments that appear promising in enhancing such sharing. Future studies could extend our findings by assessing—either qualitatively or quantitatively—how these instruments have facilitated (or currently facilitate) non-governmental open data sharing (as is), and how they might do so more effectively in the future (to be).

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