Towards a Sustainable Open Data ECOsystem

D4.1
Motivations of non-government actors to become active contributors to the Open Data ecosystem

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 955569.

Project Acronym	ODECO
Project Title	Towards a Sustainable Open Data ECOsystem
Grant Agreement No.	955569
Start date of Project	01-10-2021
Duration of the Project	48 months
Deliverable Number	D4.1
Deliverable Title	Motivations of non-government actors to become active contributors to the Open Data ecosystem
Dissemination Level	Public
Deliverable Leader	Università degli Studi di Camerino (UNICAM)
Submission Date	28-06-2024
Author(s)	Barbara Re – UNICAM, Héctor Ochoa Ortiz – UNICAM, Ahmad Ashraf Ahmad Shaharudin – TU Delft, Davide Di Staso - TU Delft, Giorgos Papageorgiou – Farosnet S.A., Alejandra Celis Vargas - AAU, Liubov Pilshchikova - TU Delft

Document history

Version #	Date	Description (Section, page number)	Author & Organisation
V0.1	13-02-2024	First draft table of content	Barbara Re, Héctor Ochoa Ortiz - UNICAM
V0.1a	22-02-2024	Review of the table of content	Davide Di Staso - TU Delft, Giorgos Papageorgiou – Farosnet S.A., Alejandra Celis Vargas - AAU, Liubov Pilshchikova - TU Delft, Héctor Ochoa Ortiz - UNICAM, Ahmad Ashraf Ahmad Shaharudin – TU Delft
V0.2	01-03-2024	First draft of introduction and motivation for each stakeholder	Davide Di Staso - TU Delft, Giorgos Papageorgiou – Farosnet S.A., Alejandra Celis Vargas - AAU, Liubov Pilshchikova - TU Delft, Héctor Ochoa Ortiz - UNICAM, Ahmad Ashraf Ahmad Shaharudin – TU Delft
V0.2a	09-03-2024	Revision of introduction and motivation for each stakeholder	Barbara Re – UNICAM
V0.3	11-03-2024	Finish the motivations for each stakeholder, first draft of barriers for each stakeholder	Davide Di Staso - TU Delft, Giorgos Papageorgiou – Farosnet S.A., Alejandra Celis Vargas - AAU, Liubov Pilshchikova - TU Delft, Héctor Ochoa Ortiz - UNICAM, Ahmad Ashraf Ahmad Shaharudin – TU Delft

Version #	Date	Description (Section, page number)	Author & Organisation
V0.3a	20-03-2024	Revision of V0.3	Barbara Re – UNICAM
V0.4	21-03-2024	Finish barriers for each stakeholder	Davide Di Staso - TU Delft, Giorgos Papageorgiou – Farosnet S.A., Alejandra Celis Vargas - AAU, Liubov Pilshchikova - TU Delft, Héctor Ochoa Ortiz - UNICAM, Ahmad Ashraf Ahmad Shaharudin – TU Delft
V0.4a	27-03-2024	Revision of V0.4	Barbara Re – UNICAM
V0.5	28-03-2024	Conclusions for each stakeholder	Davide Di Staso - TU Delft, Giorgos Papageorgiou – Farosnet S.A., Alejandra Celis Vargas - AAU, Liubov Pilshchikova - TU Delft, Héctor Ochoa Ortiz - UNICAM, Ahmad Ashraf Ahmad Shaharudin – TU Delft
V0.6	03-05-2024	Shared introduction and conclusion, revision of V0.5. End of Draft 1	Héctor Ochoa Ortiz, Barbara Re - UNICAM
V0.6a	08-05-2024	Revision of V0.6	Joep Crompvoets - KUL
V0.6b	19-05-2024	Revision of V0.6	Anneke Zuiderwijk-van Eijk – TU Delft
V0.7	24-05-2024	Fixes on the introduction shared parts, and conclusion	Héctor Ochoa Ortiz - UNICAM, Ahmad Ashraf Ahmad Shaharudin – TU Delft, Davide Di Staso - TU Delft, Giorgos Papageorgiou – Farosnet S.A., Alejandra Celis Vargas - AAU, Liubov Pilshchikova - TU Delft
V0.7a	27-05-2024	Revision of V0.7	Joep Crompvoets - KUL
V0.7b	28-05-2024	Revision of V0.7	Anneke Zuiderwijk-van Eijk – TU Delft
V0.8	06-06-2024	Fix of the final version	Héctor Ochoa Ortiz, Barbara Re - UNICAM
V0.9	25-06-2024	Final revision	Barbara Re - UNICAM
V0.10	25-06-2024	Approval	Bastiaan van Loenen, TUD
V1.0	28-06-2024	Final editing	Danitsja van Heusden, TUD

Table of Contents

List of Figures

List of Tables

Abbreviations

D	Deliverable
ESR	Early Stage Researcher
MS	Milestone
NGD	Non-Government Data
OD	Open Data
ODECO	Open Data ECOsystem
WP	Work Package

Nr	Partner	Partner short name	Country
Beneficiary			
1	Technische Universiteit Delft	TU Delft	Netherlands
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

1 Introduction

1.1 Problem definition

Task 4.1 explores the motivations of non-government actors to become active contributors to the Open Data ecosystem by releasing their data into the open data ecosystem.

Governmental actors have historically been the dominant providers of open data. In many cases, such responsibility is engraved in policy documents, from non-binding strategic plans to binding laws and regulations such as the EU Open Data Directive. On the other hand, while there have been some initiatives by non-governmental actors to publish their data as open data, it is still limited and largely remains to be desired (van Loenen et al., 2018). Non-governmental actors are outside the public/governmental sector, such as companies, civil society organisations, and the media. Exploring the motivations for non-governmental actors to contribute to open data is thus essential to developing sustainable Open Data Ecosystems that incorporate both government and non-government open data.

Aligned with the ODECO's Description of Action, this deliverable aims to answer the following three research questions:

- RQ1: What are the motivations of non-governmental data holders to contribute to the open data ecosystem?
- RQ2: What barriers do non-governmental data holders face when contributing to open data ecosystem?
- RQ3: How can the motivations and barriers to sharing non-governmental data become enablers?

Motivations are defined as "the need or reason for doing something" or the "willingness to do something" (Cambridge Dictionary, 2024). On the other hand, barriers are "anything used or acting to block someone from going somewhere or from doing something, or to block something from happening" (Cambridge Dictionary, 2024). In this deliverable, barriers refer to things that hinder actors from contributing to open data ecosystem, negatively affecting the open data community creation. They thus should also be studied in conjunction with motivations to share their data as open data. Their negative influence varies depending on the stakeholders, but they have some typical characteristics that must be considered in the study. Enablers are "something or someone that makes it possible for a particular thing to happen or be done" (Cambridge Dictionary, 2024). In this deliverable, enablers refer to situations in the ecosystem that facilitate or enhance the contribution of open data by non-governmental actors by leveraging the motivations and barriers for them to do so. Motivations and barriers of the following non-government stakeholders were identified: non-specialist users, data journalists, students, NGOs, commercial organisations, and open data intermediaries.

For each stakeholder group, we outline the methods employed and the types of data sources used, including primary (interviews, questionnaires, focus groups, etc.) or secondary (literature review, use case analysis, etc.). Where relevant, we broadened our analysis of stakeholders' motivations and barriers to contribute to open data ecosystems. For example, in the section on non-specialist citizens, we also by considered knowledge (rather than data) contributions.

1.2 Role of this deliverable in the ODECO project

The ODECO deliverable 4.1 is part of Working Package 4, "From an Exclusive to an Inclusive Open Data Ecosystem". In D4.1, we seek to understand the **motivations** of non-government actors to become active contributors to the open data ecosystem sharing their own data as open data. The relation to the other deliverables in WP4 is as follows:

- D4.2 explores **technical strategies** to steer the behavior 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.
- D4.3 explores a **governance strategy** to steer the behavior of non-government data holders towards open data. It will report on steering mechanisms and approaches for activating non-government data holders in the open data ecosystem.

This deliverable also marks the completion of the milestone MS6 "Joint research deliverables" after successfully delivering the first research deliverables (D2.1, D3.1, and D4.1).

D4.1 complements Deliverable 3.3, "Closing the cycle: Promoting open data users' contribution from a governance perspective". D3.3 explores ways to sustainably establish the contribution of open government data users to open data ecosystems by identifying motivations to do it. D4.1 differs from D3.3 as D4.1 is centred on having an inclusive ecosystem where non-government actors share their data, while D3.3 is centred on closing the cycle and users of open government data contributing back to the ecosystem.

1.3 Structure

This report is structured as follows: Chapters 2 to 7 present the motivations and barriers of each stakeholder type to contribute to the Open Data Ecosystem. Each chapter briefly defines the given stakeholder, followed by the methodology, results, and conclusion. Chapter 8 serves as the discussion and conclusion for the whole document. Shared motivations and barriers between the stakeholders are discussed, and questions are proposed for future deliverables in WP4 (D4.2 and D4.3).

2 Non-specialist citizens

2.1 Introduction

In the context of open data ecosystems, non-specialist citizens are interested in accessing open data or can benefit from open data while lacking the specialised skills needed to analyse datasets. To engage non-specialist citizens in sharing their data, we developed a new approach, an "Open data game jam", which is an event similar to an open data hackathon, with the critical difference that participants make a video game rather than an application. In this section, we explain why we chose to develop this novel approach, starting with an explanation of the opportunities and challenges of open data hackathons.

In recent years, open data hackathons have emerged as a promising approach to engage citizens (both specialist and non-specialist) in the reuse of open data. Open data hackathons typically last 1-3 days, during which participants use open data to develop new solutions. Like other hackathons, they are "accelerated design processes" (Falk, 2022) demanding rapid results. While solutions are rarely developed beyond the event, prototyping fosters a deeper understanding of the problem and potential solutions. Organisers range from government bodies to local activists and NGOs, each with various motivations, such as: (1) promoting data reuse, (2) building a community around open data (Jaskiewicz et al., 2019), (3) supporting Nonprofit Organisations (NPOs) (Hou & Wang, 2017), (4) addressing specific societal challenges (Lodato & DiSalvo, 2016), (5) creating new business models around open data (Kitsios & Kamariotou, 2018). Open data hackathons often attract data experts with strong analysis skills and non-experts with contextual knowledge and lived experiences. Non-specialist citizens can contribute to making sense of open datasets through their "thick data" (Wang, 2016), which is the qualitative context needed to interpret quantitative data, such as ethnographic observations and lived experiences. We will refer to this type of data as "knowledge" that non-specialist citizens possess, and that they can contribute to open data ecosystems. We focus on the context of open data hackathons and similar "accelerated design processes" (Falk, 2022) with open data because of their capacity to increase communities' ability to work with open data (Jaskiewicz et al., 2019). However, (open data) hackathons have been criticised for taking a "solutionist" (Morozov, 2013) approach to social issues, meaning that they focus on technology rather than social issues. At an (open data) hackathon, issues tend to be oversimplified, and solutions exclusively rely on technology rather than social change. This critique does not apply to all hackathons. Additionally, the problem of solutionism is not necessarily about the event itself but how it is framed and studied. Nonetheless, there is a need to move the focus of hackathons from technology to social issues.

To refocus open data hackathons on social issues, we changed the "invitation" (Lindström and Ståhl, 2014) to participants from using technology to create solutions to using technology to articulate (describe) the issues (Lodato and DiSalvo, 2016). Our understanding of the "invitation" to participants is similar to Lindström and Ståhl's definition (2014, p. 329): the invitation included an "area of curiosity" (social issues) and "a proposition of how to engage with it" (making a video game). Our new approach is an open data game jam, an event where participants collectively produce a video game about a social issue of their choosing. Most of our participants had never made a video game before but still possessed sufficient digital skills to craft a prototype in a few hours. We introduced participants to a beginner-friendly game engine which relies on visual coding and offered technical help throughout the event. Participants could pick an issue they directly experienced and contribute their thick data (lived experience). Additionally, we invited participants to brainstorm and include available open data about the issue in their games.

2.2 Methodology

This section examines the approach used to understand the motivations and barriers of non-specialist citizens who want to contribute their knowledge toopen data ecosystems, in the context of an open data game jam.

The open data game jam was attended by master students of the Faculty of Industrial Design Engineering (IDE) at TU Delft. The game jam was part of an academic course consisting of a series of one-day workshops on different topics hosted by other lecturers. Students were free to pick and choose any workshop and earn credits for attendance only. Our event was one such workshop attended by 45 Master's students, with 23 students filling in the surveys and eight participating in the debrief interview. Participants were invited to describe a social issue through an interactive video game. During the design process, they had to form teams around specific issues, research available data, and use it to brainstorm possible game mechanics. Participants combined their experience of the issue with available open data to represent it in a game.

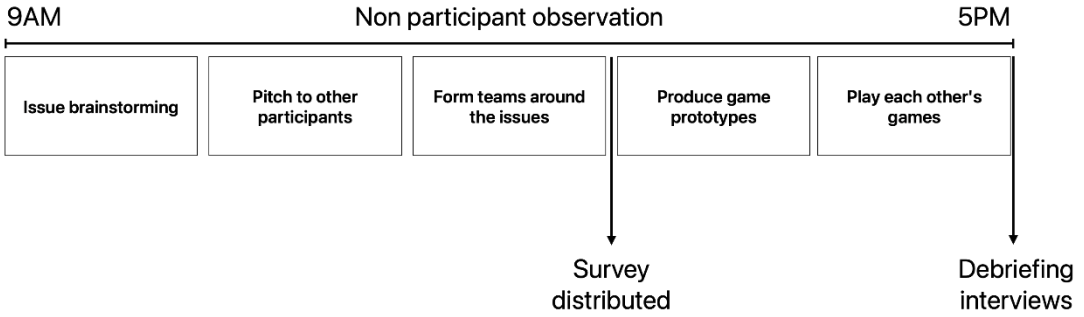


Figure 1: Data collection timeline

We used a combination of surveys, observations, and debrief interviews to understand participants' motivations to contribute data. The data collection timeline is shown in Figure 1. We distributed the surveys right after teams were formed around specific issues (about two hours into the session). Debriefing interviews were conducted at the very end of the session after participants played each other's games. Non-participant observations were conducted throughout the game jam by a designated researcher. A summary of the data sources used to study participants' motivation to contribute their data is shown in Table 1.

Table 1: Overview of the data collection methods

Method	Participants	Description	Timeline
Survey	23 Master's students of the Faculty of Industrial Design Engineering at TU Delft	Brief survey on the demographics and motivations for attending	Distributed after teams were formed around different issues
Observation		Observation of the one-day workshop using an observer's sheet to understand participants' interactions and motivations	Throughout the entire event
Debrief focus group interview	8 selected students (2 teams working on two different games)	10' focus group interviews	After participants played each other's games

2.3 Results

This section presents the data collected through the methods outlined earlier. We start by presenting participants' existing knowledge as measured through the surveys, then we discuss their motivations for contributing to open data ecosystems, and finally, we discuss barriers that affect their contribution. To measure whether non-specialists attended the game jam, we included items about existing knowledge in the pretest survey. Figures 2 and 3 visualise the distribution of Likert responses on a stacked bar chart. For example, on the item "Knowledge – I know who/how many people are affected by this issue", one person answered "0", two people answered "1", seven people answered "5", etc. We consider answers greater than 3 on the Likert scale as "agree". As shown in Figure 2, 10 participants agreed they knew how to analyse datasets (the answer on the Likert scale was greater than 3). In our sample, 8 participants agreed that they knew how to make games, and a majority of participants agreed that they possessed knowledge about the specific social issue being addressed in their team. Based on the survey, our sample included a mix of expert and non-expert participants who had good knowledge of a social issue but lacked technical knowledge and data skills.

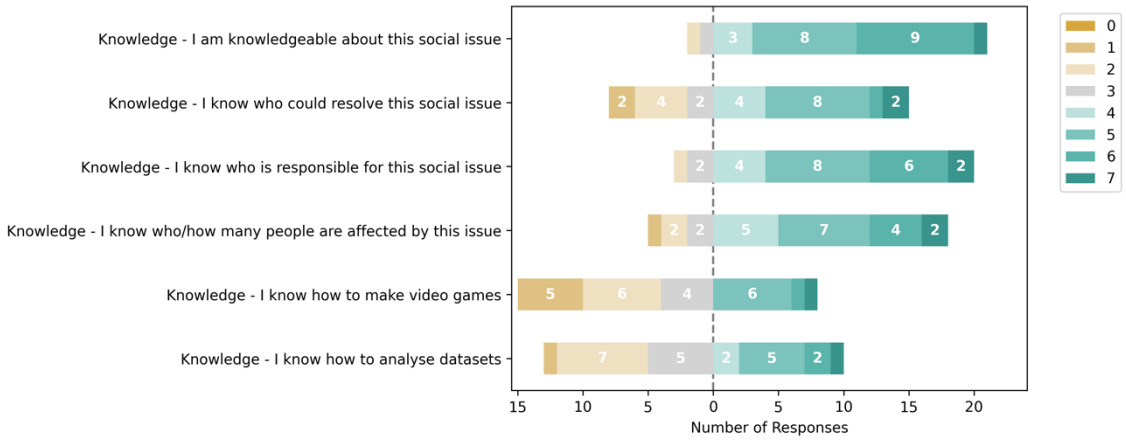


Figure 2: Participant's knowledge at the beginning of the open data game jam. The numbers inside the stacked bars represent the number of participants who picked that answer.

2.3.1 Motivation

Based on the survey (figure 3) and the non-participant observation, we found three main motivating factors for participants to attend the event and share their knowledge. First, participants were motivated by the opportunity to learn new digital skills. The event effectively offered an introduction to the basics of coding, and for some participants, this was an opportunity to write code for the first time while getting technical support. Second, participants were motivated by the competition with other teams. The event included a final showcase of the game prototypes, where participants would play each other's games and select the winners. Third, as shown by the pretest surveys, most participants agreed that having fun was a motivation to attend. The creative process involved in producing a game prototype motivated participants to attend and contribute.

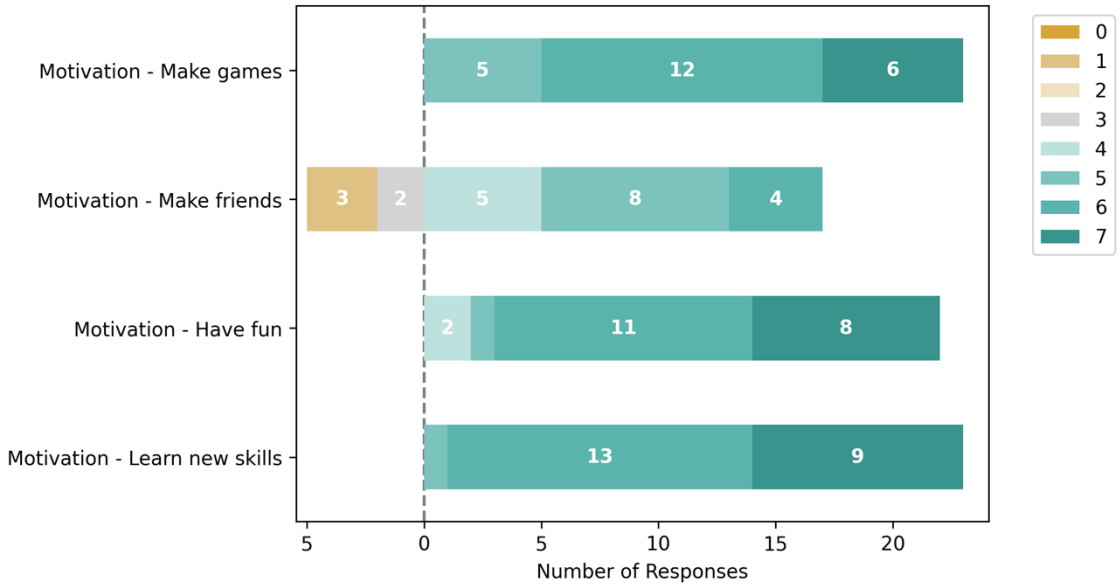


Figure 3: Motivations for attending the open data game jam recorded in the survey

Table 2 : Motivations for non-expert citizens to attend the game jam

Motivation	Description
Learning digital skills	Learning new digital skills and the basics of coding through a beginner friendly approach and tools
Competition with other teams	Game jam challenge. At the end of the event participants went around the room and played each other's games, and 3 winners selected. Competition between the teams and time pressure was a motivating factor
Enjoyment	Enjoyment of the creative process of producing a game prototype was a motivating factor

2.3.2 Barriers

We observed three main barriers to participants sharing the knowledge of the issue through the event: (1) the technicality of the (video game) prototypes, (2) the availability of participants, and (3) friction in collaborative digital work. As found in previous literature, we observed that low-fidelity prototypes such as mock-ups and drawings incentivised team discussions and group reflection. On the other hand, high-fidelity prototypes (such as computer code) pushed participants towards more individual work. This result aligns with the findings of Jaskiewicz et al. (2019) in the context of open data hackathons. The morning section of the workshop, dedicated to brainstorming and ideating a game, was more inclusive of participants who wanted to contribute their data about the issue. However, in the afternoon, dedicated to game development, participants mostly worked individually. Another barrier is the availability of participants to attend a one-day workshop. Non-expert users might be unable to dedicate a full day or even multiple days to a game jam. This workshop was part of coursework and was attended by master's students who were earning credits. However, other user groups' found it harder to attend. Another area for improvement was the friction caused by collaborating on digital prototypes.

The game engine used in the jam software does not allow real-time collaboration, which can lead to non-technical people getting excluded. The workshop aimed to initiate discussions around social issues so that issue experts could share their knowledge with technical experts and collaborate on producing a game prototype. This issue is not limited to the specific game engine used for this game jam. Versioning and multi-user collaboration can be challenging even for experienced developers. This can cause friction in including everyone's contribution. In most groups, the overall coding of the video game was delegated to a single person, which limited collaboration. A final barrier was the tension originating from participants' differing motivations; expert users are more interested in software development and creating high-fidelity prototypes, while non-expert users are more interested in creativity and brainstorming. Team formation methods are crucial to enable the collaboration of these two groups.

Table 3: Barriers to non-expert citizens' contribution to open data ecosystems

Barrier	Description
Technicality of the prototypes (high vs low fidelity)	The production of high-fidelity prototypes makes it harder for non-specialist citizens (problem owners) to share their knowledge of the issue
Collaboration tools	Hard to manage and integrate multiple contributions into the same digital prototype
Team formation method	Need to have balanced teams that are not only composed of technical experts, but which contain a mix of domain and technical expertise. Friction in forming groups around this criterion.
Availability of participants	Non-expert citizens may not have enough time and resources to attend open data events

2.4 Conclusion

This section aimed to uncover non-specialist citizens' motivations and barriers to becoming active knowledge contributors to open data ecosystems. We started by defining non-specialist users as individuals interested in or who might benefit from reusing open datasets while needing more specialised data skills. We identified open data events as a promising approach to engaging non-specialist citizens in reusing open data. To understand the motivations and barriers for citizens to contribute with their knowledge, we organised a participatory experiment with non-specialist citizens: a one-day open data game jam. We collected data through observations, surveys and debriefing interviews. We found three main motivations for citizens to contribute with their knowledge: (1) learning digital skills, (2) competition with other teams, and (3) enjoyment. Practitioners can leverage these factors to motivate non-expert citizens to share their knowledgeas problem-owners. At the same time, we found four barriers affecting citizens that intend to contribute with their knowledge: (1) the technicality of the prototypes, (2) collaboration tools, (4) team formation method, and (5) availability of participants. Practitioners should balance motivating participants with the opportunity to learn new skills and build technical prototypes, giving enough space for problem owners to share their knowledge through low-fidelity mockups. Our results are convergent with the findings of Jaskiewicz et al. (2019) on the role of conceptual and specialised prototypes at open data hackathons.

Acknowledgements
We thank Lærke Christiansen (TU Delft, Faculty of Technology Policy and Management) for collecting data as a non-participant observer and for her support throughout the game jam.

3 Data journalists

3.1 Introduction

In our society, journalism plays a pivotal role in keeping citizens informed, updated, and interested in the events and developments of their community. As our societies increasingly rely on data, journalism must evolve and accommodate this momentous shift. The seeds of the use of data in journalism were sown during the 19th century when the Manchester Guardian published a table with the schools of the city (Rogers, 2011). When Florence Nightingale analysed and published data from the Crimean War (Rogers, 2010), these cases were the exceptions, and the use of data at that time was the exception. With the introduction of computers, a more structured approach was embraced when Meyer used a computer to analyse data from the riots in Detroit in the 1960s (Gray et al., 2012) and later pioneered Precision Journalism (Meyer, 2002).

The next big step for journalism is the open data movement. Almost at the same time as the US popularised the open data movement with the launch of its open data portal, the Guardian quoted the term data journalism (Rogers, 2008). The most important difference with previous forms of data journalism was that journalists were no longer focused on the collection of data, but on their analysis.

Since then, data journalism has been adopted by other media organisations. Although there is a lot of interest in the domain of academia and the industry, the use of open data and the motivations of journalists to contribute to the open data ecosystem have yet to be explored. However, as journalists recognise the increasing value of open data and realise their potential to enhance transparency, accountability, and public engagement, they can gradually take a more active role in the ecosystem.

3.2 Method

This section examines the method that supports the understanding of the motivations and barriers journalists face when contributing to sharing their data as open datain the open data ecosystem.

This research examines journalists' contributions to the open data ecosystem, where they provide their own data and share knowledge as communicators who analyze open data to extract meaningful insights and construct compelling narratives that enhance understanding among non-expert audiences. The methodology of this research is based on three pillars. Initially, a systematic literature review was conducted (Papageorgiou and Loukis, 2023) to identify the areas that academic research covered on the intersection of open data and journalism, and the review outcomes were used to plan the fourth step of the research. In the next part of the research, three semi-structured interviews were conducted with journalists and data analysts from three distinct media organisations across the European Union. The interviewees were employees of small media organisations focusing on data journalism or strongly inclined towards utilising data journalism. The interviews were conducted online for Eurologus, a media organisation in Belgium, where one journalist was interviewed. For Divergent, a media organisation from Portugal, one journalist and one data analyst were interviewed. For Farosnet, the interview was conducted in person, and the chief editor and the data analyst were interviewed. The questions were formulated based on the findings from the literature review to examine how journalists use open data and the barriers they encounter in their process. These interviews gathered qualitative insights on the practices the industry adopted in using open data. The third part is ongoing action research (Morini 2023; Appelgren and Nygren 2014; Grubenmann 2016;) in Farosnet (publisher of the Greek Edition of HuffPost), where the researcher is placed through the ODECO project. This research method identifies specific needs and challenges journalists face when integrating open data into their reporting. This involves meticulously planning and designing iterative cycles of action and

reflection to fine-tune our approach and methodologies. By keeping a journal and conducting regular reflection sessions, strategies were continuously assessed and adapted to better support and engage journalists in effectively utilising open data within the newsroom.

3.3 Results

3.3.1 Motivation

The primary function that the journalist serves in the open data ecosystem is that of the communicator. To utilise open data in their work, they must analyse, visualise, and, in several cases, reach out to experts, as specialised understanding is required to extract meaningful insights from the data in many instances. Finally, they also have to construct compelling storytelling around their findings that will be pleasing and engaging for their audience and allow people with no expert knowledge to understand the root of the problem without delving into it themselves. Through this process, two main motivations for journalists to contribute to the open data ecosystem become apparent: the desire to enhance public understanding and the drive to foster transparency and accountability.

Transparency and accountability

The main reason that journalists have to get involved and contribute to the open data ecosystem is to promote a culture of transparency and accountability in society. This finding became prevalent in the interviews and the action research as their primary motivation. In all cases, the focus of using open data in journalistic activities was to display social issues and expose the deep roots of the problems using infographics and data. Communicating complex data to a wider audience cultivates a more informed and engaged citizenry. Their contribution to the open data ecosystem empowers citizens to advocate for transparency and better governance.

Enhanced credibility

Another reason journalists want to use open data in their work is to boost their credibility. By supporting their opinions with verifiable data, journalists can transform their articles from mere opinion pieces into well-substantiated analyses, thereby enhancing their trustworthiness and authority in the eyes of the public. This requires journalists to include references to their data sets and highlight their methodology of analysis so that their work is reproducible by the audience.

3.3.2 Barriers

During the interviews and the action research, several barriers were observed that prevented journalists from becoming active contributors to the open data ecosystem.

Open data are not the only source of information

During the interviews, it was clarified that journalists use more than just open data. Although they explicitly mentioned they use data from official sources, these are not only published on open data portals but often include data acquired by requesting them from other European or governmental agencies.

Lack of skills to use and analyze open data

It became clear from all the interviews and the action research that journalists must possess the skills to find, analyse, and use open data. In all cases, experts from other fields (data analysts, visual artists) were required. Although this is an easily bypassed barrier, it creates other problems; it increases the complexity of using open data as more people have to collaborate and coordinate. It also increases the cost of the published articles as management has to add more people to the payroll.

Lack of interest

The lack of interest in open data became evident during the action research. For seven months, we were actively working in the newsroom with the chief editor and producing articles; the other journalists were interested in getting involved with what we were doing. This lack of interest must be explored further.

Limited time

This was mentioned in interviews but was also encountered in the action research. Journalists' main activity is to present the news. Still, as analysing data and compiling comprehensive infographics is a time-consuming process, it is a frequent phenomenon that when an article with results extracted from data analysis is prepared, other news is more relevant to the public. Therefore, the impact of the article is reduced.

Not willing to share their data

This was encountered during the action research and the interviews: the journalists were not keen to share the datasets they had compiled as they considered them an asset for the media organisation. When confronted about their willingness to share their datasets openly, they replied that monetary compensation would be required. The main reasoning behind this stance is their concern that their competitors could utilise the datasets they have compiled through extensive research and effort, and sharing them without compensation would eliminate their organisation's strategic advantage.

3.4 Conclusion

The introduction of open data as a primary source for data journalists has the potential to fuel them with abundant useful information but also provides the incentives to make them active contributors in the open data ecosystem. The main motivation of journalists to engage with the open data ecosystem is aligned with the core values of the open data movement on transparency and accountability, highlighting a promising entanglement. However, the barriers detected have more to do with the managerial aspects of media organisations and the need for journalists to acquire more skills and resources. Although journalists intend to use and, by extension, contribute to the open data ecosystem, they must embrace a cultural shift toward a more collaborative and open practice paradigm.

4 Elementary school students

4.1 Introduction

Students can be defined as individuals actively engaged in a learning process in formal or hybrid (formal/informal) educational environments, ranging from basic to higher education. 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). Young students in basic school education have been revealed as significant actors in open data and data literacy initiatives (Celis Vargas et al., 2023). Building a larger open data literate community is essential for fostering citizens able to participate and benefit from open data. Although the open data field has recognised students as a strategic user group to promote the skills and competencies necessary for increasing citizen participation and ensuring the long-term sustainability of open data ecosystems, they have been participating as users of open data rather than active contributors in open data ecosystems. The current study explores this user group as non-government actors, acknowledging that while they may engage in private or public educational institutions, they interact autonomously within educational systems.

Current open data initiatives in education seek to equip students with the essential skills needed for the current fast-changing and data-driven society (Cook et al., 2018) , often called 21st-century skills (Romero et al., 2015). The potential of using open data has mainly been related to the connection of classroom activities to real facts and, secondly, to increasing teachers' and students' motivation (Coughlan, 2020). Open data learning activities have ranged from using OD in regular school subjects such as chemistry and geography (Pence et al., 2015), engaging with local problems and data in undergraduate courses about open data (Palova & Vejacka, 2022), and extracurricular activities such as public hackathons (Davis & Shneyer, 2020). According to a previous systematic mapping review (Celis Vargas et al., 2023), in current initiatives in elementary school, learning goals are often related to increasing awareness about open data and developing criticality. For example, Badioze Zaman et al. (2021) focus on increasing open data readiness by using in classroom pet robots and IoT, and Saddiqa et al. (2019) have related data literacy in schools with the ability to identify which types of data are needed for solving a problem and the ability to use visualisation technologies for exploring and presenting the data in greater detail and understandable way.

Research Pellegrino & Antelmi (2023) has shown that open data initiatives at the school level primarily focus on using open datasets or data exploitation rather than on their production. Although elementary school students create their data using open government data in a few learning activities, their data is not currently open or shared outside the classroom. The current study aims to uncover the students' motivations and barriers to potentially sharing their data in open data ecosystems.

4.2 Method

This section examines the method that supports the understanding of the motivations and barriers students face when contributing to sharing their data in the open data ecosystem.

Considering the novelty of the topic, a systematic literature review and exploratory empirical studies were conducted. Firstly, the systematic literature review helped to understand the barriers to sharing data, considering the current use and awareness of open data in schools. For example, from the literature, it was possible to identify that the concept of open data is still highly abstract for students and teachers; therefore, asking directly about their motivation was not considered. Grant & Booth (2009) Three main steps were conducted: defining the scope, identifying the

articles through iterative searches and categorising them according to students' motivations and barriers to sharing their data in open data ecosystems. Secondly, two exploratory empirical studies were conducted in formal and informal learning environments to better understand elementary school students' latent or implicit motivations. One study in a formal educational environment included 39 students aged 15 to 16 and 5 teachers in a Danish school. In an informal learning environment, the study included 40 students aged 14 to 18 engaged in an active citizenship initiative organised by a Danish non-profit organisation. Sanders & Stappers (2012) Different qualitative methods were used to explore implicit or explicit motivations, such as individual and focus group interviews, observations, workshops and an open questionnaire. Table 4 summarises the applied methods and participants involved in the two studies.

Table 4: Methods and participants

Formal educational environment: Conducted in a Danish school during a week		
Method	**Participants**	**Description**
Workshop and survey	39 school students aged 15-16 years old in 9th grade.	The workshop was developed as an OD learning activity including two parts. The first part proposed an individual data exploration and second part focused on group work to create a Data story with visualisations. At the end of the workshop, students answered a brief survey. Duration: 2h
Focus group interview	15 school students (3 groups of 5 students) aged 15-16 years old in 9th grade	Informal interviews were conducted with a group of students after the workshop. Duration: 20 min
Semi-structured interviews	5 elementary school teachers	Semi-structured interview. Duration: 60 minutes
Informal educational environment with focus of active citizenship		
Method	**Participants**	**Description**
Nonparticipant observation	50 children aged 14-18 years old from different nationalities	Non-participant observation during the co-creation workshops conducted by the partner organisation CoC Playful Minds during the Children's General Assembly CGA 2022. Duration: one week

Sessions were recorded and transcribed for analysis, and observations were recorded in a diary. The data collected was analysed together following a thematic network analysis approach (Attride-Stirling, 2001). Firstly, potential students' motivations were coded, keeping the participants worded as much as possible. Secondly, categories were made to show the different motivations of students and barriers to sharing their data in open data ecosystems. Finally, global themes were identified to create a map of student's motivations. Figure 4 visualises the methodological flow, including the different samples and methods.

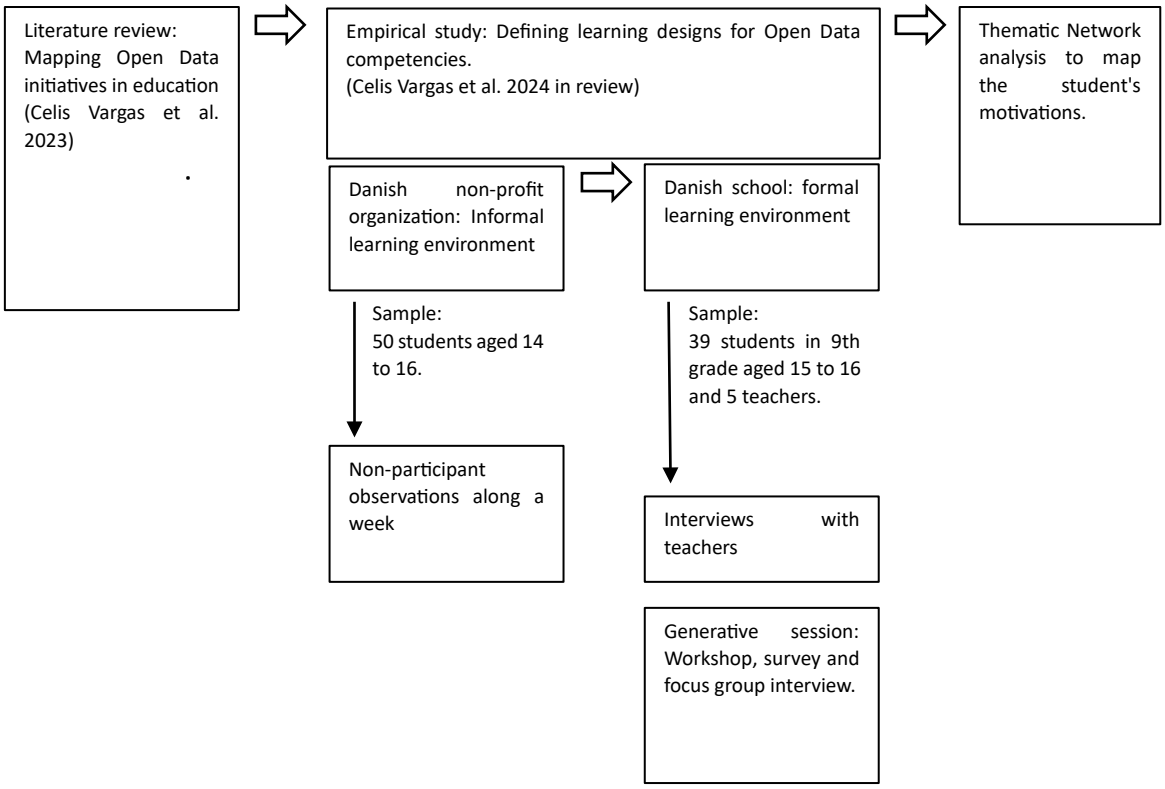


Figure 4: Methodological flow

4.3 Results

Considering the novelty of open data integration in elementary school, student data contribution has been identified as a potential rather than a current activity. The literature or the empirical study did not explicitly mention motivations and barriers for opening data created by elementary school students. An inductive back-and-forth analytic process helped uncover them in connection to the students' context and learning goals.

4.3.1 Motivation

Five main motivations create an overview of the potential incentives behind potentially opening non-government data produced by students. Students' motivations were found to be associated with (i) being active citizens, (ii) raising awareness of local issues around students' context and daily life, (iii) helping the community around the school, considering students as important actors in local ecosystems, (iv) seeing what students learn in schools as useful in the real world, and (v) making school activities more relevant, interesting, and fun.

(i) Being active citizens. Celis Vargas et al. (2023) have identified that open data learning activities, especially, seek the development of competencies for active citizenship address activities for the collection of their own data. In those cases, students have been involved in creating simple spreadsheets and collecting more complex data using tools such as sensors, games, or mobile applications (Badioze Zaman et al., 2021; Chicaiza et al., 2017; Saddiqa, Larsen, et al., 2019; Saddiqa et al., 2021b; Vallejo-Figueroa et al., 2018). The motivation is actively participating as citizens to create a better world. For example, during the focus interviews, students wondered about their school projects: "How is this going to create a better world?".

(ii) Raising awareness of local issues around students' context and daily life. Considering students as experts in their local experience, they can create and share local datasets addressing aspects of their environment and daily life experiences. From their perspective, they want to raise

awareness and provide a contextual understanding of local issues. Their motivation behind this is raising their voice, being heard, and making "Children's voice as important as others".

(iii) Helping the community around the school, considering students as important actors in local ecosystems. Students are motivated by helping the community around them, implicitly to feel belonging and build their identity and place. Creating and sharing data has been identified as an opportunity to build networks in their local communities by addressing problems from other actors and contributing to solving them with data. "The school could be part of the local community by creating better data", and "I think local problems could be more fun because students can do something".

(iv) Seeing what students learn in schools as useful in the real world. It was relevant for young pupils in elementary school to see what they do in school being used in the real world. It increases the authenticity of their learning experience. "If I'm sharing it, and it could be used afterwards, students will be more proud and more engaged to make it right because they know that it's likely to be used for something meaningful afterwards".

(v) Making school activities more relevant, interesting, and fun. Creating and sharing their data might increase their motivation for learning by fulfilling their intrinsic motivation for making something relevant, being heard, and connecting to their communities. Overall, students are motivated by active learning experiences where they can experiment and learn by themselves.

4.3.2 Barriers

Five barriers to opening the data produced by students in learning activities are identified, as well as the main elements in learning designs, such as the characteristics of the learners and other actors involved, like teachers, and the learning environment, including tools. These challenges were identified through a literature review and empirical study. The main barriers found 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 open data is, and (iv) the risk of disclosing personal data from young pupils.

(i) Teachers need more technical skills and significant training. Teachers have an essential role in educational design. Considering different pedagogical approaches, teachers lead or facilitate learning activities and propose the main tools and resources. Several studies have pointed out the need for more technical skills for managing data, and digital skills are a primary barrier to achieving the potential of open data as an educational resource.

(ii) Updating classroom technology. Depending on the specific context, tools, platforms, and methods for adapting classrooms to fast-changing technology could change simultaneously. Nevertheless, investment, skills, and administration are factors to consider. The most traditional educational systems are characterised by slow adaptation and low technology insertion.

(iii) The concept of open data is highly abstract. Several authors have stressed the challenge that understanding and using open data presents for students due to its high level of abstraction (Atenas et al., 2015; Coughlan, 2020; Saddiqa et al., 2021a). For example, Saddiqa et al. (2021a) I Wolff et al. (2016) have suggested contextualising the data for better understanding, using open data from students' municipalities. Furthermore, the need for customised hands-on open data collection, interpretation and exploitation tools and methods has been made explicit to overcome this barrier. However, developing tools and methods simultaneously entangles new challenges for the usually steady educational systems.

(iv) Low awareness about what open data is. During the empirical study, students and teachers referred to open data as any information found on the Internet. For example, teachers claimed to use open data for their teaching. Still, when asked more in-depth about their sources and process for managing the OD, it was explicit that they understood open data as any available information on the Internet. On the other hand, it is a completely new term for the pupils.

(v) Risk of disclosing personal data from pupils. Ethical data management is essential in the user context of elementary school students since children are usually a vulnerable group. Due to low awareness of data management, schools, teachers, and parents are at risk of violating GDPR.

4.4 Conclusion

Motivations change according to the participants' awareness. Teachers' primary motivation was learning about new tools and making students' learning activities more authentic using real facts.

Open data learning designs consider that opening or sharing their data might increase authenticity and motivation in elementary school students.

5 Non-governmental organisations

5.1 Introduction

Non-Governmental Organisations (NGOs), also interchangeably called Non-Profit Organisations (NPOs) in this section, take up an intermediary role in the open data ecosystem, where they bridge the gap between open data providers and users (Gonzalez-Zapata and Heeks, 2015). NPOs are unique as intermediaries because there are specific user communities they are focusing on to address a social issue (Enaholo, 2017) while also not seeking to gain any profits from it (Salamon and Anheier, 1992). Historically, NPOs pushed for data openness, developed the open data research field, and resolved the practicalities of open data use (Enaholo, 2017). There are many ways in which NGOs contribute data back to the open data ecosystem. For example, they create tools and applications to aggregate or enhance the data, making it more accessible and understandable for the users. Moreover, they can produce or collect additional open data to enhance their use and re-share it with the users. NPOs can also request the data they or their users need from the data providers and republish it as open. The motivation to contribute back in various ways that NPOs have may come from the focus and aims they have. The aim is to provide information and services that the community needs, which the government does not provide, and motivate NPOs to aggregate existing data and collect and publish the available data as open (Ricker et al., 2020). If NPOs aim to improve overall openness and transparency, it can push them to aim for various projects and have open data and open source on that principle (Baack, 2015). However, NGOs may face barriers that prevent them from contributing (Chattapadhyay, 2014). Thus, in the rest of this section, we discuss the motivations, i.e. enablers of the NGOs to contribute data back to the open data ecosystem, as well as possible barriers to sharing the data.

5.2 Method

This section examines the method that supports understanding the motivations and barriers of NPOs/NGOs to contribute to sharing their data in the open data ecosystem. The case study approach was used to collect the data and investigate the motivations of the NPOs/NGOs to become active data contributors to the open data ecosystem. The selection criteria for the case studies were:

1. Non-profit organizations should have different missions/focuses/aims.
2. Each case should have more than one type of open data activity.
3. The cases work on different levels, i.e., municipal/regional/national.
4. The cases involve organizations and people willing and ready to cooperate in the research and share information required to conduct this research.

The three cases we have focused on are NPOs: Open Knowledge Belgium, Open Knowledge Foundation Germany and CityLAB Berlin. We conducted eight semi-structured interviews with three NPO employees from each organisation, both online and in person. We interviewed employees who work on open data-related projects within the NPO. Additionally, we collected information from public web pages describing the open data projects. A summary of the data sources is presented in Table 5. We used an inductive approach to analyse the qualitative data due to the study's exploratory nature.

Table 5: Sources of the qualitative data

Method	Participants	Description
Semi-structured interviews	Employees of three NPOs. Eight interviews in total.	Online and in-person interviews were conducted individually with available employees who work on the projects related to and using open data. Duration: 1h Period of the data collection: September 2022 to December 2023
Information from the relevant websites	Twelve webpages related to the NPOs' open data projects	The descriptions of the relevant open data projects were collected.

5.3 Results

In general, our results support the literature's findings on how open data is contributed to the open data ecosystem by NGOs and what their motivations can be to do it (Enaholo, 2017; Ricker et al., 2020). NGOs create applications that aggregate different data sources or enhance the available data for such tools. This improved data is then available as open data for any user to download, often with an overall project being open source. NGOs also take the role of the data demander and advisor and build relations with data providers who might need to be more willing or capable of opening their data. Thus, NPOs get closed-off data from the providers and republish it as open data. Moreover, NPOs can collect the needed data for their projects and provide it to any other user as open. The motivations behind the NPOs' publishing the available data as open vary; some may be more prominent than others for the organisation. Overall, we found five reasons that can motivate NGOs to contribute open data back to the open data ecosystem. We also found two barriers to these motivations that can stop NGOs from sharing their data as open.

5.3.1 Motivations

Firstly, opening the data can serve demonstrative purposes. Creating a project with open data enhanced or reused and made available can encourage other stakeholders or make them more aware of its availability. NPOs that target community needs are motivated by showing the power of open data and engaging relevant stakeholders, such as other potential data providers, to open relevant data.

Secondly, NPOs are motivated by the help they can provide with the local and global societal issues that align with their organisational goals. Many aim to educate by sharing open data with communities, encouraging the reuse of open data, or contributing the data to the cause. Open government data might be available on topics and issues that become relevant, but this data needs to be utilised. By finding ways to enhance the data and publish it as open, the NPO can highlight it and help those affected by the issue. For example, as energy consumption became more relevant due to rising prices, CityLab Berlin created a tool showing the energy usage of public buildings with the data used in it being available as open. Providing open data to the targeted communities can help them educate themselves on the issue. Although they might need tools and the help of an intermediary to interpret the data, the NPOs can overcome the findability and accessibility barriers that the community may face. Those communities are then more engaged in solving their local issues.

Thirdly, the positive feedback from the community motivates NPOs to pursue data sharing and continue their projects. Moreover, the community can give feedback on data issues and suggestions when they are interested and involved. Such feedback is welcomed by NGOs and motivates them to have projects that are open source and open data.

Fourthly, some NPOs have transparency and openness of data and knowledge as their main goals. Thus, they are motivated by their organisational goals and the employees' personal beliefs to open up the data. If the data is not openly available and aggregated elsewhere on important issues, NPOs can be prompted to aggregate and collect the data themselves from closed sources. As the data is published, the NPOs can open the previously closed data. For example, CityLab Berlin has a platform to help find local services for mental health help, for which the data has been collected from various closed or partially open sources, and through the project, it is now available as open. Fifthly, NPOs distinguish themselves from for-profit organisations. They want their data to be reused widely by and benefit a variety of communities, NGOs, and governmental organisations, if applicable. Thus, NPOs can be motivated by the opportunities for other stakeholders that they would create. That is most likely achieved if the data is open.

To conclude, we found five motivations of NGOs to open their data: (1) showing the power of open data, which would increase other stakeholders' awareness of available open datasets; (2) utilising available open data to help with the local and global societal issues; (3) receiving positive feedback from the community, which can act as an external motivator for NGOs to push forward with open data project; (4) following organisational goals and the personal beliefs of the employees in openness and transparency; and (5) creating opportunities for other stakeholders to reuse NGOs' data for their benefit.

Table 6: Motivations for NPOs to contribute open data

Motivation	Description
Show the power of open data	Creating a project with enhanced or reused open data can engage other stakeholders or make them more aware of the open data available
Help with the local and global societal issues	There is open government data that might be available on societal issues, but not utilised. By finding ways to enhance the data and publish it as open, the NPO can highlight it and help those affected by the issue
Receive positive feedback from the community	The community can give feedback on the issues with the data and give suggestions when they are interested and involved which motivates NGOs to continue the project
Follow organisational goals and the personal beliefs of the employees in openness and transparency	Some NPOs have transparency and openness of data and knowledge as their main goals and employees join NPOs because they share the vision
Create opportunities for other stakeholders	NGOs want their data to be reused widely by and benefit a variety of communities, NGOs, private and governmental organisations

5.3.2 Barriers

NGOs face barriers that can demotivate them from sharing their data, as open data is closely related to their resources (Salamon and Anheier, 1992). As NGOs are non-profit organisations, funding their projects can be a pressing topic, especially for smaller-sized organisations. Thus, the first barrier is the need for more financial resources, i.e., funding for the projects that would let them publish their data. NGOs might need help to continue existing projects and stop providing

timely open datasets or be unable to pay for the existing infrastructure support, making the data inaccessible. For example, if the interest in the project from the public is low, some NGOs might have to prioritise funding other projects and, thus, stop collecting and publishing new open data.

The second barrier is affected by the first one. The barrier is the lack of knowledge and technical skills of NGOs' employees, which prevents them from publishing the data they have as open. It can be that they cannot process all the data or do not know how to provide it licensed adequately and openly. NGOs short on financial resources cannot hire additional employees with the required skills. They might, however, go to the communities of volunteers and open data activists who are more skilled and collaborate with them on delivering the data.

The third barrier is a lack of a common portal for NGOs and civil societies to share data. NGOs cannot add to the open government data portals. However, creating and/or maintaining such a platform would require a lot of financial and human resources that the average NGO cannot afford. The barriers we found are summarised in Table 7; there are two barriers to the motivations that stop NGOs from sharing the data as open: (1) the lack of financial resources, which limits NGOs ability to pursue open data projects; (2) the lack of knowledge and technical skills of NGOs' employees, affecting the NGOs capacity to license and publish dataset correctly; and (3) the lack of an existing common portal for NGOs to share their data.

Table 7: Mentioned barriers

Barriers	Description
The lack of financial resources	The nature of non-profit oganisational model, means that NGOs need to secure funding in a form of grants or individual donations. Some NGOs may not be able to obtain enough funding for theit open data projects
The lack of knowledge and technical skills of NGOs' employees	The lack of knowledge and technical skills of NGOs' employees prevents them from publishing the data they have as open or they do not know how to provide it properly licensed as open. NGOs that are short on their financial resources are unable to hire additional employees with the required skills.
The lack of an existing common portal for NGOs to share their data	NGOs cannot add to the open government data portals and there is no existing common portal for NGOs and civil societies. However, creating such a platform and/or maintaining it would require a lot of financial and human resources that the average NGO cannot afford.

5.4 Conclusion

To conclude, we posed the research question: What are the motivations of non-governmental organisations to share their data as open back to the open data ecosystem? Using case studies and the inductive approach to case studies analysis, we collected and analysed qualitative data from three non-governmental organisations working with and producing open data. For their motivations to share open data back into the ecosystem, we found five motivational aspects such as showing the power of open data, helping with local and global societal issues, receiving positive feedback from the community, following organisational goals and personal beliefs of the employees in openness and transparency, and creating opportunities for other stakeholders. However, there are barriers to opening the data due to the lack of financial resources, knowledge, and technical skills of NGOs' employees and an existing common portal for NGOs to share their data.

6 Commercial organisations

6.1 Introduction

Commercial organisations are defined as those whose goal is to make an economic profit. This is illustrated in contrast to users who intend non-commercial use, which Creative Commons (Creative Commons, 2023) defines as "means not primarily intended for or directed towards commercial advantage or monetary compensation." Depending on their field and necessities, commercial organisations may have different motivations to contribute 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 use its data and contribute data and value to the ecosystem. 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 Wiki, 2024 and OpenStreetMap Foundation, 2024). By studying OSM, we plan to answer what enables commercial organisations to contribute to a collaborative open data project.

6.2 Method

This section examines the method that supports the understanding of the motivations and barriers of commercial organisations to contribute to sharing their data in the open data ecosystem. A qualitative semi-structured interview was conducted with commercial organisations to determine the motivation and barriers to contributing to the OpenStreetMap ecosystem. Employees in 25 companies were interviewed, including both big corporations and SMEs. We wanted to contact companies who are taking an active role in contributing to the project. To do that, we identified two lists of value contributors: the OSM Foundation corporate members (OpenStreetMap Foundation, 2024) and the OSM Wiki Organised Editing page (OpenStreetMap Wiki, 2024). We tried to contact all for-profit companies from both lists. The final list of interviewees was completed through personal contacts (as the ESR has been part of the OSM community for over 10 years on an individual level) and by proposing the interviewees nominate future possible interviewees.

Interviewees were asked the following questions: "Does your organisation contribute to OSM?", "Why?", "How?", "What is the motivation for your organisation to contribute to OSM?", and "Are there any barriers to the contribution?". These questions were part of a more extensive interview where other topics not directly related to this deliverable were also asked: which services does the company provide, how and why are they using OSM data, and strengths and weaknesses of the project. Although unrelated, these answers also helped contextualise each interviewee's answers regarding the motivations and barriers to contribution.

The interviews were conducted via video call, lasting 30 to 60 minutes. If a video call was not possible, the questions were sent to the interviewees to answer in text. Notes from the interviews were taken and written down. Keywords were then extracted from the answers and aggregated into tables, which allowed the qualitative data to be measured quantitatively. Interviewees were asked how and why they contributed value to the project, including directly about motivations and barriers to the contribution. These questions were complemented by questions about the company-provided services, how and why they are using OSM data, and the project's strengths and weaknesses. These questions are unrelated to this deliverable but helped give context to each interviewee's answers regarding the motivations and barriers to contribution.

Table 8: Sources of the case study data

Method	Participants	Description
Semi-structured qualitative interviews	Employees in 25 companies (7 big corporations, 18 SMEs)	Survey asking about the company provided services, OD use and reuse, relationship with the OSM Ecosystem, motivations and barriers to use and contribute to OSM, and strengths and weaknesses of the project.

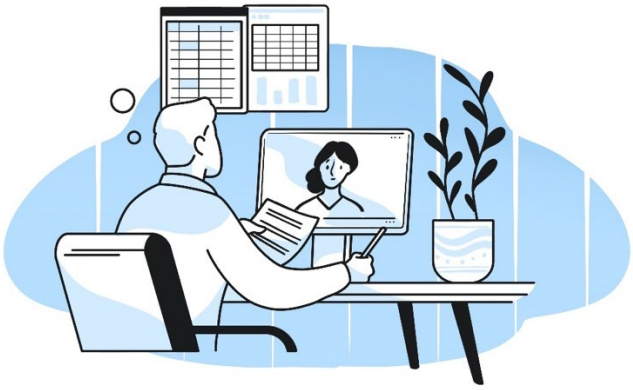


Figure 5: Artist's impression of the chosen methodology. Drawing by Iulian Thomas

6.3 Results

6.3.1 Motivation

The most mentioned motivations to contribute with data relate to direct benefits to their business. By improving the data quality in their sources, OSM in this case, and aligning them with their own datasets, they can offer their clients more accurate and better services. Other motivations mentioned include the social value of their data contributions compared to direct profit. Being grateful and having the desire to give back are also among these, as is being part of the "open" movement and thinking of OSM as a valuable service that ought to be sustained. Another motivation mentioned, which encompasses social and own-profit values, is to build mapping communities related to an area or topic the company is interested in. By training volunteers, including their clients, commercial organisations can ensure future sustainability in data quality in their desired realm.

Table 9: Motivations for commercial organisations to contribute open data

Motivation	Description
Improving the data quality	The organisations use OSM as one of their data sources. By improving the data quality, they can deliver better services to their customers.
Alignment of OSM to their dataset	Some organisations have their own private dataset, and want to align OSM to their dataset.
Community building	Some organisations are interested in a given topic or domain. They kickstart communities in that topic or domain to maintain data continuity and freshness.
Standardization of the OSM schema	OSM schema is sometimes subjective and up for interpretation. For some organisations, this is a

Motivation	Description
	motivation to contribute to the project, to lower the subjectivity of the data.
Being grateful and wanting to give back	Some organisations feel that OSM has provided value to them and their products, and feel it is only fair to give back and provide value to the project, to keep it going.

6.3.2 Barriers

Many commercial organisations identified data integration and tools as the main obstacles to data input. The problem is recognised as a need for more tools for merging several datasets, as a requisite for data imports into OSM is to integrate the imported data with the existing data and tools for importing large datasets. Some interviewees have also mentioned being concerned about the compatibility of their data licenses with OpenStreetMap.

Compared to large organisations, SMEs face obstacles due to insufficient resources, including limited money, labour, and time. SMEs are directing their efforts towards collaborating in ways that would provide the most advantages for their organisation. That means that the company's focus on collaboration with the project may not be on data, but on other value-creating ways (e.g., sponsoring, tools). Big corporations, on the other hand, have mentioned seeing greater resistance from the OSM community than SMEs. This is due to the fear of some community members that big corporations become dominant in the project, displacing the community-based approach based around volunteers. Therefore, big corporations' actions are always under heavy scrutiny.

Table 10: Barriers of commercial organizations to contribute Open Data

Barrier	Description
Technical / Tools	Lack of data integration tools, and tools for importing large datasets.
License compatibility	Datasets generated by commercial organisations are sometimes a combined product of different sources, for which the license may not be compatible with OSM's ODbL license.
Insufficient resources [SMEs]	Limited money, labor and time, compared to large organisations.
Resistance by other community members [Big corporations]	Resistance by community members as they fear big corporations may dominate the project landscape.

6.4 Conclusion

In several cases, commercial organisations' motivations relate directly to improving or benefiting their business. This is expected, as commercial organisations, by definition, aim to achieve economic profit. This was complemented by motivations in the social value of their contributions, which do not directly relate to financial profit.

Commercial organisations, however, still see barriers to the contribution: legal, other stakeholders' attitudes, lack of resources, and technical. Work on the following deliverables of this Working Package 4 has to resolve technical and governance mechanisms to steer stakeholder motivations into enablers, which can lower the existing barriers and foster motivations for commercial organisations to take a more critical role in the open data ecosystem.

7 Open Data intermediaries

7.1 Introduction

Open data intermediaries are defined as "third-party actors who provide specialised 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 are developers who process and include open data in apps/software, crowdsourcing platforms that gather and publish data as open data, and organisations that transform open data into easily digestible information such as visual forms. Various types of actors can play the role of open data intermediaries, including public organisations, companies, civil society organisations, and research organisations (Corbett et al., 2018; Enaholo & Dina, 2020; Meijer & Potjer, 2018; Navalkha, 2021). They carry out various tasks depending on their specialised resources and capabilities, such as compiling data, validating data, and improving technical data openness (Shaharudin et al., 2023). Thus, through some of their tasks, some open data intermediaries (re-)produce data that could be contributed back to the open data ecosystem.

As all actors in the open data ecosystem, including open data intermediaries, have their agency and thus are self-interested (Davies, 2011; Poikola et al., 2011), their motivations to contribute to open data naturally have to be aligned with their interests. In other words, open data intermediaries must either be convinced that they can directly or indirectly capture value by publishing open data (intrinsic motivation), or they must be forced by external conditions such as through law and regulations to do so (extrinsic motivation).

7.2 Method

This section examines the method supporting the understanding of motivations and barriers of open data intermediaries to contribute to sharing their data in the open data ecosystem. We interviewed open data intermediaries, providers, and users to explore the motivations and barriers for open data intermediaries to deliver data back to open data ecosystems. The interviewees may not explicitly refer to these motivations and barriers. Still, they are induced from the interviews based on the current incentives or the perceived benefits for open data intermediaries to contribute data in open data ecosystems. We take the inductive approach in our analysis due to the exploratory nature of this study. We selected the interviewees through purposive sampling. We focused on two (non-public) open data intermediaries, namely Esri and OpenStreetMap, and interviewed representatives from various branches of the two organisations and the users of their services. The focus on the two organisations is due to their significant role in the geospatial data domain, and both have served the function of open data intermediaries for many years. It is also worth noting that four out of six thematic categories of the high-value datasets identified under the EU Open Data Directive are geospatial data. We also interviewed representatives from several public organisations serving the role of open data providers and/or intermediaries.

Table 11: Information on the interviews conducted

Method	Participants	Description
Semi-structured interviews	Interview groups: open data intermediaries, open data providers, and open data users. No. of interviews: 48	Mode: Online. Period: April 2023 - August 2023 & December 2023 - February 2024.

7.3 Results

7.3.1 Motivation

Some open data intermediaries may contribute open data as a means to increase the visibility of their organisation. By publishing open data that users find valuable, open data intermediaries raise awareness about their organisation and what they offer, directing users to consider engaging them for their products/services even though those products/services may not be directly related to open data. These open data intermediaries may also adopt the freemium business model, offering specific datasets as open data but others for a fee or only accessible through their proprietary products. This can be seen in the case of Esri. The company offers some pre-processed open data through its Living Atlas platform, where anyone, including non-customers, can access and use the data they provided through the platform. When users use that data and attribute it to Esri, other users will also discover about Esri. Esri offers a lot more pre-processed data on its proprietary software. Hence, users may be enticed to subscribe to Esri software. Thus, by providing open data that is accessible and usable to non-customers, Esri may, ultimately, expand its customer base, generating more income for itself.

Open data intermediaries may also contribute to open data to support other partners in their network, which, in turn, strengthens their network influence or market power. A case in point is the Overture Maps Foundation, a collaboration initiated by Amazon, Meta, Microsoft, and TomTom. The foundation enhances open data, mainly from OpenStreetMap, by integrating it with data from other sources, including the foundation's members, and releases the augmented data as open data that is fit for purpose. Developers can then use the open data to develop geospatial-based services, particularly those connected to the foundation's members' platforms. By supporting these developers, the foundation members can benefit from network effects, i.e. as the developers within their network flourish, they may earn a share of those developers' income.

Altruism or the desire to contribute to society may motivate some open data intermediaries to contribute open data. This is especially true for open data intermediaries in civil society and non-profit organisations. For example, the Humanitarian OpenStreetMap Team (HOT) carry out humanitarian actions and community development initiatives. When disaster strikes, HOT initiates the call for volunteers to help provide disaster area map data to facilitate humanitarian response, such as by Red Cross societies, Médecins Sans Frontières, and UN agencies. Additionally, HOT works with local stakeholders in other community projects, such as providing map data to improve response to epidemiological disease outbreaks. One of the interviewees shared that they started to get involved in contributing data to OpenStreetMap (OSM) during the Nepal earthquake in 2015 out of the desire to help those affected by the catastrophe.

Additionally, some open data intermediaries may be motivated to provide open data if there is a platform on which they can release the data quickly. Besides, by having a shared platform for numerous open data providers and users, the visibility and reuse of the data may be greater than if the open data were shared via individual platforms. With more visibility and reuse, open data intermediaries may be motivated to share more open data. Another interviewee mentioned that open data intermediaries may build such platforms, facilitating the release of open data to other intermediaries and providers. They can also promote the adoption of a freemium business model through such platforms, where while some (or most) data is provided as open data, some are paid data. Through that business model, open data intermediaries may have a business case in providing open data, that is, by enticing users also to consider obtaining their paid data.

In summary, four motivations for open data intermediaries to contribute to open data were gathered, as presented in Table 12.

Table 12: Motivations for open data intermediaries to contribute open data

Motivation	Description
Support the visibility of their organizations	By providing open data, open data intermediaries can increase the visibility of their organization; hence, it is a form of marketing for their products and services.
Support other partners within their networks	Some open data intermediaries provide open data to support the business or operation of their partners, which they would also get the benefit from. This may further strengthen their position within their network.
The desire to contribute to society	Some open data intermediaries are driven by philanthropic or altruistic motivations to contribute open data that could benefit society.
The availability of open data platforms to share open data	Open Data intermediaries could be more motivated to release open data if there are open data platforms that could facilitate them to do so. This is because not all open data intermediaries have the capability and resources to develop and maintain their own data platforms.

7.3.2 Barriers

Open Data intermediaries may be reluctant to share open data because of their business interests. For example, some of the datasets in the Living Atlas platform curated by Esri are not available as open data. Instead, they may only be used by Esri's customers on its software, ArcGIS. One of the reasons for this is to attract more customers to subscribe to the ArcGIS software, hence generating income for Esri. To some extent, this is understandable since Esri has pre-processed and curated those datasets, and such tasks require technical and human resources, including harmonising and validating them, ensuring they are reliable and usable by end users.

Furthermore, current legislation around open data only compels a few intermediaries to contribute back to open data. An interviewee noted that, at present, the law mostly only requires the public sector to provide open data and not the other sectors. Thus, open data intermediaries outside the public sector are not legally responsible for delivering open data. The interviewee suggests that, in the absence of such a law, (public or private) funders can encourage open data intermediaries to provide open data by including such requirements in the contracts. Moving forward, policymakers should consider expanding the law requiring specific private and civil organisations to provide open data. Additionally, open data providers may also offer certain types of open data under the share-alike license, necessitating open data intermediaries to share the value-added data as open data as well.

Additionally, not all open data intermediaries already have their data platform; hence, sharing open data would require additional infrastructure and investment in human resources. Once developed, maintaining the infrastructure will also incur recurring costs. As one of the interviewees pointed out, most open data platforms are currently limited to government data and do not facilitate open data contributions by non-government sectors.
In summary, the barriers that prevent open data intermediaries from contributing to open data were gathered as presented in Table 13.

Table 13: Barriers for open data intermediaries to contribute open data

Motivation	Description
Protecting business interests	Some open data intermediaries are hesitant to release (some of) their data as open data because they want to protect their business interests.
No compelling legislation	There are limited or no legal requirements that compel open data intermediaries to provide open data.
Additional costs to develop and maintain open data platforms	Developing and maintaining data platforms to release open data would incur additional costs to open data intermediaries.

7.4 Conclusion

The study aims to investigate the motivations and barriers for open data intermediaries to contribute to open data. We uncovered four motivations and three barriers through interviews with open data intermediaries, providers, and users. The (potential) motivations are to support the visibility of their organisations, to support other partners within their networks, the desire to contribute to society, and the availability of open data platforms for them to share open data. The barriers to open data contribution are protecting their business interests, the lack of compelling legislation, and the additional costs of developing and maintaining open data platforms.

8 Discussion

In this Discussion section, we grouped similar motivations and barriers to contributing to open data by different non-government actors to identify the common motivations and barriers. Based on those common motivations and barriers, we also identified the enablers for them to contribute to open data.

8.1 Common motivations and barriers

During Training Week 4 in April 2024 at KU Leuven, Belgium, a workshop was organised to identify common motivations and barriers for non-government actors to share open data. The workshop consisted of setting up an online whiteboard where the motivations and barriers for each actor, as written in previous sections, were written down. During the workshop, participants clustered into groups after an in-depth discussion on each of the motivations and barriers, going from the domain - or stakeholder-specific level to a more generic one. Each participant presented the motivation related to the stakeholder they represent, and then all the others commented until a shared agreement was reached. The main goal of the discussion was to identify the common motivations and barriers to defining shared trends. This work continued online a week after the workshop in a video call between the authors of this deliverable.

Although these common motivations and barriers cluster individual non-government actors' motivations and barriers, they are not expected for all actors. Common obstacles and clusters might reflect sub-groups of actors with similar characteristics or contexts.

8.1.1 Common motivations

Seven common motivations were found in the workshop, which are explained in detail below. Table 14 summarises the general picture and shows the stakeholders who mentioned each motivation.

For many non-government actors studied, some motivations related to their benefit were identified. Such motivations include supporting other partners within an organisation network for their benefit, the private value of contributing, the feeling of belonging, and enjoyment.

Aligning the different stakeholders' benefit motivations is critical to achieving the goal of data sharing. Own benefit motivations are supported by the desire to create an impact, mentioned in the clusters of supporting other partners, helping the community, and creating social impact.

Finally, the availability of and desire to improve technical skills and solutions are mentioned as motivations and potential motivations. This means that creating the correct technical environment can be an enabler for data sharing and including possible stakeholders in the process of improving the technical environment.

Table 14: Common motivations to contributing open data

Common motivations	Non-specialist actors	Data journalists	Elementary school students	Non-governmental organisations	Commercial organisations	Open data intermediaries
Supporting other stakeholders within an organisation network for their own benefit				X	X	X
Supporting and creating communities that would benefit from open data			X	X		
Private value		X		X		X
Belonging			X		X	
Creating social impact		X	X	X		X
Engagement / enjoyment	X		X			
To improve technical skills or internal data processes	X				X	

8.1.2 Common barriers

Six common barriers were found in the workshop, which are explained in detail below. The general picture is summarised in Table 15, which stakeholders who mentioned each barrier marked.

Regarding shared barriers, lack of resources is the most mentioned barrier, with 5 out of the 6 studied non-governmental actors mentioning it. Other considerably mentioned barriers are misaligned goals and interests, and a lack of technical tools is the most cited barrier, with 4 out of the 6 studied non-governmental actors saying them. The lack of technical tools in the barrier cluster pairs with the technical motivations described by some actors. Technical steering mechanisms are, therefore, shown to be crucial in motivating and creating barrier-free open data ecosystems where stakeholders can share their data. Deliverable D4.2 will delve in-depth into answering the questions these mechanisms pose.

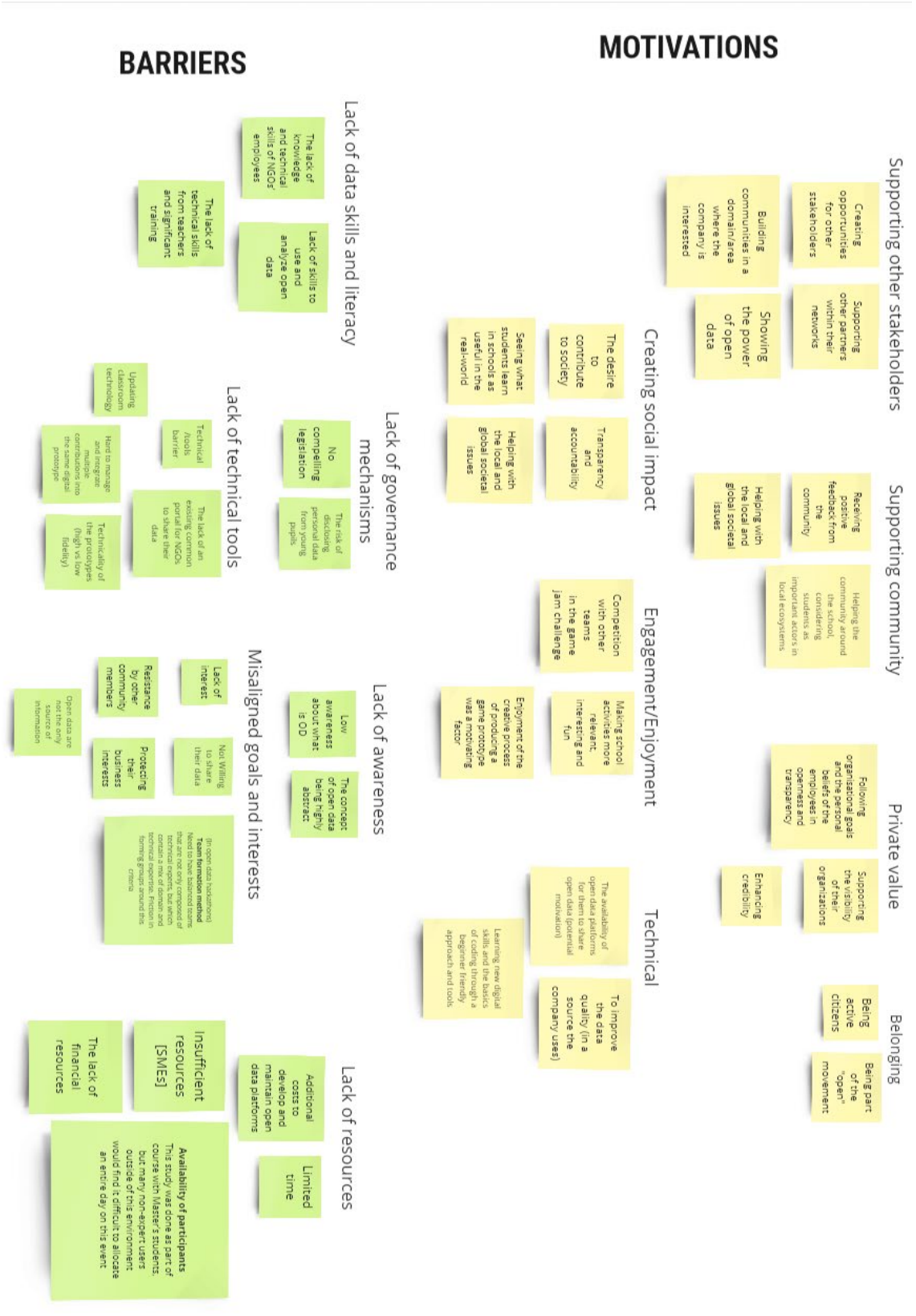
Regarding the misaligned goals and interests, creating spaces aligned with the domains and topics the non-governmental actors are interested in is important in creating a low-barrier environment and showing them the potential benefits of participating, following the principle shown in the shared motivations.

Two out of the six case studies stated the lack of governance mechanisms cluster. Stakeholders mentioned issues with a lack of compelling legislation and privacy concerns. Appropriate governance is, therefore, regarded as important in lowering the barriers and enabling data sharing in the open data ecosystem. Deliverable D4.3 will dive into answering the questions this cluster creates.

Finally, three and one out of six of the case studies found a lack of data skills and literacy and a lack of awareness, respectively. Improved training in open data topics can help overcome these barriers.

Table 15: Common barriers to contributing open data

Common barriers	Non-specialist actors	Data journalists	Elementary school students	Non-governmental organisations	Commercial actors	Open data intermediaries
Lack of data skills and literacy		X	X	X		
Lack of governance mechanisms			X			X
Lack of awareness about the value of open data			X			
Lack of technical tools	X		X	X	X	
Misaligned goals and interests	X	X			X	X
Lack of resources	X	X		X	X	X


MOTIVATIONS
Supporting other stakeholders
Creating opportunities for other stakeholders
Supporting other partners within their networks
Building communities in a domain/area where the company is interested
Showing the power of open data
Supporting community
Receiving positive feedback from the community
Helping with the local and global societal issues
Helping the community around the school, considering students as important actors in local ecosystems
Private value
Following organizational goals and the personal beliefs of the employees in openness and transparency
Supporting the visibility of their organizations
Enhancing credibility
Belonging
Being active citizens
Being part of the "open" movement
Creating social impact
The desire to contribute to society
Transparency and accountability
Seeing what students learn in schools as useful in the real-world
Helping with the local and global societal issues
Engagement/Enjoyment
Competition with other teams in the game Jam challenge
Making school activities more relevant, interesting and fun
Enjoyment of the creative process of producing a game prototype was a motivating factor
Technical
The availability of open data platforms for them to share open data (potential motivation)
To improve the data quality (in a source the company uses)
Learning new digital skills and the basics of coding through a beginner friendly approach and tools
BARRIERS
Lack of data skills and literacy
The lack of knowledge and technical skills of NGOs' employees
Lack of skills to use and analyze open data
The lack of technical skills from teachers and significant training
Lack of governance mechanisms
No compelling legislation
The risk of disclosing personal data from young pupils
Lack of technical tools
Updating classroom technology
Technical /tools barrier
Hard to manage and integrate contributions into the software prototype
The lack of an existing common portal for NGOs to share their data
Technicality of the prototypes (high vs low fidelity)
Lack of awareness
Low awareness about what is OD
The concept of open data being highly abstract
Misaligned goals and interests
Lack of interest
Not Willing to share their data
Resistance by other community members
Protecting their business interests
Open data are not the only source of information
(In open data hackathons) Team formation method
Lack of resources
Additional costs to develop and maintain open data platforms
Limited time
Insufficient resources [SMEs]
The lack of financial resources
Availability of participants
This study was done as part of course with Master's students, but many non-expert users outside of this environment would find it difficult to allocate an entire day on this event.

8.2 Enablers

This subsection answers RQ3: "How to turn the motivations and barriers to the sharing of non-governmental data as open data into enablers?". Once the motivations and barriers have been defined, situations that allow these motivations and barriers to be leveraged have been identified. The final list includes seven enablers, each relating to one or several motivations or barriers. They are described in Table 16, based on a reflection on the work done in the workshop.

Table 16: Enablers and related motivations and barriers

Enabler	Related motivation	Related barrier
Availability of training in data skills and literacy		Lack of data skills and literacy
Availability of appropiate technical tools	To improve technical skills or internal data processes	Lack of technical tools
Alignment of private value and interests with open data sharing	Private value	Misaligned goals and interests
Availability of resources (financial, time, people/workforce)		Lack of resources
Existence of data-sharing communities	Supporting other stakeholders, supporting communities, belonging	
Awareness about the social impact of open data sharing	Creating social impact	Lack of awareness
Presence of engagement or enjoyment activities	Engagement / enjoyment	

9 Conclusion

9.1 Summary of the results and further actions

This deliverable addressed the following three research questions:

- RQ1: What are the motivations of non-governmental data holders to contribute to the open data ecosystem?
- RQ2: What barriers do non-governmental data holders face when contributing to open data ecosystem?
- RQ3: How can the motivations and barriers to sharing non-governmental data as open data become enablers?

Seven common motivations for non-government data holders to contribute their data as open data were identified (RQ1): "Supporting other stakeholders within an organisation network for their benefit", "Supporting and creating communities that would benefit from open data", "Private value", "Belonging", "Creating social impact", "Engagement/enjoyment", and "To improve technical skills or internal data processes".

Six common barriers were also identified (RQ2): "Lack of data skills and literacy", "Lack of governance mechanisms," "Lack of awareness about the value of open data," "Lack of technical tools," "Misaligned goals and interests," and "Lack of resources."

Finally, motivations and barriers were turned into seven common enablers (RQ3): "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/workforce)", "Existence of data-sharing communities", "Awareness about the social impact of open data sharing", and "Presence of engagement or enjoyment activities".

Further deliverables in WP4 will build on D4.1, exploring technical (D4.2) and governance (D4.3) strategies to steer the behaviour of non-government data holders towards open data.

9.2 Limitations

One of the main limitations of the study we conducted is that the analysis is based mainly on case studies and related interviews that are limited in number and heterogeneous. A common drawback of case studies is that they are often criticized for being subjective, biased, or lacking in rigour (Idowu, 2016).

Because they focus on particular domains, generalising results takes a lot of work. Bias can be another issue with case studies, as it can step into various stages by selecting non-representative cases or by interpreting the results in a way that favours a specific view, potentially skewing results. Furthermore, small sample sizes hinder representativeness, and replication can be problematic due to the unique nature of each case. Additionally, narrow scopes may overlook crucial contextual elements. Lastly, the subjective nature of qualitative data interpretation adds another layer of complexity. These limitations underscore the need for careful consideration and critical evaluation of conclusions drawn from case studies.

What we observe and report in this deliverable is based on the researcher's interpretation and selection of data, which personal views, assumptions, or preferences can influence. A case-control study could have improved the systematic observation, improving the quality and completeness of the results, but it was out of scope.

Despite the limitations of the performed research, we still hold that the research results provide welcome new preliminary insights in the motivations, barriers and enablers of non-governmental

data holders to contribute open data to the open data ecosystem. Our research can be considered inspirational for future researchers that will study this topic in more depth.

10 References

Anderson, J., Sarkar, D., & Palen, L. (2019). Corporate Editors in the Evolving Landscape of OpenStreetMap. *ISPRS International Journal of Geo-Information*, *8*(5), Article 5. https://doi.org/10.3390/ijgi8050232

Appelgren, E., and G. Nygren. 2014. "Data Journalism in Sweden: Introducing new Methods and Genres of Journalism Into "old" Organizations." Digital Journalism 2 (3): 394–405. doi:10.1080/21670811.2014.884344

Atenas, J., Havemann, L., & Priego, E. (2015). Open Data as Open Educational Resources: Towards Transversal Skills and Global Citizenship. *Open Praxis*, *7*(4). https://doi.org/10.5944/openpraxis.7.4.233

Attride-Stirling, J. (2001). Thematic networks: An analytic tool for qualitative research. *Qualitative Research*, *1*(3), 385–405. https://doi.org/10.1177/146879410100100307

Baack, S. (2015). Datafication and empowerment: How the Open Data movement re-articulates notions of democracy, participation, and journalism. *Big Data & Society*, *2*(2), 2053951715594634. https://doi.org/10.1177/2053951715594634

Boyles, J. L. (2020). Laboratories for news? Experimenting with journalism hackathons. *Journalism*, *21*(9), 1338–1354. https://doi.org/10.1177/1464884917737213

Cambridge Dictionary. (2024). *Motivation*. https://dictionary.cambridge.org/dictionary/english/motivation

Celis Vargas, A., Magnussen, R., Mulder, I., & Larsen, B. (2023). Towards a framework for Open Data literacy in education: A systematic mapping review of Open Data skills and learning approaches. *Interaction Design and Architecture(s)*, *57*, 133–151. https://doi.org/10.55612/s-5002-057-008

Chattapadhyay, S. (2014). Access and use of government data by research and advocacy organisations in India: A survey of (potential) Open Data ecosystem. *Proceedings of the 8th International Conference on Theory and Practice of Electronic Governance*, 361–364. https://doi.org/10.1145/2691195.2691262

Chicaiza, J., Piedra, N., Lopez-Vargas, J., & Tovar-Caro, E. (2017). Recommendation of open educational resources. An approach based on linked Open Data. *2017 IEEE Global Engineering Education Conference (EDUCON)*, 1316–1321. https://doi.org/10.1109/EDUCON.2017.7943018

Concilio, G., & Mulder, I. (2018). *Open4Citizens Policy brief*. OPEN4CITIZENS - Empowering citizens to make meaningful use of Open Data. http://open4citizens.eu/wp-content/uploads/2016/01/O4C_D4.8_30.06.2018_Final.pdf

Cook, K., Cakirlar, C., Goddard, T., Demuth, R. C., & Wells, J. (2018). Teaching Open Science: Published Data and Digital Literacy in Archaeology Classrooms. *Advances in Archaeological Practice*, *6*(2), 144–156. https://doi.org/10.1017/aap.2018.5

Corbett, J., Templier, M., & Takeda, H. (2018, January 3). The Making of a "Top" Open Data City: A Case Study of Edmonton's Open Data Initiative. *Proceedings of the 51st Hawaii International Conference on System Sciences*. https://doi.org/10.24251/HICSS.2018.308

Coughlan, T. (2020). The use of Open Data as a material for learning. *Educational Technology Research and Development*, *68*(1), 383–411. https://doi.org/10.1007/s11423-019-09706-y

Creative Commons. (2024). *CC BY-NC-SA 4.0 Legal Code | Attribution-NonCommercial-ShareAlike 4.0 International | Creative Commons*. https://creativecommons.org/licenses/by-nc-sa/4.0/legalcode

Davies, T. (2011). Open Data: Infrastructures and ecosystems. *ACM Web Science Conference*.

Davis, K., & Shneyer, E. (2020). Computer science as a tool for developing future civic change-makers. *SIGCSE 2020 - Proceedings of the 51st ACM Technical Symposium on Computer Science Education*, 1344. https://doi.org/10.1145/3328778.3372636

Enaholo, P. (2017). Beyond mere advocacy: CSOs and the role of intermediaries in Nigeria's Open Data ecosystem. *The Social Dynamics of Open Data*. https://zenodo.org/records/1117797

Enaholo, P., & Dina, D. (2020). Journalists and the intermediation of Open Data: A Nigerian perspective. In *Situating Open Data: Global Trends in Local Contexts* (pp. 31–49). African Minds. https://www.scienceopen.com/hosted-document?doi=10.47622/978-1-928502-12-8_2

Falk, J. (2022). *How Game Jams and Hackathons Accelerate Design Processes* (arXiv:2205.04966). arXiv. https://doi.org/10.48550/arXiv.2205.04966

González-Zapata, F., & Heeks, R. (2015, May). Understanding multiple roles of intermediaries in Open Government Data. *Proceedings of the 13th International Conference on Social Implications of Computers in Developing Countries*.

Gray, J., Bounegru, L., & Chambers, L. (2012). *The Data Journalism Handbook* (1st ed.). O'Reilly Media, Inc.

Grubenmann, S. 2016. "Action Research." Digital Journalism 4 (1): 160–176. DOI: 10.1080/21670811. 2015.1093274

Hou, Y., & Wang, D. (2017). Hacking with NPOs: Collaborative Analytics and Broker Roles in Civic Data Hackathons. *Proceedings of the ACM on Human-Computer Interaction*, *1*(CSCW), 53:1-53:16. https://doi.org/10.1145/3134688

Idowu, O. E. (2016). Criticisms, Constraints and Constructions of Case Study Research Strategy. *Asian Journal of Business and Management*, *4*(5). Retrieved from https://www.ajouronline.com/index.php/AJBM/article/view/4166

Jaskiewicz, T., Mulder, I., Morelli, N., & Pedersen, J. (2019). Hacking the hackathon format to empower citizens in outsmarting "smart" cities. *Interaction Design and Architecture(s)*, *43*, 8–29. https://doi.org/10.55612/s-5002-043-001

Kitsios, F., & Kamariotou, M. (2018). Open Data hackathons: An innovative strategy to enhance entrepreneurial intention. *International Journal of Innovation Science*, *10*(4), 519–538. https://doi.org/10.1108/IJIS-06-2017-0055

Lodato, T. J., & DiSalvo, C. (2016). Issue-oriented hackathons as material participation. *New Media & Society*, *18*(4), 539–557. https://doi.org/10.1177/1461444816629467

Maron, M. (2020). *An Incomplete History of Companies and Professionals in OpenStreetMap*. http://2020.stateofthemap.org/sessions/RHDUV9/

Meijer, A., & Potjer, S. (2018). Citizen-generated Open Data: An explorative analysis of 25 cases. *Government Information Quarterly*, *35*(4), 613–621. https://doi.org/10.1016/j.giq.2018.10.004

Meyer, P. (2002). *Precision Journalism: A Reporter's Introduction to Social Science Methods* (4th ed.). Rowman & Littlefield Publishers.

Morini, F. (2023). Data Journalism as "Terra Incognita": Newcomers' Tensions in Shifting Towards Data Journalism Epistemology. Journalism Practice, 1–17. https://doi.org/10.1080/17512786.2023.2185656

Navalkha, C. (2021). *Data for Housing Justice: Examining Activists' Use of Open Government Data for Housing Justice in Boston, MA and New York, NY* [Thesis, Massachusetts Institute of Technology]. https://dspace.mit.edu/handle/1721.1/138973

OpenstreetMap Foundation. (2024). *Corporate Members—OpenStreetMap Foundation*. https://osmfoundation.org/wiki/Corporate_Members

OpenStreetMap Wiki. (2024). *Organised Editing/Activities—OpenStreetMap Wiki*. https://wiki.openstreetmap.org/w/index.php?title=Organised_Editing/Activities&oldid=2656488

Palova, D., & Vejacka, M. (2022). Experience with Open Data in Project-Based Learning. *2022 45th Jubilee International Convention on Information, Communication and Electronic Technology, MIPRO 2022 - Proceedings*, 689–694. https://doi.org/10.23919/MIPRO55190.2022.9803595

Papageorgiou, G., Euripides, L., Magnussen, R., & Charalabidis, Y. (2023). Open Data journalism: A domain mapping review. *Proceedings of the 16th International Conference on Theory and Practice of Electronic Governance*, 159–166. https://doi.org/10.1145/3614321.3614340

Park, C. H., Longo, J., & Johnston, E. W. (2020). Exploring Non-State Stakeholder and Community-Led Open Governance: Beyond the Three Pillars of Open Government. *Public Performance & Management Review*, *43*(3), 587–612. https://doi.org/10.1080/15309576.2019.1677253

Pellegrino, M., & Antelmi, A. (2023). At School of Open Data: A Literature Review: *Proceedings of the 15th International Conference on Computer Supported Education*, 172–183. https://doi.org/10.5220/0011747500003470

Pence, H. E., Williams, A. J., & Belford, R. E. (2015). New Tools and Challenges for Chemical Education: Mobile Learning, Augmented Reality, and Distributed Cognition in the Dawn of the Social and Semantic Web. In *Chemistry Education: Best Practices, Opportunities and Trends*. https://doi.org/10.1002/9783527679300.ch28

Poikola, A., Kola, P., & Hintikka, K. A. (2010). *Public data: An introduction to opening information resources*. Ministry of Transport and Communications.

Ricker, B., Cinnamon, J., & Dierwechter, Y. (2020). When Open Data and data activism meet: An analysis of civic participation in Cape Town, South Africa. *Canadian Geographies / Géographies Canadiennes*, *64*(3), 359–373. https://doi.org/10.1111/cag.12608

Rogers, S. (2008, December 18). Turning official figures into understandable graphics, at the press of a button. *The Guardian*. https://www.theguardian.com/help/insideguardian/2008/dec/18/unemploymentdata

Rogers, S. (2010, August 13). Florence Nightingale, data journalist: Information has always been beautiful. *The Guardian*. https://www.theguardian.com/news/datablog/2010/aug/13/florence-nightingale-graphics

Rogers, S. (2011, September 26). *The first Guardian data journalism: May 5, 1821*. The Guardian. http://www.theguardian.com/news/datablog/2011/sep/26/data-journalism-guardian

Romero, M., Usart, M., & Ott, M. (2015). Can Serious Games Contribute to Developing and Sustaining 21st Century Skills? *Games and Culture*, *10*(2), 148–177. https://doi.org/10.1177/1555412014548919

Saddiqa, M., Larsen, B., Magnussen, R., Rasmussen, L. L., & Pedersen, J. M. (2019). Open Data visualization in Danish schools: A case study. *Journal of WSCG*, *2019*(WSCG2019CS), 17–26. https://doi.org/10.24132/CSRN.2019.2902.2.3

Saddiqa, M., Magnussen, R., Larsen, B., & Pedersen, J. M. (2021). Digital innovation in education: Perspectives, opportunities and challenges of educational Open Data and sensor data. *CEUR Workshop Proceedings*, *2991*, 74–83.

Saddiqa, M., Rasmussen, L., Magnussen, R., Larsen, B., & Pedersen, J. M. (2019). Bringing Open Data into Danish schools and its potential impact on school pupils. *Proceedings of the 15th International Symposium on Open Collaboration, OpenSym 2019*. https://doi.org/10.1145/3306446.3340821

Salamon, L. M., & Anheier, H. K. (1992). In search of the non-profit sector. I: The question of definitions. *Voluntas: International Journal of Voluntary and Nonprofit Organizations*, *3*(2), 125–151. https://doi.org/10.1007/BF01397770

Shaharudin, A., van Loenen, B., & Janssen, M. (2023). Towards a Common Definition of Open Data Intermediaries. *Digital Government: Research and Practice*, *4*(2), 6:1-6:21. https://doi.org/10.1145/3585537

Vallejo-Figueroa, S., Rodriguez-Artacho, M., Castro-Gil, M., & Cristobal, E. S. (2018). Using text mining and linked Open Data to assist the mashup of educational resources. *2018 IEEE Global Engineering Education Conference (EDUCON)*, 1606–1611. https://doi.org/10.1109/EDUCON.2018.8363427

van Loenen, B., Vancauwenberghe, G., & Crompvoets, J. (Eds.). (2018). *Open Data Exposed*. T.M.C. Asser Press. https://link.springer.com/book/10.1007/978-94-6265-261-3

Wang, T. "Why Big Data Needs Thick Data. Medium," 2016. https://medium.com/ethnography-matters/why-big-data-needs-thick-data-b4b3e75e3d7.Wolff, A., Cavero Montaner, J. J., & Kortuem, G. (2016). Urban Data in the primary classroom: Bringing data literacy to the UK curriculum. *The Journal of Community Informatics*, *12*(3). https://doi.org/10.15353/joci.v12i3.3278

Zaman, H. B., Baharin, H., & Ahmad, A. (2021). Fusion Technology and Visualisation to Share STEM Data Using PETS Robots (i-COMEL) for Open Data Readiness Amongst Primary School Children. In *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence*

and Lecture Notes in Bioinformatics): Vol. 13051 LNCS. https://doi.org/10.1007/978-3-030-90235-3_16