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Barriers and Enablers of Open Data Provision and Usage: The Case of Estonian municipalities

Master's Thesis (15 ECTS)

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Abstract:

This thesis aims to explore the Estonia's OGD development at the national and local levels, through an integrated analysis of various indices and evolution of the Estonian OGD portal, systematic literature review and qualitative analysis on main barriers of open data provision by municipalities performed in the form of interviews with 12 municipalities, whereas interview protocol is developed by drawing from the Innovation Resistance Theory. The research shows that although Estonia has made progress in the national level open data ecosystem, mainly due to improvements in the OGD portal usability and legislative amendments, local governments are lagging behind in the provision of OGD. The literature review highlights the lack of previous research focusing on Estonian and European local level open data, emphasizing the need to explore the barriers and enablers of municipal OGD. The findings of the interviews with Estonian municipalities indicate the importance of addressing identified barriers such as limited awareness of open data concepts, lack of skills and resources for OGD preparation and the uncertainty about the value of municipal OGD. The research contributes to an in-depth understanding of Estonia's journey on the open data landscape, shedding light on the achievements and providing practical recommendations for moving towards a more sustainable open data ecosystem.

Keywords:

Open data, Open data ecosystem, Open data portal, Open Government Data, OGD, Systematic Literature Review, SLR, Benchmark, Local government, Municipalities, Innovation Resistance theory, IRT

CERCS: P175 Informatics, systems theory, S214 Social changes, theory of social work

Avaandmete pakkumise ja kasutamise takistajad ja võimaldajad Eesti kohalike omavalitsuste näitel

Lühikokkuvõte:

Lõputöö eesmärk on uurida Eesti avaandmete arengut riiklikul ja kohalikul tasandil, mis hõlmab erinevate indeksite ja Eesti avaandmete portaali arengu integreeritud analüüsi, teaduskirjanduse süstemaatilist analüüsi ning kvalitatiivset analüüsi kohalike omavalitsuste poolt avaandmete pakkumise peamiste takistuste ja võimaldajate kohta. Selleks viidi läbi intervjuud 12 omavalitsusega, kusjuures intervjuu protokolli väljatöötamisel lähtuti innovatsiooni vastuseisu teooriast. Uurimusest selgub, et kuigi Eesti on teinud avaandmete ökosüsteemis riigi tasandil edusamme, eelkõige tänu avaandmete portaali kasutatavuse parandamisele ja seadusandluse muudatustele, on kohalikud omavalitsused avaandmete

pakkumisel maha jäänud. Süstemaatilises kirjanduse ülevaates rõhutatakse Eesti ja Euroopa kohaliku tasandi avaandmetele keskenduvate varasemate uuringute puudumist, rõhutades seega vajadust uurida omavalitsuste avaandmete pakkumise takistusi ja võimaldajaid. Eesti omavalitsustega läbiviidud intervjuude tulemused näitavad, kui oluline on tegeleda tuvastatud takistustega, nagu piiratud teadlikkus avaandmete kontseptsioonist, oskuste ja ressursside puudumine avaandmete ettevalmistamisel ning kahtlused kohalike omavalitsuste avaandmete väärtuse osas. Uurimistöö aitab põhjalikult mõista Eesti teekonda avaandmete maastikul, valgustades saavutusi ja andes praktilisi soovitusi edasiliikumiseks jätkusuutlikuma avaandmete ökosüsteemi suunas.

Võtmesõnad:

Avaandmed, avaandmete ökosüsteem, avaandmete portaal, avatud valitsuse andmed, süstemaatiline kirjanduse ülevaade, indeksid, kohalik omavalitsus, innovatsiooni vastuseisu teooria

CERCS: P175 Informaatika, süsteemiteooria, S214 Sotsiaalsed muutused, sotsiaaltöö teooria

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Introduction

Estonia has garnered global reputation of a "digital state" or "e-country". However, despite its considerable success in digital governance, the country has been struggling with providing and maintaining open government data (OGD) [1], which is considered to have social, economic and environmental value for different institutions and sectors, as well as to individuals [2]. From 2020 significant advancements can be observed, as evidenced by Estonia's notable progress in the European Open Data Maturity Report [3]. The country was ranked 24th in 2018 and jumped to 5th position in 2020 and 2021, maintaining the leadership position in subsequent years.

Over the past decade, various benchmarks, including the Open Data Inventory, Open Data Readiness Assessment, Open Data Barometer, Global Open Data Index, World Justice Project Open Government Index, OGD Report and Open Data Maturity in Europe [4] have been developed for ranking and comparing countries. These benchmarks utilize different methodologies and indicators, which evolve over time, and relying on a single report may inadvertently halt or slow down the progress of OGD initiatives by limiting a holistic understanding of the complex and multifaceted nature of open data ecosystems, influenced by diverse factors and contexts [5]. Therefore, cross-index comparison becomes essential to gain a more comprehensive understanding of progress and potential weaknesses.

Local administrative level can be a source of data most close to the citizen and carrying great value in itself, but until now still underused or not used at all [6]. Estonia is administratively composed of a total of 79 local governments (LGs), including 15 urban municipalities and 64 rural municipalities (as of January 1, 2024). These local governments are entrusted with the responsibility of decision-making and organization of all aspects of local life. The state, however, can impose obligations on them, but this is strictly contingent upon legal provisions or mutual agreements with the local governments. The functions and competence of municipalities are regulated by the Local Government Organisation Act[1]. According to the legislation, all local authorities, regardless of their size, have the task of organising:

- the provision of social services, the provision of social benefits and other social assistance, the welfare of the elderly, cultural, sports and youth work, housing and utilities, water supply and sewage, the provision of public services and amenities, waste management, spatial planning, public transport within the municipality, and the construction and maintenance of roads or streets, unless these functions have been assigned by law to other body/organization;

[1] https://www.riigiteataja.ee/en/eli/501072023003/consolide

- maintenance of pre-school childcare institutions, basic schools, secondary schools and hobby schools, libraries, community centres, museums, sports facilities, shelters, care homes, health care institutions and other local institutions owned by the local government. The Act may prescribe that certain expenses are covered from the state budget or other sources.

In addition to the abovementioned responsibilities, local governments also undertake the decision-making and organization of local matters that are not explicitly assigned by law to any other entity for resolution and management. This includes, but is not limited to, initiatives such as place marketing and tourism.

A study conducted in 2022, examining the information systems of local government revealed that the information systems of municipalities and state do not form a coherent integrated ecosystem [7]. The knowledge of service management and development is generally low, and majority of local governments do not prioritize data management and open data as relevant issues. The digital divide between local authorities and state agencies is also referred to in Estonian Digital Agenda 2030[2]. This highlights the need for a more in-depth examination of the situation of municipalities that would enable investigation of possible causes through if issues have been identified.

The Ministry of Economic Affairs and Communications (MKM) is the owner of the Estonian open data portal avaandmed.eesti.ee[3]. The representative of MKM was consulted twice during the writing of this thesis for further background information and possible research directions.

The objective of this thesis is to examine Estonian OGD development at the national and local levels, identifying the main barriers municipalities face when openly sharing OGD, defining corrective actions to improve the situation. The following research questions are defined to attain this objective:

a) RQ1: How has the Estonia's position evolved within open data rankings and to what extent the local administrative level is covered by them?
b) RQ2: What is the current state of art regarding the open (government) data ecosystem at both the local and regional levels in Estonia and Europe?
c) RQ3: What are the main barriers and enablers for Estonian local governments to openly share and maintain data, and how these barriers can be overcome?

To achieve the thesis objective and answer the defined research questions, a multidimensional methodology is utilized, including the (1) analysis of Estonian performance in different benchmarks and the evolvement of open data policy and the portal, (2) systematic literature review, and (3) qualitative analysis of barriers faced by LGs when opening their data through interviews with LGs, whose protocol is developed through the OGD-adapted

[2] https://www.mkm.ee/en/e-state-and-connectivity/digital-agenda-2030
[3] https://avaandmed.eesti.ee/

Innovation Resistance Theory (IRT), which is intended to study functional and psychological factors OGD barriers, empirically identifying predictors affecting public agencies' resistance to openly sharing government data [8].

Based on the findings of the research, proposals towards improvement of the current open data ecosystem are made. The author is involved with Estonian Association of Municipalities, which represents the common interests and arranges co-operation of local governments (LG). In IT field, the association is responsible for developing and implementing the digital transformation plan of LGs, which includes the topics of data governance and open data. The results of the thesis are expected to be utilized in the development of supportive measures for municipalities.

The thesis is structured as follows:

- The first Section presents introduction, and the second Section provides a list of terms and acronyms used in the thesis;
- Section 3 presents methodology of the thesis;
- Section 4 explores Estonian progress as open data publisher in different EU and global rankings;
- Section 5 examines the evolvement of Estonian policymaking and OGD portal, including municipal open data provision;
- Section 6 presents the results on Systematic Literature Review (SLR);
- Section 7 reflects the results of the interviews with local governments' representatives on barriers and enablers towards OGD publishing and maintenance and the recommended measures for ecosystem improvement;
- Discussion, conclusions and future research directions are presented in last Section.

As the research on regional and local level open data is limited, the thesis provides new insight to the role of Estonian municipalities in providing open data and the barriers and enablers related to municipal OGD publishing and maintenance.

The findings contribute to better understanding of open data ecosystem and could be used as input for data governance and open data policymaking. Furthermore, the practical value lies in recommendations that emerge from the interviews with municipalities that highlight specific measures, which can be implemented by national agencies and local authorities to mature Estonian open data ecosystem.

For the improvement of formatting, styling and translation, Copilot[4] has been used as a supportive tool.

[4] https://copilot.microsoft.com/

1 Terms and acronyms

Term, acronym	Description
OGD	Open government data
LG	Local government/authority, also referred in the thesis as "municipality"
IRT	Innovation Resistance Theory
OECD	Organisation for Economic Co-operation and Development
CKAN	Comprehensive Knowledge Archive Network
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
API	Application Programming Interface
MKM	Estonian Ministry of Economic Affairs and Communications
DMS	Document Management System

2 Methodology

To achieve the thesis objective, a multi-faceted methodology is employed comprising the following steps (which are detailed later in the text):

1) the historical performance of Estonian OGD through various rankings and benchmarks is analysed;
2) the Estonian OGD portal and policymaking developments are explored, which encompasses aspects such as data provision, overall architecture, and legislative influences shaping the Estonian open data ecosystem;
3) systematic literature review (SLR) is conducted to collect and analyse relevant research on the Estonian OGD ecosystem;;
4) qualitative analyses of barriers and enablers associated with the OGD publishing and maintenance at local level of Estonia utilizing the OGD-adapted Innovation Resistance Theory model, which includes (a) development of the interview protocol, (b) creating interview sample, (c) conducting interviews with the representatives of local governments, (d) analysing the interviews (transcribing, coding etc.).

To fulfil the first step of examining the progress of Estonian OGD in rankings and indices over the years, a systematic approach is adopted. Drawing from a list of prominent and extensively discussed indices, including the *Open Data Inventory, Open Data Readiness Assessment, Open Data Barometer, Global Open Data Index, World Justice Project Open Government Index, OECD OGD Report* and *Open Data Maturity Report* in Europe [4] [5], those that cover Estonia are identified, namely (1) *Open Data Inventory* (Open Data Watch), (2) *Open Government Index* (World Justice Project (WJP)), (3) *OECD Open, Useful and Re-usable data (OURdata) Index*, (4) *Open Data Barometer* (World Wide Web foundation), (5) *Open Data Maturity* in Europe (European Data Portal). The research encompasses (a) detailed examination of the structure of each index and delving into their methodologies to identify major changes over time, (2) analysis of Estonia's performance within these indices, spanning multiple years. The detailed analysis is presented in section 3, referring to the first research question (RQ1).

To fulfil the second step, an analysis of the evolvement of Estonian OGD portal is performed. This involves an examination of Estonian OGD portal content, focusing on both the diversity of topics covered and the extent of data provision by local governments. In addition, the legislative amendments, which contributed to the improvement of OGD ecosystem are analysed. This provides a more in-depth understanding of the underlying factors, which have contributed to Estonia's "jump" in the rankings and complements the first research question.

While RQ1 predominantly contribute to the problem statement, RQ2 and RQ3 are the central research questions with more complex procedures carried out to answer them. To this end, they are covered in more detail in the further sub-sections.

2.1 Methodology of Systematic Literature Review

To fulfil the third step, SLR approach was utilized, to systematically examine and synthesize existing research on the open (government) data ecosystem, with a specific focus on Estonia, to identify key themes explored in prior studies, the barriers and enablers of municipal OGD, as well as to analyse the contextual factors and themes investigated in previous research addressing open (government) data at the local or regional levels within Europe. This includes: (a) analysis of research specific to Estonian OGD, (b) local level of Estonian OGD ecosystem, (c) local/city/municipality OGD ecosystems at European level. The latter two elements of the SLR are of particular interest due to the identification of limited local OGD provision during the examination of the Estonian OGD portal. The interest extends to assessing the advancement (if any) at the local level, which, when found limited, expanded to the European level. This expansion aims to fuel future research within the Estonian context, identifying prominent research areas and associated findings. Furthermore, the review seeks to establish a comparative analysis between the findings from research on the open data ecosystem in Estonia and studies conducted on a European scale, aiming to identify similarities, differences, and potential implications for Estonian and broader European contexts. To this end, the methodology defined by Kitchenham is followed [20]. As such, the SLR involves the identification, selection, relevance assessment, and synthesis of relevant research studies.

In the first step, to achieve the SLR objective, the following questions are defined:

1) *What are the key themes that have been explored in prior research focusing on the open (government) data ecosystem of Estonia at the local government level?*
2) *What has been the context of previous research addressing open (government) data at the local or regional levels within Europe?*
3) *How can the findings from research on the open data ecosystem in Estonia be compared with those from studies conducted on a European scale?*

SLR was carried by searching digital libraries covered by Scopus and Web of Science (WoS). Given the limited number of studies that were identified during this research for Estonian case, the search was complemented later by Google Scholar results. These databases were queried for keywords *"Open government data", "OGD", "open data", "local government", "municipal*", "cit*", "district", "region", "Estonia", "Europe"* that were combined using Boolean operators AND and OR. First, studies addressing open (government) data at the local government level in Estonia were identified (1st query in Table 1). Given the limited number of articles identified, totalling 10 articles after the deduplication process, the query was expanded to encompass the country level (2nd query in Table 1). This tripled the number of results in Web of Science and doubled in Scopus. Recognizing the broader European context, a third query was executed to identify relevant studies concerning municipal open data at the European level (3rd query in Table 1).

Table 1. Search queries

No	Search terms in the title/keywords
1	("Open government data" OR "OGD" OR "open data") AND ("Estonia*" OR "EE" OR "EST") AND ("local government*" OR "LG*" OR "municipal*" OR “cit*” OR “district” OR “region*”)
2	("Open government data" OR "OGD" OR "open data") AND ("Estonia*" OR "EE" OR "EST")
3	("Open government data" OR "OGD" OR "open data") AND ("EU" OR "Europe*" OR "European Union") AND "("local government*" OR "LG*" OR "municipal*" OR “cit*” OR “district” OR “region*”)

These queries were applied to the article title, keywords, and abstract fields to narrow down the retrieved papers to primary studies, where the searched elements serve as the primary focus of the research. For the third query, the search was refined to include only English-language results from the last 5 years, ensuring a focus on recent studies (the search was conducted in August 2023).

The literature search of 1st and 2nd query in Table 1 resulted in 33 records in Web of Science and 65 in Scopus, with a combined count of 39 records after duplicates were removed. Subsequently, the 3rd query produced 175 in Web of Science and 220 in Scopus, amounting to 183 distinct papers after duplicates were removed. Consequently, the cumulative number of selected records across all three queries reached 222.

To ensure comprehensive coverage, an additional search on Google Scholar was conducted using the keywords "open data" and "Estonia." The first 100 results were examined, resulting in the identification of 7 new records added to the initial results obtained from Web of Science and Scopus.

In the next step the title and abstract of selected records (229) were screened, (see the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart in Figure 1). To determine the study relevance, the following criteria was used (reading the title and abstract):

a) the study places significant emphasis on open (government) data;
b) open (government) data is addressed within the context of the local or regional level, encompassing areas such as data governance, citizen engagement, and public services, among others.

This resulted in 58 papers selected for eligibility assessment: 15 records addressing Q1 and 43 records for Q2. All these studies underwent a thorough assessment through the reading of their full articles. 29 papers with low relevance were excluded based on predefined criteria. Following this rigorous evaluation, the final selection for inclusion in the review comprised 29 studies that met the criteria for relevance and depth of content. To systematically analyse the selected studies, a protocol was created, where for each article the protocol (Appendix I) extracted: (1) the descriptive data; (2) scope of the study and keywords; (3) a brief description or objectives; (4) the theory used or research method; (5) results. The results of the SLR are presented in Section 5.

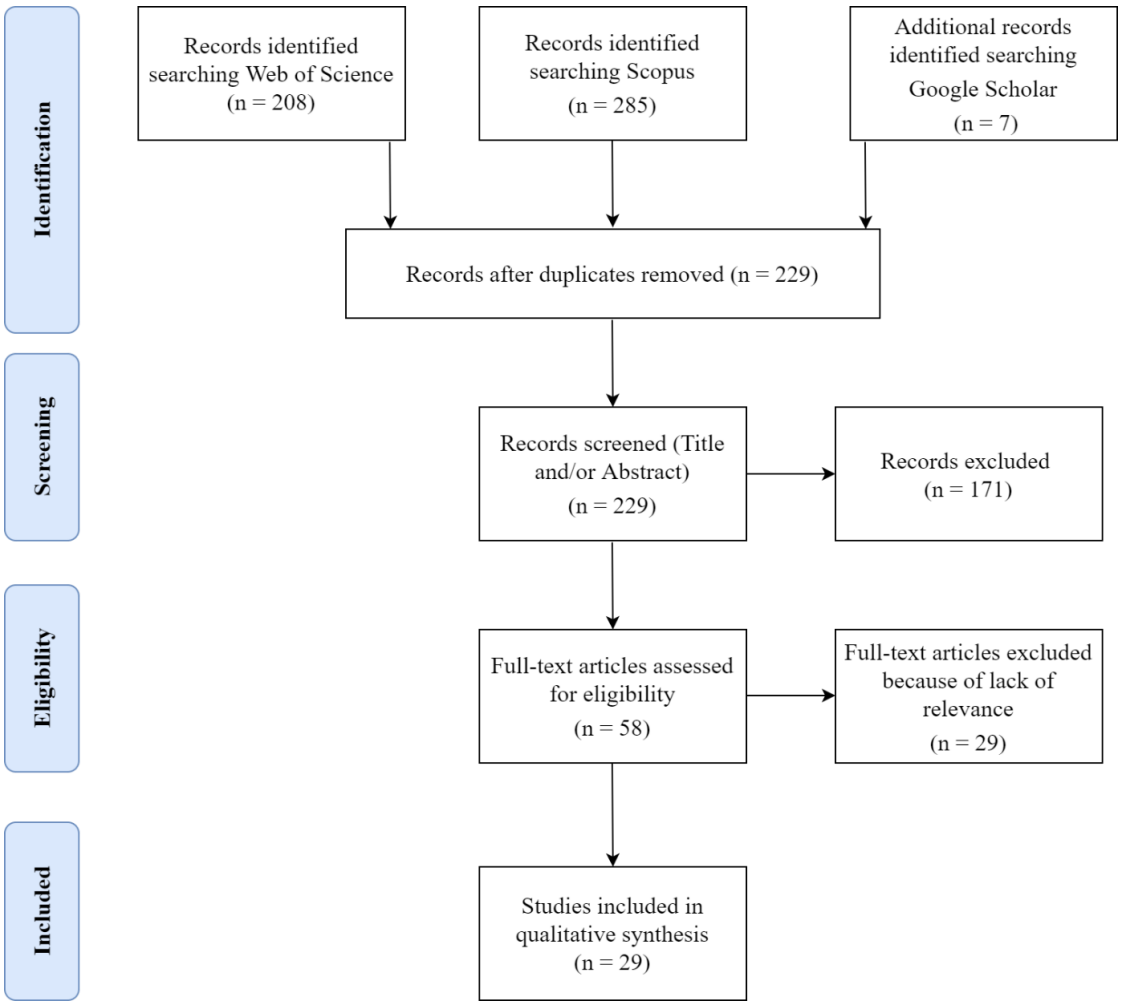

Figure 1. PRISMA flow diagram of SLR

2.2 Theoretical foundations for determining barriers to openly share governmental data by local governments

To fulfil the fourth step qualitative analyses of barriers and enablers associated with the OGD publishing and maintenance at local level of Estonia is performed.

This thesis utilizes the model elaborated by Nikiforova and Zuiderwijk [8], to study open government data barriers, where OGD is seen as a source of innovation. They propose an OGD-adapted IRT model to study the resistance of public authorities to openly share government data. Innovation Resistance Theory (IRT) was developed by Ram and Sheth in 1989 [9]. They argued that customers resist innovations even though they are necessary and desirable and they "face several barriers that paralyze their desire to adopt innovations" [9], p.7. According to IRT, barriers are grouped into two categories:

1. functional barriers that arise if consumers face significant changes from adopting the innovation. Functional barriers are related to product usage, value and risks;
2. psychological barriers, which arise from customers' traditions and perceived product image. These barriers usually occur as a result of conflict with the prior beliefs of customers.

IRT has been widely used in academic research in the field of marketing and business [10], and many studies have utilised IRT as the basis for empirical evaluation of consumer resistance to innovations [11]. However, the use of IRT in the e-government domain is rather limited to two studies. Prakash and Das [12] explored determinants and consequences of citizens' resistance to use digital contact tracing apps that governments worldwide used as a critical element in their COVID-19 pandemic lockdown exit strategy. Nikiforova & Zuiderwijk [8] developed the initial version of the OGD-adapted IRT model to empirically identify predictors affecting public agencies' resistance to openly sharing data that was found appropriate for the defined RQ - *What are the main barriers and enablers of local governments in Estonia to openly share and maintain data?*

The conceptual model of Nikiforova & Zuiderwijk [8] consists of five main IRT barrier categories, where for every barrier a list of relevant barriers associated with the OGD and their opening by public agencies were defined based on the literature review (Table 2). A total of 36 measurement items were defined and are further validated in a qualitative study through interviews with public agencies. Based on these barriers five hypotheses have been defined to study the resistance of public authorities to openly share government data. For each barrier type hypothesis is developed as "[Construct∈ {Usage barrier; Value Barrier; Risk barrier; Tradition Barrier; Image Barrier}] has a positive effect on public agencies' resistance toward openly sharing government data" (H1: Usage barrier, H2: Value Barrier, H3: Risk barrier, H4: Tradition Barrier, H5: Image Barrier) [8], p.3.

H1: *Usage barrier (UB) has a positive effect on public agencies' resistance toward openly sharing government data.*

H2: *Value barrier (VB) has a positive effect on public agencies' resistance toward openly sharing government data.*

H3: *Risk barrier (RB) has a positive effect on public agencies' resistance toward openly sharing government data.*

H4: *Tradition barrier (TB) has a positive effect on public agencies' resistance toward openly sharing government data.*

H5: *Image barrier (IB) has a positive effect on public agencies' resistance toward openly sharing government data.*

Figure 2 presents the model, where the numbers in brackets refer to the number of measurement items defined for the barrier, which are presented in Table 2.

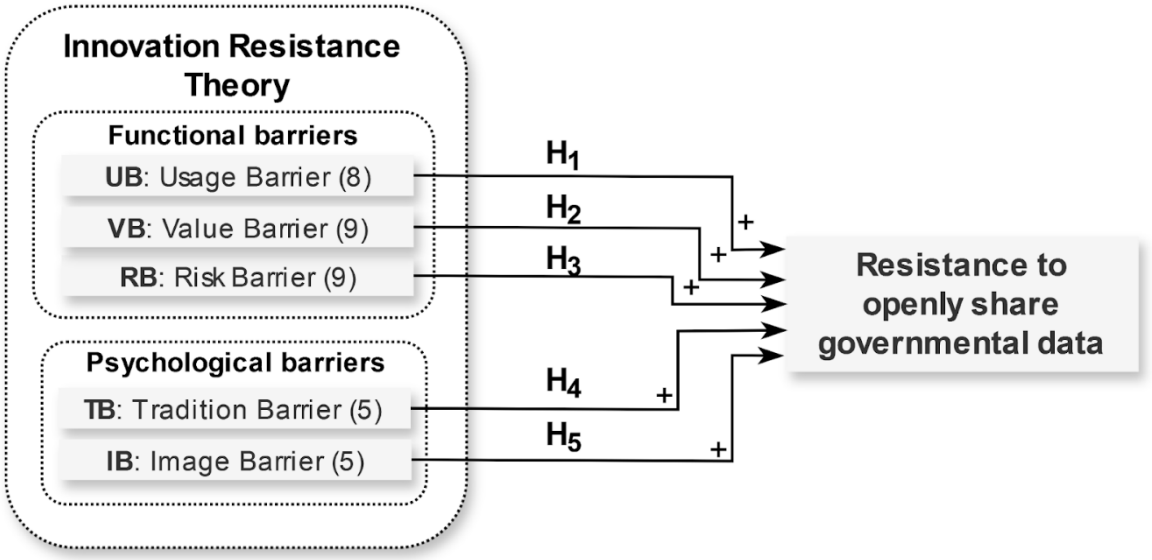

Figure 2. Research model and proposed hypotheses (the numbers in brackets refer to the number of measurement items in Table 3) (Nikiforova & Zuiderwijk, 2022)

Table 2. The proposed Innovation Resistance Theory (IRT) model and its elements (Nikiforova & Zuiderwijk, 2022)

Barrier	**Measurement item**
Usage Barrier (UB)	UB1: It is difficult to attain the appropriate quality level for open government data to be shared openly UB2: It is difficult to prepare data for publication so that they comply with OGD principles UB3: It is difficult to prepare data for publication so that they become appropriate for reuse UB4: Data are difficult to publish on the OGD portal due to the complexity of the process UB5: Data are difficult to publish on the OGD portal due to the unclear process UB6: Data are difficult to publish on the OGD portal due to their limited functionality UB7: Open government data portals often do not allow for semi-automation of the publishing process UB8: It is difficult to maintain openly shared government data
Value Barrier (VB)	VB1: My organization believes that openly sharing government data is often not valuable for the public VB2: Many open government datasets are not appropriate for reuse VB3: Many open government datasets suffer from data quality issues (completeness, accuracy, uniqueness, consistency etc.) VB4: The public gains of openly sharing government data are often lower than the costs VB5: My organizations' gains of openly sharing government data are often lower than the costs VB6: Data preparation is too resource-consuming for my organization VB7: Open government data do not provide any value to my organization VB8: Open data that my organization can openly share will not provide value to users VB9: The amount of resources to be spent to prepare, publish and maintain open government data outweigh the benefit my organization gains from it
Risk Barrier (RB)	RB1: My organization fears the misuse of openly shared government data RB2: My organization fears the misinterpretation of openly shared government data RB3: My organization fears that openly shared government data will not be reused RB4: My organization fears violating data protection legislation when openly sharing government data RB5: My organization fears that sensitive data will be exposed as a result of opening its data RB6: My organization fears making mistakes when preparing data for publication RB7: My organization fears that users will find existing errors in the data RB8: My organization fears that openly sharing its data will reduce its gains (otherwise the organization could sell the data or use it in another beneficial way)

Barrier	Measurement item
	RB9: My organization fears that openly sharing its data will allow its competitors to benefit from this data
Tradition Barrier (TB)	TB1: Freedom of information requests are sufficient for the public to obtain government data TB2: My organization is reluctant to implement the culture change required for openly sharing government data TB3: Employees in my organization lack the skills required for openly sharing government data TB4: Employees in my organization lack the skills required for maintaining openly shared government data TB5: My organization is reluctant to radically change the organizational processes that would enable openly sharing government data
Image Barrier (IB)	IB1: My organization has a negative image of open government data IB2: My organization believes that open government data is not valuable for users IB3: My organization fears that openly sharing government data will damage the reputation of my organization IB4: My organization fears that the accidental publication of low-quality data will damage the reputation of my organization IB5: My organization fears that associating them to incorrect conclusions drawn from OGD analysis by OGD users will damage the reputation of my organization

While the model is approach-agnostic, allowing to utilize both the quantitative and qualitative approach, the authors of the model suggest conducting a qualitative study to gain richer insights and dive deeper into the challenges organization may face, navigating conversation, considering the unique setting of an individual organization. As such, study suggests conducting interviews with actual respondents - representatives of public agencies.

To this end, interview protocol is developed based on the developed model, which is described in the next section along with the sampling approach utilized in this study.

2.2.1 Interview protocol

Based on the proposed OGD-adapted IRT model and its elements, the initial interview protocol was elaborated by Nikiforova & Zuiderwijk as a continuation of their study [8] to which the author of this thesis was invited. Considering the context of this thesis, the protocol has been tailored to its objectives. This was done by extending it to cover (1) OGD ecosystem through 5 questions, and (2) organizations experience with the Estonian national portal avaandmed.eesti.ee. As the interviews focused on local governments, all the questions were adapted to municipalities' perspective. The final interview protocol can be found in Appendix II. To avoid language barrier, the interview protocol was translated into the respondent's native language - Estonian.

The interview protocol consists of four major sections. The first section consists of 4 questions about the general profile of the organization that the respondent represents and his/her awareness of open data:

1) the local government, in which the interviewee works (name, domain);
2) the role of the respondent in it;
3) the type of data the municipality collects;
4) the awareness of the concept of "open data".

The last question was added in the light of the survey that revealed limited awareness of open data amongst Estonian residents [13].

The second section includes questions about sharing openly data on municipal website or portal and national open data portal. Most of the Estonian LGs have not published any data in national portal, but there might be datasets that are openly shared on the municipal website (e.g., document registers) (as analysis of Estonian Open Data Portal documented in Section 4 revealed). The Public Information Act indicates the data that should be disclosed in open format also by local governments, if possible and appropriate, and would not involve disproportionately great effort. Hence, this interview section was split into two separate blocks repeating questions to gain more insight on the experience with both hubs and identify possible datasets that possess the characteristics of open data on local level websites.

In the light of the above, this section contains questions:

1) *whether the municipality has ever openly shared its own data or the data it collected from other sources;*
2) *what were the drivers for doing this or what were the reasons for not sharing them openly;*
3) *what type of data the municipality shared openly? and how often;*
4) *what was the process of openly sharing data? and who within the organization were involved;*
5) *what challenges the organization faced in openly sharing data;*
6) *what have been the specific cases, where municipality's open data was reused by third party?*

The latter question was added to this section to identify possible use cases of OGD usage, which could contribute to better understanding of the ecosystem If the LG had not shared data on national open data, additional question about the reasons for not doing it would be asked.

The third section includes IRT model-related questions. As this study is explorative in nature, each measurement item was converted into an open-ended question of the form "*To what extent do the following situations form a barrier to openly sharing your organization's data: …*" where each barrier listed in Table 3 was then addressed. Open-ended question and long responses were given preference over closed-ended questions (yes/no) as the interest

was to understand the respondents' experiences with actual barriers faced by local governments. Before a specific barrier was addressed, the respondent was introduced with a definition of that barrier and asked whether there were any barriers that would form a challenge for the organization to openly share data related to this barrier. The same question was asked after a list of questions regarding specific barrier, i.e., *whether there are any other barriers that could form a barrier?* (see Table 3). After all the barriers' related questions have been asked, another general question about whether there are any other barriers not related to the above categories that form a challenge for openly sharing the municipality's data. These additional questions would help to verify whether all potentially relevant barriers were captured, as well as would contribute to the refinement of the developed model.

Table 3: Example of transforming usage barrier and associated items into interview questions

Barrier and measurement items	**Interview questions**
Usage barrier (UB)	**Q12.** Are there any usage barriers related to the required changes in your municipality's routines that form a challenge for openly sharing your municipality's data? (UB)
	Q13. To what extent do the following situations form a barrier to openly sharing your municipality's data:
UB1: It is difficult to attain the appropriate quality level for open government data to be shared openly	− an inappropriate quality level of your organization's data? **(UB1)**
UB2: It is difficult to prepare data for publication so that they comply with OGD principles	− a complicated process to prepare data for sharing? **(UB2)**
UB3: It is difficult to prepare data for publication so that they become appropriate for reuse	− a complicated process to make your municipality's data reusable by others? **(UB3)**
UB4: Data are difficult to publish on the OGD portal due to the complexity of the process	− a complicated process to publish your municipality's data on an open data portal? **(UB4)**
UB5: Data are difficult to publish on the OGD portal due to the unclear process	− an unclear process of publishing your municipality's data on an open data portal **(UB5)**
UB6: Data are difficult to publish on the OGD portal due to their limited functionality	− limited functionality of open data portals? **(UB6)**
UB7: Open government data portals often do not allow for semi-automation of the publishing process	− no possibility to semi-automate my organization's process to openly share its data? **(UB7)**
UB8: It is difficult to maintain openly shared government data	− the need and a complicated process to maintain data once published **(UB8)**
	Q14. Are there any other usage barriers that form a barrier for your municipality to openly share its data? **(UBn)**
Value Barrier (**VB**)	…
Risk Barrier (**RB**)	…
Tradition Barrier (**TB**)	…
Image Barrier (**IB**)	…

The last section about overall open data ecosystem and potential improvements was used to get a better understanding of the respondent's general awareness of OGD and gain insight of possible enablers of open data provision. The fourth section consists of 5 questions:

1) *how the respondent sees the OGD ecosystem and its actors;*
2) *whether respondent is aware of policy documents or initiatives guiding developments of OGD on Estonian or European level;*
3) *which actions should be taken at the national level;*
4) *which actions by municipalities to improve the disclosure of open data by LGs;*
5) *what is the benefit or value of open data?*

2.2.2 Interview sample

In crafting the interview sample, the selection criteria were based on the following considerations for municipalities:

- the number of residents in local government (size of LG);
- geographical diversity;
- representation of the in the national open data portal.

According to Estonian Population Register[5] (as of 01.01.2024), the average number of residents in local governments was 17 381, but the median of residents is at the same time significantly lower (7 793), as only 4 municipalities out of 79 have over 50 000 residents and the smallest LG has only 165 registered inhabitants. This was one of the starting points of the selection process, where the objective was to include LGs from three categories: 1) less than 50 000 residents, 2) from 10 000 to 50 000 and 3) less than 10 000 residents.

Next, the geographical distribution was considered to include municipalities from every region (Northern, Southern etc). Finally, the local governments that have published data in national open data portal were identified based on the findings in section 4. The aim was to include 1/3 of the municipalities disclosing open data on national portal in the final sample, i.e. thereby diversifying the sample and including in the sample those LGs that had an experience with the OGD publishing and thereby able to provide insights on complexities associated with this process. On the other hand, those municipalities that lacked previous experience with national portal could provide a deeper understanding of what has been preventing from making data public available on it.

The selection process resulted in 16 local governments of whom 12 gave their consent for the interview. The final sample included 12 municipalities.

The informed consent for recording the interview and further use of collected data was obtained by sending it to the respondents prior to the interview and then signing it digitally by the participant and the researcher.

[5] https://www.siseministeerium.ee/en/activities/population-procedures/population-register

All the interviews were conducted in Estonian online using MS Teams software and were recorded. The recordings were then converted into MP3 audio-file format with VLC software and transcribed with Estonian speech recognition and transcription tool available on tekstiks.ee [14]. The transcriptions were analysed with qualitative data analysis software NVivo, where all the interviews were coded based on the questions of the protocol. The list of codes with number of files and references are available in Appendix III, whereas the results are presented in Section 6.

3 Estonia's Progress in EU and Global Rankings

This section analyses Estonian position in EU and global rankings thereby answering RQ1. The aim is to elucidate the manner and dimensions in which Estonia has evolved over time within these rankings and to what extent the local administrative level is covered. Through this examination, implications from the existing reports that considers Estonia, namely *Open Data Maturity Report*, *OECD OURdata Index*, *Open Data Inventory*, *Open Government Index*, *Open Data Barometer* are drawn, shedding light on the implications and insights that emerge from Estonia's progression in the sphere of OGD. This knowledge serves as a foundational framework for a comprehensive understanding of the current Estonian positioning in the studied domain, as well as the findings are utilized as input for the first research question (RQ1).

3.1 Open Data Maturity in Europe – European Data Portal

According to European Open Data Maturity methodology papers [15], data for the reports spanning from 2019 to 2023 was gathered through a questionnaire distributed to the national open government data representatives collaborating with the European Commission and the Public Sector Information Expert Group. The questionnaire is structured against the four open data dimensions:

1) **Open Data Policy**[6] focuses on the open data policies and strategies, incorporating three indicators: (1) policy framework, (2) governance of open data and (3) open data implementation. The dimensions underwent an update in 2022, introducing additional questions for each indicator to better account for federal and regional realities in Europe. Furthermore, there was a heightened emphasis on promoting specific data types, including geospatial data, citizen-generated data, and high-value datasets;
2) **Open Data Impact** analyses the willingness, preparedness, and ability to measure both the reuse and the impact of open data. The first indicator includes strategic awareness measuring the level of reuse and impact. The second indicator was added in 2022 to gauge whether and how countries measure the reuse of open data and the methods employed. Other indicators evaluate impact within the four impact areas: the governmental (before 2022 was political), societal, environmental, and economic impact areas;
3) **Open Data Portal** evaluates portal features, functions provided for users, and the usage of the portal (e.g., analytics tools, responsiveness, API usage). The dimension also focuses on data provision, including local or regional data sources and portal sustainability;
4) **Open Data Quality** focuses on metadata currency (up to date'ness) and completeness of data. It also monitors the compliance with Data Catalogue Vocabulary Application Profile (DCAT-AP) metadata standard, and the quality of deployment of the published data.

[6] https://data.europa.eu/sites/default/files/method-paper_insights-report_n7_2022_0.pdf

Estonia's standing in these dimensions evolved significantly, moving from 27th in 2018 to 13th in 2019 as a "follower" and leaping to 5th place within a year. Since 2020, the country has consistently held the ranking of a "trendsetter," with the best result achieved in 2023 with a notable score of 96%, compared to 93% in 2022 and 94% in 2021, as reported in the recent Open Data Maturity Report edition [16]. The Figure 3 illustrates the Estonia's progress across ODM report editions, capturing the evolution in both maturity level and ranking, encapsulating the performance in each individual dimension. It showcases that the most substantial improvements occurred in the (a) impact dimension, specifically in as awareness, reuse measurement, (b) portal functionality, and (c) data quality, including monitoring and compliance.

Figure 3. Estonian scores and ranking in European Open Data Maturity assessment 2018-2023

The maturity rating methodology underwent a revision in 2019, enhancing the comparability of dimensions in the ranking since that year, as indicated by the Report's statement on changes in methodologies. However, despite this refinement, conducting a seamless comparison across the years remains challenging due to ongoing adjustments in methodology dimensions.

A granular examination of the dimensions reveals that **policy** indicators have consistently scored over 80% since 2018. In contrast, factors such as portal features, data provision, and portal sustainability were prominent contributors to lower scores in 2018 and 2019. While all other **portal** indicators consistently achieved scores between 95-100%, data provision was still lower (72%) in 2022. Exploring the detailed country questionnaire reveals that one of the reasons is, that only bigger local governments, with more than one third of Estonia's

population, publish data in machine readable formats and smaller local governments lack the knowledge and funds for it.

Examining the detailed scores within the **impact dimension** reveals notable advancements, particularly in social and economic impacts, both of which have experienced significant improvements, stabilizing at a commendable 100% for the past three years. Conversely, open data quality emerges as a challenging dimension for Estonia.

Within **open data quality**, substantial enhancements are evident in DCAT-AP compliance, surging from 53% to a 100%, and monitoring and measures, escalating from 81% to 100%. This was largely due to the launch of new open data portal further discussed in section 4. However, the indicator for data and metadata currency, including completeness since 2020, hovers around 70%. A significant contributing factor to this lower score is the predominant manual addition and editing of metadata in the national open data portal, rather than automated sourcing from the origin.

Another indicator impacting the quality dimension is deployment quality and linked data, with the latter aspect being introduced to the indicator in 2020. There has been a minor progress during 2021-2023, from 67% to 72%. The country questionnaire indicates that licencing part has been organised very well, but the linked data is a rather new concept.

Although Open Data Maturity is carried out annually, the progress assessment is difficult due to the changes in methodology, also due to the reliance on self-assessment that introduces subjectivity, with provided data contingent on the perspectives of the country representatives giving the feedback [5]. This inherent subjectivity highlights the complexity of progress assessment within the context of open data maturity.

3.2 OECD Open, Useful and Re-usable data (OURdata) Index

The OURdata Index benchmarks the design and implementation of open data policies at the central level, emphasizing the sustained political and policy relevance in this domain [17]. New report 2023 OURdata Index was published at the end of 2023, while the previous policy paper was of 2020.

The last report encompasses over 670 data points collected across 36 OECD countries throughout 2022 [18]. The index is structured in three pillars:

- data availability – OGD policy framework, stakeholder engagement for data release and datasets available on central OD portal;
- data accessibility – formal requirements (open licence, metadata), stakeholder engagement for data quality and completeness, actual implementation of these requirements;
- government support for data reuse – promotion of data re-use by government, value co-creation initiatives and partnerships, monitoring impact.

According to the 2020 report, Estonia received a score of 0,51 out of 1, securing the 24th position out of 32 countries. Estonia performed better in the data accessibility pillar, with the score of 0,80 (7th rank). Conversely, in the Government Support for Data Reuse pillar, Estonia had a lower score of 0,31.

The 2023 report emphasizes that due to changes in the questions and factors used for the Index sub-pillars, the results of 2023 cannot be compared directly at a detailed country level to earlier versions, still the overall comparison at the composite level can be made.

As the index considers similar aspects as European Open Data Maturity (publication of OGD, policy framework, open data portal), Estonian position has improved significantly, ranking 4th out of 36 countries in 2023. Zooming into the pillars, the highest scores include content of the open by default policy (0,87), content of the free, open access to data policy (0,92) and data literacy programmes in government (0,97). While the lowest scores comprise the implementation (availability of high value datasets) as 0,59 and monitoring impact (0,58).

3.3 Open Data Inventory (Open Data Watch)

The Open Data Inventory (ODIN) serves as an assessment tool for evaluating the coverage and openness of data available on the websites maintained by national statistical offices (NSOs) and any official government website accessible from the NSO site [19]. In the case of Estonia, the evaluation is based on the website www.stat.ee/en/node, which is overseen by the national agency Statistics Estonia. Thus, it does not cover OGD initiative in its entirety.

The Estonian profile within the Open Data Inventory (ODIN) framework, shown in Figure 4, highlights certain areas requiring attention, with coverage identified as a key aspect in need of improvement [20]. Notably, challenges persist in the social statistics subscore and the availability of data on the subnational level that have led to lower scores. Despite these challenges, the overall score ranks Estonia 5th in Northern Europe and the 11th position globally in 2022.

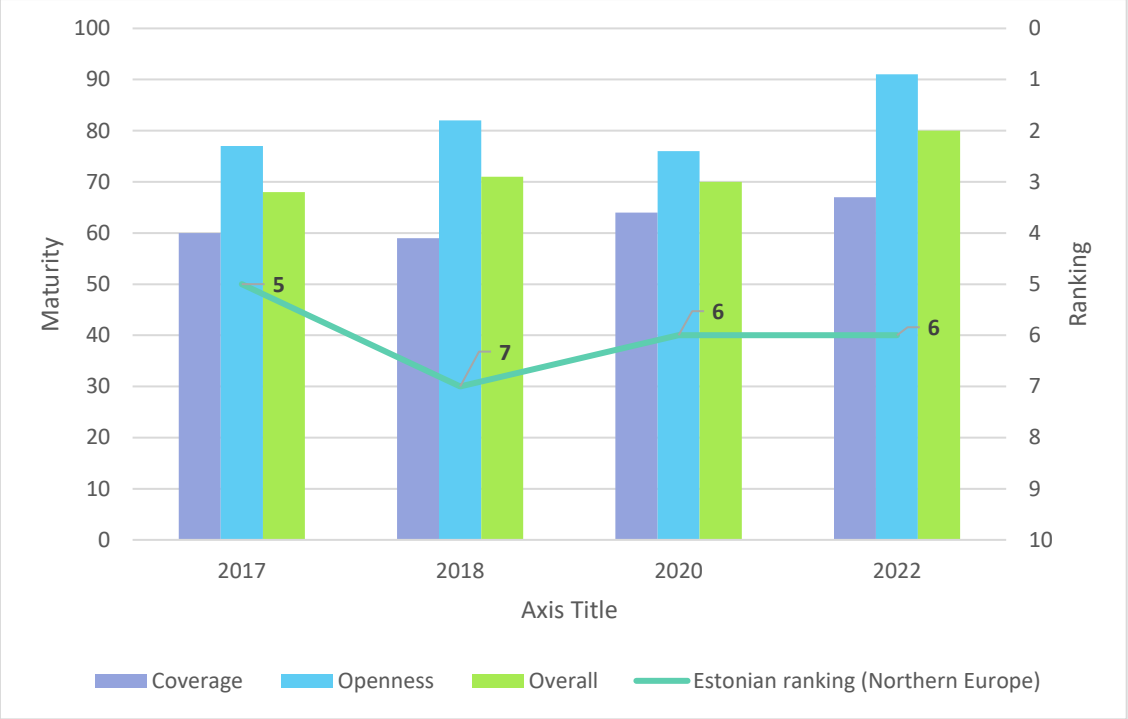

Figure 4. Estonian score and ranking of ODIN (2017-2022)

3.4 Open Government Index - World Justice Project (WJP)

While the World Justice Project is not primarily focused on OGD, Open Government plays a pivotal role as one of the essential components within Factor #3 of the Index. The Open Government Index evaluates the extent to which basic laws and information on legal rights are publicized, in addition to scrutinizing the quality of information disseminated by the government [21]. The index includes four dimensions:

1) publicized laws and government data – public availability of basic laws, government information, drafts of legislation etc.;
2) right to information – requests for information of government agencies (completeness of information, reasonable time and cost);
3) civic participation – protection of the freedom of opinion, assembly and right to petition; availability of information about decisions affecting the community;
4) complaint mechanisms - ability to complain about the provision of public services or government officers carrying out their legal duties.

Estonia's score for 2023 stands at 0,81, positioning the country at the 9th place globally and the 7th in the regional ranking. Estonia has maintained a score of at least 0,80 since 2019. Notably, within the sub-factors, the highest and most important score from the OGD perspective is of publicized laws and government data (0,88), with 5th position in the global ranking. However, sub-scores for "Civic Participation" and "Complaint Mechanisms" have

been comparatively weaker, resulting in the 13th position out of 31 countries in the regional ranking [21].

3.5 Open Data Barometer – World Wide Web foundation

Open Data Barometer aimed to unveil the prevalence and impact of open data initiatives globally, provides comparative data on governments and regions. The methodology employs contextual data, technical assessments and secondary indicators [22]. The last edition of Global version was published in 2017 and the Leaders Edition in 2018, making it rather outdated. The Barometer is structured around three sub-indexes:

- readiness assesses government policies and action, entrepreneurs and business, citizens and civil society;
- implementation evaluates accountability dataset cluster, innovation dataset cluster and social policy dataset cluster;
- impacts – political, economic and social [23].

In 2016, Estonia garnered a score of 36, securing the 44th position out of 115 countries. The readiness sub-index revealed that citizens and civil rights received the highest score of 81, while entrepreneurs and business - the lowest score of 31. However, the impact scores were notably low, registering at 0 in the political and social dimensions and 20 in the economic dimension.

Estonia's lower scores align with the findings of the 2020 OECD OURdata Index. This consistency can be attributed to the lesser interest in open data from policymakers until 2018 when OGD provision gained increased attention. The alignment in scores suggests a parallel evolution in the recognition and prioritization of open data initiatives within Estonia's policy landscape.

3.6 Dynamics of Estonia’s ranking in open data indices

RQ1 examined how has the Estonia’s position evolved within open data rankings and to what extent the local administrative level is covered by them.

Estonia is included in five out of 7 widely known [4][5] open data benchmarks/indices, analysed above: (1) Open Data Inventory (Open Data Watch), (2) Open Government Index (World Justice Project (WJP)), (3) OECD Open, Useful and Re-usable data (OURdata) Index, (4) Open Data Barometer (World Wide Web foundation) and (5) Open Data Maturity in Europe (European Data Portal).

The other two benchmarks referred to in previous literature [4][5] do not include Estonia:

1) World Bank's Open Data Readiness Assessment (ODRA), which is a tool to assist in planning the actions that government authority could consider in order to establish an Open Data program, at either the national level or in a sub-national government [24]. The latest version 3.1 was released in 2015. By 2023,18 readiness assessments have been performed, not including any European countries;
2) The Global Open Data Index (GODI) developed by Open Knowledge Foundation is a benchmarking tool to measure how governments around the world publish open data. However, the project is now archived, as the last assessment was GODI 2016/2017, which included 94 countries, but no Estonia [25].

The analysis of these indices and Estonian ranking within them reveals significant progress in Estonia's standing, particularly in the European Open Data Maturity report, where it moved from 27th place in 2018 to a "trendsetter" position by 2020, holding the 4th place in 2023. Despite methodological changes making year-to-year comparisons challenging, Estonia showed consistent improvement in policy indicators and made substantial advancements in the impact dimension. However, challenges persist in data provision, particularly from smaller local governments, although not being systematically analysed by this report. The open data quality scores are the lowest among dimensions especially data and metadata currency, and linked data.

According to the OECD OURdata Index report of 2023, Estonia ranks 4th out of 36 countries, with high scores in policy content and government data literacy programs. However, the availability of high-value datasets and impact monitoring scored lower. The Open Data Inventory (ODIN) evaluation, based on data from Statistics Estonia, identified coverage as a key area for improvement, particularly in social statistics and subnational data availability, addressing again the shortcomings with local level data, although not analysed further in the report.

The World Justice Project, while not primarily focused on OGD, ranks Estonia 9th globally and 7th regionally in 2023, with a high score for publicized laws and government data. However, the country ranks 13th out of 31 countries in "Civic Participation" and "Complaint Mechanisms". The Open Data Barometer is rather outdated by now, as the last edition of Global version was published in 2017 and the Leaders Edition in 2018.

The findings of this section are also in line with research paper [2] comparing open data benchmarks in 2021, concluding that most benchmarks primarily focus on central governments while only the Global Open Data Index, includes the focus on regional or local levels. Unfortunately, Estonia was not included in the assessment and the project has been archived, limiting in-depth insights about the country's local open data landscape.

4 Evolvement of Estonian Open Data Portal and policy-making

This section addresses RQ1 by analysing in more depth the underlying factors, that contributed to Estonia's "jump" in the rankings. First, the development of Estonian open data portal and legislative amendments contributing to OGD ecosystem improvement is provided. Then, analysis of the portal content and data provision by local governments is performed. This knowledge will be used as one of the bases for developing the interview protocol in connection with the third research question.

4.1 Evolution of Estonian OGD portal and legislative amendments contributing to OGD ecosystem

Estonia launched its first national open data portal in 2015. The portal was built on Comprehensive Knowledge Archive Network (CKAN) platform, as one of the most popular open-source data management systems adopted for OGD portals [26] [27]. However, the initial implementation was limited and many features of CKAN platform left unused, with the portal hosting a relatively small number of datasets [28]. In the summer of 2018, the national open data portal in Estonia demonstrated limited data availability, providing only 89 datasets [1]. Data holders were required to create an open data catalogue on their website and forms for requesting open data. It was inconvenient for data users, as they needed to go through a complicated process to request the data and wait for the response [28]. As was identified during the discussion with the representative of MKM, although the provision of open data was limited through the portal, the situation was better in some domains, e.g., legislation on Riigi Teataja[7] and spatial data on Geoportal[8].

Unlike many European countries, Estonia has the national interoperability infrastructure, the X-Road[9], often considered in literature as one of the reasons for subdued focus on open data in Estonia [1]. The X-Road provides unified and secure data exchange, used by Estonian public sector institutions for exchanging data and offering services to the citizens. As it enables data reuse conveniently also for private organisations, a significant amount of required data can be obtained from X-Road services. The X-Road was probably the main cause why Estonian policymakers remained sceptical of OGD initiatives, although there was societal and international pressure, including the importance of OGD in international e-Government rankings [29] [28].

In 2018, the Estonian Ministry of Economic Affairs and Communications entered a contract with Open Knowledge Estonia (non-profit organization) to improve the performance of Estonia's OGD ecosystem. According to the study [28], by 2020 substantial improvements in various performance indicators were identified, namely: (1) number of datasets; (2) unique users; (3) number of applications on portal; (4) OGD events and news articles and social

[7] https://www.riigiteataja.ee/en/

[8] https://geoportaal.ee/eng/

[9] https://x-road.global/

media groups; (5) ranking of Estonia in European OD Maturity report jumped from 27th to 14th place.

In 2020, the Estonian Ministry of Economics and Communication initiated an analysis and development process for of a new open data portal. Based on the documentation of Estonian Open Data Portal [30], the ministry initially intended to utilize the CKAN open-source platform. After conducting a thorough analyses, the decision was made to abandon the initial plan. The rationale presented in the document highlighted that the required functionalities would have necessitated a significant redevelopment of most of the existing CKAN components. Consequently, the ministry opted for an alternative path and proceeded to develop a custom-made platform to better meet the specific needs and requirements of the new open data portal that is examined within the next sub-section.

Legislation played a pivotal role in the transformation. By the end of 2021, **amendments to Estonian Public Information Act** entered into force to bring the Estonian legislation in line with EU Directive 2019/1024 on open data. Several obligations were imposed on public information provision and re-use, including [31]:

- open data should include data descriptions describing data sets and data;
- data that are collected or produced in the course of scientific research activities and are used as evidence in the research process, or are commonly accepted in the research community as necessary to validate research findings and results (*research data*), shall be made available for re-use if the production of research data has been funded from the budget of the state, local governments or legal persons in public law and researchers, research performing persons or research funding persons have already made them publicly available through an institutional or subject-based repository. Scientific publications shall not be deemed to be research data;
- open data subject to frequent or real-time updates (*dynamic data*) shall be made available for re-use immediately after collection, or in the case of a manual update immediately after the modification of the data, via an application programming interface (*API*) and, where relevant, as a bulk download;
- the re-use of open data shall generally not be subject to conditions. If imposing conditions for making the data available for re-use is necessary in the public interest, such conditions shall be objective, proportionate and non-discriminatory;
- open data the re-use of which is associated with important benefits for society, the environment, and the economy (*high-value datasets*) shall be made available for re-use by the holder of information free of charge in a machine-readable format via a suitable API and, where relevant, as a bulk download;
- income from supplying information for re-use shall not exceed the costs incurred for the reproduction, provision, and dissemination of open data as well as for anonymisation of personal data and protection of business secrets.

The amendments introduced several obligations related to public information provision and re-use, emphasizing aspects such as open data descriptions, availability of research data, immediate release of dynamic data, non-restrictive re-use conditions, and free-of-charge

access to high-value datasets. Although Public Information Act regulates the broader public information concept, its relevance regarding open data provision is crucial, as OGD is part of public information.

These legislative amendments in synergy with improvements in open data portal usability emerged as key factors for the increase of Estonian ranking in European Open Data Maturity and WJP Open Government Index. However, while there has been substantial progress at the national level, the local level seems to be struggling. As evidenced by the European Open Data Maturity country questionnaire, only larger local governments residing over one third of Estonia's population, publish data in machine readable formats, whereas smaller local governments lack the necessary knowledge and funds.

This is also in line with research paper [2] comparing open data benchmarks highlighting that most benchmarks primarily focus on governments, mainly at the national level, which is also compliant with the findings of Section 3 (RQ1), according to which the coverage of local governments by benchmarks is limited.

This can be also due to the limited awareness of open data, as evidenced by a recent **survey[10] about open data and once-only data request principle** published in February 2024. commissioned by the Ministry of Economic Affairs and Communications. According to the study, only 1/3 of Estonian residents have heard the term "open data" and 60% are not aware of it. Amongst the respondents, who are familiar with the term, only 50% know the correct meaning (e.g., data available for everyone to use). Hence, only 17% of the population in Estonia possesses an understanding of this term. While a third of the population knew the concept of open data before reading the explanatory note, significantly more have used it (58%). These statistics suggest that the term "open data" is unfamiliar and presumably underutilized, despite the actual usage of open data in practice.

Interestingly, 71% of the population considers open data to be important for society, including 18% who consider it to be especially important, but 42% of the respondents could not justify their opinion. The need for information was identified as main reason for using open data, others included overall interest, decision-making and study or research. Among the respondents who have not utilized open data so far, 71% indicated that they are not engaged in activities related to data processing or information retrieval, and there is no need for open data.

The survey revealed that **overall awareness of Estonian open data portal is deficient** – only 34% of the respondents, who are aware of open data term are aware of Estonian open data portal and mere 14% of them have used it. Encouragingly, 67% of the respondents, who had used the portal, reported a positive user experience.

[10] https://avaandmed.eesti.ee/datasets/%22avaandmed-ja-andmete-uhekordse-kusimise-pohimote%22-uuringu-alusandmed

The survey also explored expectations regarding open data, specifically inquiring about potential datasets that, if made openly accessible, could enhance the functioning of society or businesses. The multiple choice included key areas, that were all indicated by more than 59% of the respondents: transport data, economic data, environmental data, demographic data, educational data. As some of these data are collected by the municipalities, it is imperative to analyse what data they are currently sharing openly to understand their contribution to the open data initiatives.

4.2 The status of Estonian OGD portal and municipal data provision

The current open data portal **avaandmed.eesti.ee** (based on self-developed software) was officially launched in 2021. As of January 14, 2024, Estonian open data portal provides 1807 datasets - the number has more than tripled, compared to 582 datasets in May 2020 [28]. The portal lists 2232 publishers, including all public sector institutions, some of which have not yet published any data. According to portal statistics, there are over 110 active publishers, whose datasets resulted in over 135 reported use-cases. Moreover, according to the usage statistics on dataset downloads, the new portal is used by users (compared to the previous portal version discussed in the previous subsection).

Content-wised, the portal boasts the highest number of datasets within the categories of education, culture and sport (493 datasets); population and society (457); and science and technology (430). Contrary, categories like energy and agriculture, fisheries, forestry, and food have a limited number of datasets, with only 10 and 53, respectively (see Figure 5).

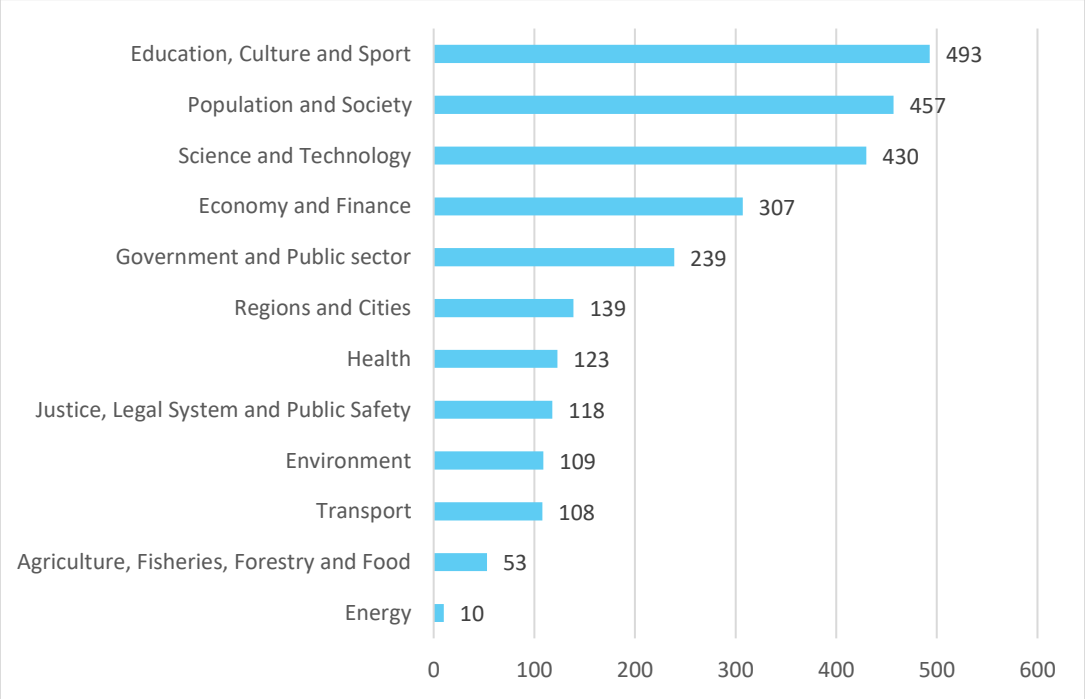

Figure 5. Number of datasets per category in avaandmed.eesti.ee (14.01.2024)

From the perspective of the focus of this thesis, the most relevant category on the national portal is “Regions and Cities” with 139 datasets. More detailed examination reveals that the primary publishers in this category include the City Governments of Tallinn and Tartu, along with the Estonian Land Board. Only 12 out of 79 (15%) local governments have published some data on the national portal (table 4).

Table 4. The datasets of Estonian local governments in national portal (14.01.2024)

Municipality Government	**Population (01.01.2023)**	**No of datasets in portal**	**Type of data**
Tallinn	426 538	102	Geospatial data, budget, sensor data, services, transport, accessibility, statistical overviews etc
Tartu	97 435	34	Geospatial data, master plan, document register, contacts, transport, cemeteries, education etc
Sillamäe	12 157	7	Education, main documents, budget
Alutaguse	4 678	6	Population, budget, main regulations and documents
Rapla	13 228	4	Procurement plan, budget, document register
Pärnu	51 874	2	Events and activities of interest, planning
Valga	15 456	2	Transport, document registry
Narva	53 625	1	Detailed spatial planning
Loksa	2 498	1	Document register
Anija	6 431	1	Document register
Harku	17 520	1	Document register
Saue	25 571	1	Document register

As anticipated, the largest cities Tallinn and Tartu, are the foremost contributors of data among the local governments. Both cities have dedicated local portals for geospatial data, accessible through https://geohub.tartulv.ee/ and https://www.tallinn.ee/en/geoportal.

In adherence to the Estonian Public Information Act, local governments are mandated to maintain a document register and disclose certain documents, such as legislation, contracts, and public letters, from their Document Management System (DMS) [31]. The public document register contains documents that are not subject to restrictions (e.g., private data of persons). The websites of municipalities typically feature direct links to the public view of their DMS, where in case of nearly 50 local governments, JSON files containing LGs legislation, contracts and official correspondence can be accessed and downloaded.

However, only a few municipalities have published links to their DMS datasets on the Open Data portal. In the case of Anija, Harku and Saue Municipalities, the portal specifies that the data has been migrated from the previous version of the national OGD portal and has not undergone a review by the publisher. The other 9 local governments have updated the metadata information of their datasets on the national portal.

As was identified during the discussion with the representative of Ministry of Economic Affairs and Communications, a new Data Portal/Gateway will be developed in near future, bringing together two separate environments: (1) State Information System management system (RIHA)[11] and (2) Open Data Portal.In addition, the usability of the portal will be improved to provide a better user experience.

To sum up, although Estonia has "jumped" in many open data rankings to higher positions, the local governments as a whole are still lagging behind, as evidenced by modest number of municipalities publishing data on national portal. The survey about open data and national OD portal awareness reveals that this topic is relatively unknown for public and might also be a constraint at local administrative level. These findings are used as input for the elaboration of the interview protocol, contributing to the identification of the main barriers of local governments to openly share and maintain data (RQ3).

[11] https://www.riha.ee/

5 Results of the Systematic Literature Review

This section addresses RQ2 by conducting systematic literature review (SLR) to collect and analyse relevant research regarding the open (government) data ecosystem at both the local and regional levels in Estonia and Europe.

The objective of systematic literature review was twofold: (1) to ascertain the extent of Estonia's representation in the scientific literature concerning OGD, and (2) to delineate the specific OGD topics that are explored at the local government level in Europe to set the background and/or to be used as input for the qualitative analysis on the barriers that Estonian LGs face when opening the data (interviews with Estonian LGs (RQ3)). The findings and summaries of these studies are presented in Tables 3 and 4.

Six out of the eight reviewed papers were published between 2018-2020, highlighting the limited progress of Estonian open data ecosystem, despite the country's advanced e-government infrastructure (table 5). As evidenced in previous chapter, Estonia was "lagging" behind in several open data benchmarks during this period. Among these papers, six delve into specific Estonian case studies, investigating aspects such as the reasons behind the country's low OGD maturity [1] [32]. The remaining two studies incorporate Estonia into broader case studies, exploring Northern European cross-country peer-to-peer communication [33] and conducting exploratory case study on OGD usage in the context of crisis management [34]. Notably, none of the studies in this review specifically address the local government level in Estonia.

Table 5. Studies addressing the first SLR objective – Estonian OGD ecosystem (Q1)

No	Reference	Year of Publication	Scope	Objective of the study
1	[35]	2018	Estonian case study, public service co-creation	To understand the transformation brought by the accessibility and utilization of OGD in co-creating public services, empowering service users, transforming them into active collaborators rather than customers of public service providers
2	[28]	2020	Estonian case study, OD ecosystem	To improve the performance Estonian OGD ecosystem though the use of action research and systems theory
3	[34]	2023	Case study of Czech Republic, Estonia and Latvia, crisis management	To understand how OGD can be used during times of crisis as a crisis management tool and how does OGD influence the co-creation of services that assist in crisis management

No	Reference	Year of Publication	Scope	Objective of the study
4	[36]	2019	Estonian case study, civic engagement	To understand the potential of open data phenomena to promote public sector innovations and civic engagement
5	[37]	2022	OD policies, Estonian case study	To provide an overview of existing systems to ensure access to open information and make proposals on how to improve open data disclosure practices in Estonia
6	[33]	2020	Nordic Europe, peer to peer communication	To explore a collaborative nature of peer-to-peer interactions in the open data area and further debates on the potential of these data-driven networks and platforms to transform the classical mechanisms of co-production and public sector innovations in e-government not only between traditional open data actors, but between peers of the movement themselves
7	[1]	2018	OGD, Estonian case study	To explore Estonia's low OGD maturity against the backdrop of a highly developed e-government by conducting an exploratory case study using document analysis, survey data and semi-structured interviews
8	[32]	2019	Open data politics, Estonian case study	To analyse the development of open data phenomena in a country known as one of the global leaders in promoting information society, demonstrating advances in building sophisticated e-government, e-commerce, e-voting and blockchain governance ecosystems

The topics addressed in these studies include: (a) open (government) data ecosystem maturity – stakeholders, barriers, enablers, policy proposals etc.; (b) OGD use for public service co-creation; (c) peer-to-peer perspective on open data.

Table 6 provides an overview of studies addressing open (government) data within the context of local or regional levels in Europe, encompassing themes such as data governance, local citizens, public services etc. Notably, although the search terms did not include keyword "smart cities", it is noteworthy that the predominant focus in studies concerning OGD at the local government level often revolves around the concept of "smart" cities or data.

21 papers were deemed most relevant, with seven specifically delving into the analysis of a distinct European region or municipality. The primary areas of focus in these studies are: 1)

open data platform or portal [38] [39] [40] [41], 2) usage of open data and data sharing [42] [43] [44], and 3) assessment of digital maturity, including the evaluation of open data within municipalities [45].

Table 6. Studies addressing the context of European OGD ecosystem at regional or local level (Q2)

No	Reference	Year of Publication	Scope	Objective of the study
1	[38]	2022	OD platforms and smart cities	To investigate the relationship between smart urban development and the use of open data platforms; understand how these are useful for defining actions and strategies that facilitate the planning of a smart city, and to find platform's common characteristics that allow cooperation of intentions between European Union cities
2	[39]	2020	OD platforms, smart cities, agency	To understand how open data platforms are coproduced by different actors based on their conceptions of open data in two European cities, Lyon and Berlin.
3	[40]	2023	OD portal assessment, data reuse	To assess compliance of the Croatian Open Data Portal with user-oriented principles that sustainable open data portals should implement adopting the metrics proposed by the European Commission
4	[42]	2019	Open data, data interoperability, common semantics	To enhance the data sharing processes in Italy-Switzerland cross-border area, particularly addressing tourism and mobility that are key economic activities for the region through the review on the data catalogues published in dati.lombardia.it and opendata.swiss.
5	[43]	2021	Open data, monitoring, COVID-19	To analyse the opportunities and critical issues surrounding the use of open data to improve the quality of life during the COVID-19 epidemic, as well as for the effective regulation of society, the participation of citizens, and their well-being
6	[44]	2023	Educational open data	To explore the role of open data in the education and the practical application of acquired knowledge. Current situation in Serbia in terms of educational open data was analysed, providing suggestions for improvement
7	[45]	2022	Digital maturity, urban municipalities,	To analyse the digital maturity self-assessment results undertaken by 11 Slovenian urban

No	Reference	Year of Publication	Scope	Objective of the study
			EC Intelligent Cities Challenge	municipalities utilising ICC's assessment methodology framework for government services and social connectivity
8	[46]	2021	OD and trust; European countries	To assess whether the extent of openness and the coverage of data sets released by European governments significantly influence citizen trust in public institutions
9	[47]	2019	OGD trends	To evaluate the global progress and explore research areas and development trends of OGD field based on the SLR
10	[48]	2019	OD re-use, relevant social groups	To evaluate the global progress and explore research areas and development trends of OGD field based on the SLR
11	[49]	2022	Linked open data, EU CPSV	To develop a process for using CPSV-AP and conduct a pilot implementation, using this process, to investigate potential benefits or challenges from its use
12	[50]	2020	Linked open data, European interoperability	To understand how LOD principles and technologies can be applied for the publication and interlinking of public administration reporting data
13	[51]	2023	Fair data ecosystem, EU	To introduce the concept of fair data ecosystem as an alternative to corporate-driven, state-led, and citizen-centric approaches to digital transformation
14	[52]	2023	OD policy, citizen participation, OD reuse	To examine how does the Open Data Directive align with and diverge from the rationale and requirements of the movement for open data, and what are the implications of this for citizen participation
15	[53]	2020	Local government transparency, SLR	To investigate the extent of research interest in local government transparency from 2000 to 2018, identifying research gaps
16	[54]	2021	OD based public services, co-creation	To develop methods for co-creating open digital services for age-friendly cities and communities enabling civic open data use of older adults, increasing digital inclusion of older adults, and co-creating sustainable digital public services for older adults

No	Reference	Year of Publication	Scope	Objective of the study
17	[55]	2022	Big and open linked data, business model canvas	To develop canvas to describe and develop business models for creating value from big and open linked data (BOLD) in smart and circular cities (SCCs)
18	[56]	2021	OGD portal, smart data, Society 5.0	To identify whether OGD portals in various countries support the open (government) data initiative and the movement to "smarter" open data, incl. high-value data, and whether they are suited for further reuse
19	[41]	2023	Open data ecosystem, OGD portal	To assess the state of open data in Croatia via application of the assessment framework developed during the Online Training Program (OTP) of Horizon 2020 project, discussing the usefulness of such evaluations based on the interpretation of the assessment results.
20	[4]	2021	Open data benchmarks, ranking	To compare the metrics and methodologies used to measure, benchmark, and rank governments' progress in OGD initiatives. Comparison between the various existing benchmarks at a single moment in time and between each benchmark at different moments in time
21	[57]	2023	OGD, Smart City, Society 5.0	To define the Society 5.0 and OGD concepts and emphasize their interconnection, as well as to provide real-world examples proving these concepts are interconnected

Other selected papers address the open data of local governments in broader context, e.g. (1) data governance, data operability and linked data [46] [47] [48] [49]; (2) transparency and citizen trust [52] [53]; (3) Society 5.0 [56] [57]; 4) public administration and public services in connection with OGD [54] [55]. As part of RQ2, which aims to establish the current state of art of the OGD ecosystem at local and regional levels in Estonia and Europe (RQ2), it was SLR revealed that studies focused on the Estonian case highlight the slow progress of Estonia's open data ecosystem despite its advanced e-government. Moreover, none of the previous studies focused on the local government level of Estonia. When expanding the scope to European level, the primary themes identified in studies that focused at regional or local levels included open data portals, open data usage and sharing, digital maturity assessments of municipalities, data interoperability and linked data, transparency, citizen trust, Society 5.0, and the intersection of public administration and services with OGD.

In order to enrich the current state of the art, more research is needed at regional and local level OGD ecosystems, in particular studies examining the progress of open data initiatives, barriers to OGD sharing and user perspectives.

6 Results of interviews with local governments on barriers and enablers towards OGD publishing and maintenance

This section addresses RQ3 by conducting qualitative study on barriers and enablers associated with the OGD publishing and maintenance at local level of Estonia utilizing the OGD-adapted Innovation Resistance Theory model. The results of the interviews are provided in line with the sections of the interview protocol (as described in Section 2.2.1): (1) general profile of the respondents, (2) organization and open data, (3) usage barriers, (4) value barriers, (5) risk barriers, (6) tradition barriers, (7) image barriers, (8) open data ecosystem. Finally, the most relevant barriers and the recommendations for measures on national and local level are provided.

6.1 General profile of the respondents

This sub-section describes the general profile of interviewed local governments and their representatives.

The interviews with 12 municipalities included in the sample were conducted between March and April 2024. In two cases, there were 2 respondents from one municipality, other 10 interviews were conducted one to one – altogether 14 respondents participated in the interviews (Table 7).

Table 7. Overview of interviews.

Code	Number of respondents
LG1	1
LG2	1
LG3	1
LG4	2
LG5	1
LG6	1
LG7	2
LG8	1
LG9	1
LG10	1
LG11	1
LG12	1

In case of half of the interviewed LGs, the number of residents in the municipality is between 10 000 and 50 000 inhabitants (see Figure 6). 3 municipalities have over 50 000 residents and 3 less than 10 000 residents registered according to population registry.

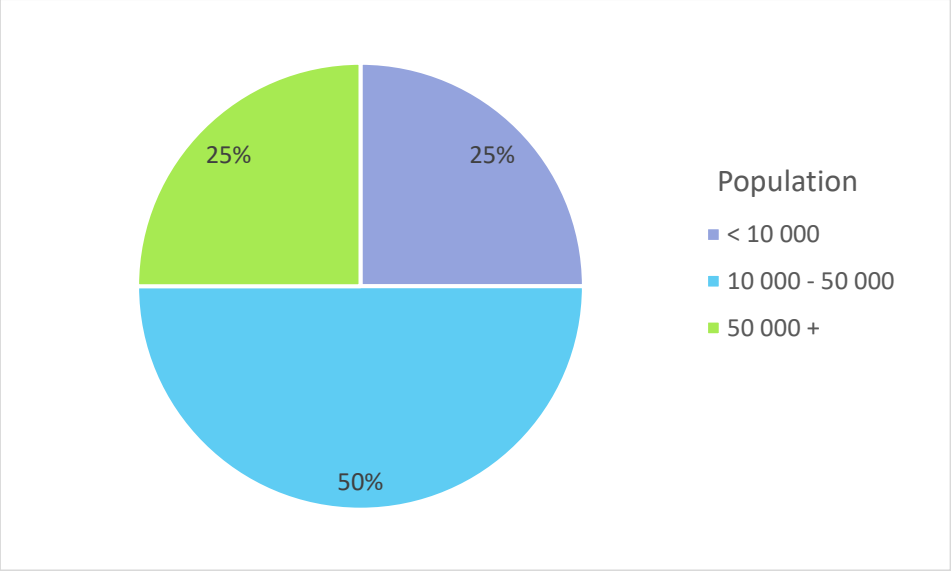

Figure 6. Number of residents in the municipality of the respondent

Half of the respondents held top-level managerial positions: Mayor, Deputy Mayor or Member of Municipal Council. 29% were Top/Leading Specialists (e.g., Data Manager, IT Advisor) and 3 respondents held the position of mid-level management (e.g., head of department) (also shown in figure 7).

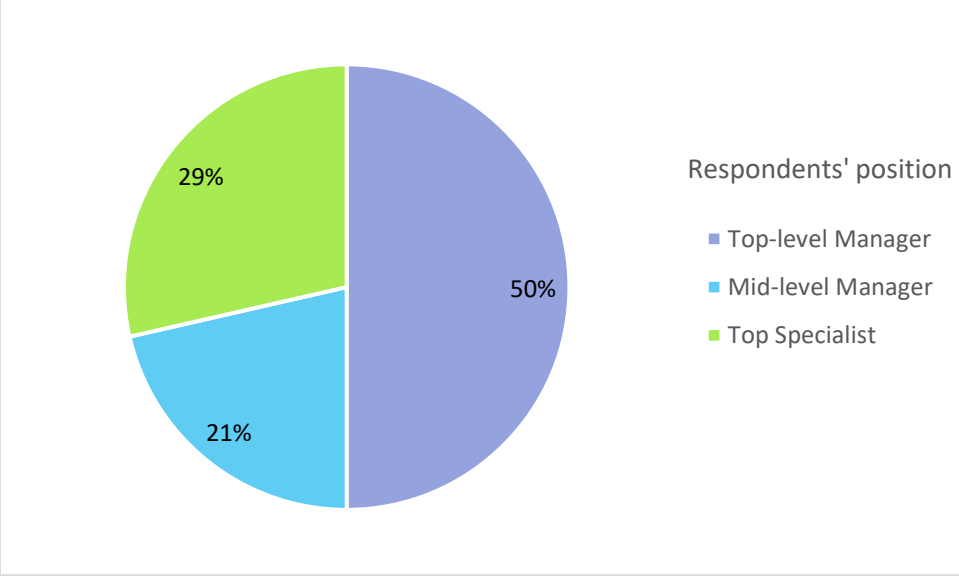

Figure 7. Position of the respondent in the municipality

6.2 Organization and provision of open data

In the first part of interview, the type of data organisation represented by the interviewee collects and publishes was explored along with the challenges and drivers for openly sharing data.

Two municipalities (LG4, LG7) highlighted that all the functions and tasks outlined in Local Government Organisation Act[12] and other legislation require data collection or processing. Types of data mentioned by all respondents are as follows:

- data collected by providing (e-)services (e.g., benefits, permits, applications);
- document management system (LG regulations, correspondence etc.);
- data about municipality's personnel (e.g., salary data, interview summaries);
- data collected into national registers (e.g., population register, education information system);
- data collected due to legal obligation (e.g., register of pets, register of cemeteries);
- geospatial data connected to land use and infrastructure (e.g., detailed plans, lighting, playgrounds);
- surveillance and sensor data (e.g., cameras, pollution sensors);
- analyses and surveys (e.g., satisfaction surveys).

Some local governments (LG2, LG4, LG7) emphasized that it is not mandatory to use GIS software and create WMS services of their spatial data, yet they have allocated additional financial and human resources to it. Two respondents pointed out that they collect additional data besides education information register, e.g., about hobby/recreational education. One respondent (LG11) divided the bases for data collection into three categories: 1) data collected by law or 2) based on consent and 3) data collected under the contract.

Respondents' awareness of the concept of "open data" was examined to understand the respondents' previous exposure to this topic and put the focus on open government data. Most of the **respondents were aware of the term "open data"** and could mention several principles of open data, but many of them acknowledged that it is somewhat difficult to distinguish between "data" and "open data" in the context of local government. 2/3 of the interviewed municipalities were not aware neither of general open data principles[13] nor of the obligation arising from the Public Information Act, according to which open data should be (if possible) published in machine-readable format and should include data descriptions describing data sets and data (metadata).

The questions about sharing organization data on municipal portal and national portal, (section two of the interview) were asked in two separate blocks as 7 of the interviewed LGs had not published any data in national portal. The first part focused on **municipal website or portal**. Most of the respondents mentioned, that they comply with the § 28 of Public Information Act[14] that stipulates the obligations of local government agencies to disclose data and information on their website, but in addition publish more, e.g. geospatial data. The table 8 summarizes the **main types of data, that respondents openly share on their**

[12] https://www.riigiteataja.ee/en/eli/501072023003/consolide
[13] https://public.resource.org/8_principles.html
[14] https://www.riigiteataja.ee/en/eli/503052023003/consolide

websites. The format of these data varies greatly, and, in many cases, data in machine-readable formats are not provided.

Table 8. Main type of data on municipal website/portal

Type of data	**Description**	**Cases**
Development plan, budget strategy and annual budget	The drafts and final versions of these documents should be available	All
Spatial plans	Comprehensive spatial plan and detailed spatial plans in line with Planning Act[15]	All
Services of municipality	Description of services, grants, permits etc. that the local authority offers to residents	All
Other geospatial data	Map layers, e.g., public transport routs and stops, local authority agencies, parking areas, public waste stations and containers, playgrounds etc.	LG1, LG2, LG11, LG4, LG5, LG7, LG9, LG 12
Statistical data	Different statistics about the municipality	LG4, LG5, LG11, LG7, LG10
Document register	LG legislation, contracts and public correspondence	All
Visualised budget implementation	Interactive visualisation of LG budget implementation by MS PowerBI	LG1, LG 10, LG3, LG 9
Procurement plan	Annual plan of procurements	All
Contacts	Contacts of local authority bodies (council and administration) and agencies (e.g., schools, kindergartens, libraries)	All

Based on the answers of the respondents, the **process of openly sharing data** in municipal websites depends on the size and internal processes of the LG. In some cases, the owner of data or the department is responsible for publishing the specific data on municipal website

[15] https://www.riigiteataja.ee/en/eli/504072023008/consolide

or designated geoportal. Smaller municipalities have only one website administrator, who collects data from data owners or to whom the data owners turn when data needs to be renewed.

The **main driver for openly sharing data on municipal website** (stimuli) in most cases is the obligation by Public Information Act and other legislation that regulates disclosure of specific information. Still, there were a few respondents that brought out, that this is not the first motive for public disclosure of LG data.

The other motives brought out by the respondents are:

- transparency of the local government agencies (LG3, LG5, LG6, LG8);
- output, whose production was supported by the public funding and as such should be publicly available (driven by their own intent rather than law or regulation) (LG10, LG4);
- to inform citizens and facilitate citizen autonomy (LG4, LG9, LG10).

In addition, LG7 and LG9 pointed out that first the data was collected to optimize their internal processes or service delivery and afterwards it was openly shared to the public (LG7, LG9).

Interviewed organizations acknowledged different **challenges of openly sharing data on the municipal websites** they have faced or are facing, which are grouped with examples to the table 9.

Table 9. Challenges that municipalities have faced in openly sharing data

Challenge	**Description or example of the challenge**
Lack of human resources	Lack of human resources or current personnel is too engaged with day-to-day activities (LG6, LG8, LG10). LG10: "*Each department is responsible for their own things on the website and if they don't have the skills to put it there or the rights, then the Communication Specialist has been there for that. Of course, when people have changed or someone is on vacation, a challenge always arises."*
Technical platform	The sharing of data should be done with less effort - technical platforms have limited functionalities (LG11, LG12)
Lack of competence and understanding	Lack of data competencies in the organization – data governance or management, data analytics, open data, data quality management etc. (LG3, LG5, LG1, LG9, LG10)

Security and privacy issues	Decision-making on data that can be publicly shared due to possible privacy breach. E.g., some spatial data (e.g., locations of sensors) could be reused for criminal motives (e.g., cyber-attacks, theft) or should be not published for national security reasons (LG1, LG2, LG9).
Reusability	Difficulties in data preparation to be shared as open data (open data principles-compliant) due to format in which they are stored by the organization (LG12) LG12: *"There is a lot of information on the website that could actually be grouped under open data, but it's not in machine-readable format today."* Possible mistakes when anonymizing data for sharing (LG9).
Organization processes	Difficult to implement the data management and publication process, so that every data owner understands and fulfils it (LG7).

At the same time organization are aware of some beneficiaries of data they are sharing, where stakeholders/ **parties, who reuse municipality's open data**, they are aware of are**:**

1) students, who use data for research and projects (e.g., new applications);
2) journalists, who use financial data and document register as basis for articles;
3) actors involved in spatial planning (e.g., real estate developers) use GIS portals;
4) entrepreneurs, who use spatial data and plans to make business decisions;
5) residents, who use information about road and street closures or snowploughing to plan their trip;
6) the Members of Municipal Council use financial data in decision-making processes.

The latter, i.e., the Members of Municipal Council mentioned by some respondents as one of the parties' using data shared on their website can be rather considered as internal users not third parties.

Some interviewed organizations appeared to be aware of some examples of reuse cases that bring public value and are based on municipal open data, which are:

- application in the public transportation domain, such as bus schedules and real-time bus departures;
- Waze that uses data of street and road closures in their application;

- Minuomavalitsus.ee[16] that publishes a systematised overview of the state of local governments' services, whereas part of data is collected from municipalities.

For some organizations, however, understanding of both re-users and use-cases is lacking, which appeared to be one of barriers that will be discussed in the later section.

As mentioned, above, five of the interviewed local governments have published some data in the Estonian open data portal avaandmed.eesti.ee[17]. At the moment of writing (as of May 2024), one of the municipalities of the sample had also published data in the national portal.

The overview of datasets published by these organization on national portal was given in section 4.2 and therefore is not duplicated here. The municipality with greatest number of datasets described that at the beginning of this year they reorganized the datasets there and combined those that were connected to the same service, so the overall number seemingly decreased, but the content remained the same. At the time of the interview, they had three types of datasets in national portal: 1) datasets in "classical machine-readable formats" as comes from respondents (e.g., JSON, CSV, XML), 2) spatial data readable by GIS software (e.g., map layers), 3) historical data, that is not updated (e.g., annual budget of a specific year as PDFs).

The main **driver to share data on national portal** was the initiative by some key persons of the municipality, and in most cases the first datasets were published already years ago. Two of the respondents admitted, that the organization had not updated the datasets since the initial disclosure and were not aware how the data sharing process initially worked. I.e., LG1 mentioned that: "...*this became relevant for a moment when there was this open data portal, but no one has dealt with it more systematically… at least for about a year and a half this topic has not been relevant at all."*

The challenges of sharing data on Estonian national portal faced by this LG were:

- no possibility to get usage statistics about the datasets (e.g., downloads in the last month/year). The overall statistics page of the portal is not usable – not possible to sort by data owner or dataset name;
- filling the metadata fields is time-consuming – organization has to fill all metadata fields when adding a new dataset (no pre-filled fields);
- different user groups need different format of the data, and it is not possible to convert data to various formats within the portal;
- no possibility to see the preview of the uploaded dataset;
- difficult to distinguish, which are the valuable datasets that should be published.

Seven of the interviewed municipalities had not shared any data on national portal at the time of the interview and four respondents cited lack of **awareness or resources as the main reason for not disclosing data** there. For example, when elaborating on the possible

[16] https://minuomavalitsus.ee/en

[17] https://avaandmed.eesti.ee/

reasons of lack of awareness of national portal existence, LG10 mentioned: "*There are so many topics here that perhaps some letters may have been overlooked or a notification has gone missing. I don't know of any other reason."* LG3 brought out: "… *we don't have the so-called resources or capability today to undertake this work, to gather these things together and start publishing them. In our house, it's more like this… the problems are on the objects, if there's a fire today, you deal with putting out that fire, rather than looking at how to possibly prevent future fires in this context - attention is paid to this, but rather less."*

There was an interesting case with one municipality, who thought they are already sharing data on national portal, as they had communicated with the Ministry of Economic Affairs and Communications and provided them with information and assumed that it would be published in the portal then. But in fact, no data were shared in the portal. This, in turn, indicates the lack of understanding of roles within the OGD ecosystem, whereas LGs are not always aware of who is responsible for data sharing, considering that this is done in a centralized manner through the Ministry, whereas the Ministry expects this to be done by LGs themselves as data owners.

Yet another reason mentioned by LG12 states that this is due to the fact that *"Many open data of municipality are today, for example, based on information systems and these information systems are located at service providers. And getting the data from there is also a bit problematic, because this is not foreseen in service level agreements."*

After general understanding of organizations experience with the OGD until now has been established, more specific barriers as implies form the developed model were discussed.

6.3 Usage barriers

Most of the usage barriers can be indicated as relevant for majority of the municipalities when openly sharing data.

Half of the respondents (6) agreed that the **inappropriate quality level of the municipality's data (UB1)** can be one of the barriers of openly sharing data. 2 respondents mentioned that the barrier lies more in the fact, that the quality level of the data is unknown or undefined. Two municipalities thought they may have quality issues in some operation fields and 2 of the respondents did not see quality as a barrier.

Majority of the interviewed municipalities (8) assessed the **process to prepare data for sharing as complicated (UB2).** 3 respondents thought, in turn, do not consider it complicated and one interviewee could not evaluate it due to lack of knowledge about this process. For the reasons for complexity of data preparation process, LG10 mentioned that in many cases they are doing manual work with no means of process automation, as well as lack of data management system. LG12 added that: "…*the information systems provide data differently and they have not taken it into account."* LG3 raised the competence issues: *"If there are no competencies and awareness in the organization, for example about the national portal, then it is difficult because someone has to start understanding it from scratch."*

LG7 indicated the process itself is not complicated, but it is difficult to make data owners to implement and follow this process.

The **process to make municipality's data reusable by others (UB3)** was found to be complicated or somewhat complicated by 8 respondents, but the reasons varied quite a lot. In more detail, they were:

1) anonymization that in some cases requires manual or tailored solutions (LG10);
2) difficult to select the most appropriate format for data further reuse, e.g., JSON, CSV or XML (LG12);
3) time required to be dedicated to preparing a through documentation/description of the data, if done thoroughly (LG4);
4) limited knowledge and understanding of what is meant by "reusability" (LG3, LG5).

Two respondents assess the process itself not to be complicated, but "…*rather the concern is that we have no knowledge who is the user of this data*" (LG11) and "…*it is hard to find out what this necessary amount of data is that someone could actually use"* (LG4).

The next three barriers (UB4, UB5, UB6) concerned the open data portal - avaandmed.eesti.ee (i.e., all further responses to be treated as referring to national portal).

5 interviewees could not assess whether the **process to publish data on an open data portal is complicated (UB4)** as they had no knowledge or previous experience with it. One respondent mentioned that they started to create an account in the portal, and with some questions related to the process to which they had no immediate answers and therefore they stopped at that point. Some other challenges the municipalities (LG4, LG6, LG7) had faced were the same with those already mentioned in previous sub-section, namely:

- publishing is too time-consuming (preparing metadata by manually filling respective form);
- difficulty in creating APIs and getting data moving between the systems;
- preparation of data in appropriate formats.

Only four respondents (LG8, LG10, LG11, LG5) agreed that the **process of publishing municipality's data on an open data portal is unclear (UB5)**. 3 municipalities mentioned that there are good guidelines available in the portal and the process is quite straightforward, "…*but maybe if you are using APIs, that might require more knowledge, but overall, most people could manage*" (LG6).

One municipality that has not published data there mentioned: *"I read the guide, according to the guide, it seems like you have steps that you complete and it is supposed to work, but since I haven't tested it, I don't know if it actually works."*

LG12 raised a different concern: *"I have understood that whatever is put up [in the portal] will be published… there seems to be no control."*

LG8 and LG9 mentioned again the awareness as one of the key factors, stressing that "… *when this knowledge [about publishing in OD portal] reaches that level, that it's actually maybe really some things that need to be done, then we would have a lot more data available through this portal."*

Half of the respondents admitted that they cannot comment on the **functionality of open data portal (UB6)**, as they had not used the Estonian OD portal. For example, LG5 mentioned: *"…why I haven't used it, maybe because I haven't understood the benefits of it. Just collecting data doesn't provide any value. No one can value data until what you have collected reflects something back to us."*

Two municipalities find the national portal to be satisfying with enough functionalities, while on the other hand, two of them criticized the following aspects:

- the limited functionality of the search tool;
- current portal does not comply with the Data Description Standard[18], which sets requirements for interoperable data descriptions;
- many datasets have referrals to another system (there is a link in the OD portal and the user must open another system to actually get the data).

Majority of the interviewed municipalities (9) acknowledged that **lack of possibility to semi-automate process to openly share its data (UB7)** is a barrier. *"If it were much easier to share data in open data portal, we would publish much more"* (LG5) and *"…if there were interfaces, it would make everything easier for us"* (LG6).

As most of the Estonian local authorities use standard solutions and information systems, two respondents (LG1, LG12) suggested that the interface with the portal should be between the standard solution already, so that same datasets of different LGs would be published through API.

The last question regarding usage barriers concerning **process to maintain data once published (UB8**) was understood differently by respondents – some of them kept in mind the maintenance of all the data municipality is managing and others referred to the data published in open data portal. As for the latter, LG7 mentioned: *"At the moment the portal has no functionality to set up storage deadlines for datasets and you have to track somewhere else that"*. On the other hand, LG6 did not see it as a problem: *"In some cases, it's good to keep certain things there. They're not going anywhere, if the need should arise."*

Other usage barriers that form a barrier for municipalities to openly share its data are grouped in table 10.

[18] https://www.kratid.ee/en/juhised

Table 10. Other usage barriers

Usage barriers	**Description or examples of the barriers**
Lack of resources	- No distinguished function or person who is responsible for open data and/or data management (LG1); - Lack of financial and human resources (LG2, LG3); - In some areas there is no data and creating it from scratch is very time-consuming (LG2).
Limited knowledge and awareness	- The meaning of open data is unclear (LG12); - Users of OD can make statistics, but not conclusions based on data (LG5); - The awareness about the national portal is limited, it is not visible enough for users (LG9); - Overall data competences and awareness of open data is low LG1, LG10, LG3
The value of organization's OD unclear	- Not clear, who is the user of local level open data and therefore the value is unclear (LG1, LG3, LG10).
The "best" format of open data not defined	− There are many machine-readable formats available, and it is unclear, which format would be most valuable for the users (LG4).
Unclear, what to publish	− Limited knowledge of the users' needs – what datasets are wanted by users, i.e., high-value datasets (HVD)(LG7); − Difficult to prioritize, which data should be published (LG1).
Technical solutions	− Lack of solutions, that would make the data processing more convenient (LG10).

6.4 Value barriers

Then, the barriers related to beliefs and values the people in the organization hold were discussed, as part of which both overall view on the open government data or datasets and the organization's open data were discussed. In some cases, these different perspectives seemed to be somewhat unclear for the respondents to distinguish, so the answers to the questions VB2 and VB3 were more about the perspective of organization's open data.

Most respondents (9) agreed or somewhat agreed that employees in their municipality believe that **openly sharing government data is often not valuable for the public (VB1).** For example, LG11: "…*Often the purpose of it is not seen, as to why or for whom it is*

needed." Three municipalities, who provided examples of use-cases they were aware of in the first section of interview, were more positive about it: *"…I actually think that the value of data to the public as a user is understood"* (LG9).

More than half of municipalities (7) acknowledged that people in their organization tend to believe that **many open government datasets are not appropriate for reuse (VB2).** Some reasons mentioned by respondents were that:

- some data becomes useless when anonymized (LG10);
- it is hard to see, who could be the user of a specific data organization owns (LG9);
- There is a belief that nothing useful can be done with open data (LG3).

3 respondents were neutral about this question and 2 interviewees did not see this as a barrier, for example LG7: "…*considering that local governments operate at the level of power closest to the individual, on the contrary, opportunities may arise to value the data, which affects the daily lives of as many people as possible."*

Nearly all municipalities (10) agreed that the organization believes that **many open government datasets suffer from data quality issues** (e.g., completeness, accuracy, uniqueness, consistency, etc.) **(VB3).** The most mentioned issues were inconsistency and inaccuracy. One example from LG8 states that "*The average salary or workload of teachers is a big mess…if the source data is incorrect, then it is not possible to get correct results."* LG9 brought out that the reason for this belief might be the fact that people in organization tend to be too critical about their data. LG7 complemented this discussion with the following: "*…as far as I know, few agencies, organisations, companies have made quality determinations to their databases…so, if you do not know the quality, that means it is of questionable quality."*

Most respondents (8) rather agreed (but not strongly) with the belief in organization that **public gains of openly sharing government data are often lower than the costs (VB4)**. For example, LG6: "*In terms of human resource cost… so much time is spent on it, but at the same time this information is not consumed, nothing is created based on it, so the question arises, why is it needed"* and LG10: "…*you are doing a lot of work within that, but what do you do with that data after that… it is just nice, that you're getting some kind of overview, but well, what's next."*

One municipality (LG4) argued that it is hard to have a straight answer, as some datasets are more valuable and interesting than others, but if the aim was to publish everything, then the costs would be too high compared to the public gains thereby pointing to the issues associated with data prioritization.

Only four municipalities believe that the **organization's gains of openly sharing government data are often lower than the costs (VB5).** For example, LG3: "… *if it were the other way around, if great benefits were seen, it would probably already be dealt with*." Three respondents had no opinion on this.

Half of municipalities agreed that **data preparation is too resource-consuming for their organization (VB6)**, as *"you have to process the data and it takes time"* (LG10). Two respondents (LG9, LG8) brough out that today it is not too resource-consuming, but they were not sure about sharing data on national portal, as they had no previous experience with it. One municipality mentioned that the biggest issue, i.e., the process that takes most resources is the data management, not sharing open data.

Half of the local governments rather agree with the belief that **open government data do not provide any value to their organization (VB7)**. For example, LG12: *"…people have not understood the value of open data"* and LG3*: "…the common understanding is that if you do something, direct return is important… indirect benefits don't tend to be seen"*. Some respondents commented that it could be the case in some fields or departments, but not a general belief in their organisation.

Most of the respondents (7) acknowledged that people in their local authority tend to believe that **open data that they can openly share will not provide value to users (VB8)**. Two municipalities mentioned that geoinformation may be an exception here, as the officials see more value in it. LG7 commented: *"…rather, there's no such belief, but very much would help if we knew more, what data users need."* LG 2 highlighted another aspect that officials in the organization that do not work with open data cannot see its value.

The final value barrier - the **number of resources to be spent to prepare, publish and maintain open government data outweigh the benefit my organization gains from it (VB9) –** lead to ambiguous responses. Only 4 municipalities totally agreed with it. Three respondents rather disagreed and five of them did not have a clear answer. For example, LG10: *"To a certain extent, I think benefits are seen, but if it starts to take most of the working time, it will go the other way."* LG9 points out that: *"I rather think that this is not the case…we overestimate the effort we must put into it and underestimate the benefit. The benefit of such things is often underestimated, as it is often indirect."*

The other value barriers that respondents see as a barrier for their municipality to openly share its data that were not covered by the model are provided in table 11.

Table 11. Other value barriers

Value barriers	**Description or example of the barrier**
Duplicated data collection by different agencies	Same kind of data is gathered by different agencies – brings the question, which of them is reliable or which data to use as a basis. E.g., in case of residents of municipalities, the data of Estonian Population Register and Statistics Estonia is different (LG10).
Value of open data portal unclear	The value of Estonian open data portal is unknown to public (LG12);

	Anonymized data in some cases is useless and can only be used for statistical purposes (LG2).
Terms "data" and "open data" are unclear	Understanding of the term "data" and "open data" is different, not uniform and needs clarification amongst the officials (LG3, LG7).
Open data not prioritized	Open data is not a priority for organization (LG8, LG10).

6.5 Risk barriers

Risk barriers refer to the degree of uncertainty regarding financial, functional, and social consequences of using open data or publishing it. In brief, most of the risk barriers included in the model can be considered relevant or somewhat relevant and one barrier was found not applicable by the respondents.

As part of this set of barriers discussed with municipalities, half of the respondents (6) agreed that the **fear of the misuse of openly shared government data (RB1)** may be a barrier. Three municipalities raised concerns about security, not only criminal activity, but also cybersecurity, which is a new topic in regards the situation in the world. On the contrary, some respondents argue that open data *per se* means that the possibilities of misuse are already minimized.

The **fear of misinterpretation of openly shared government data (RB2)** was somewhat more often acknowledged, as 8 respondents raised different concerns connected to it. For example, LG2: *"Many officials also fear that if we publish too much, people will start asking too much or get too aware… I don't see fear in it, but, well, some do".* Some gave the example of financial data and documents, that might be the source of misinterpretation as people have limited understanding of this data.

On the other hand, two respondents mentioned that if somebody makes false interpretation or conclusion, then it shows the limited understanding of this person. LG7 commented: *"…this possibility exists, but we try to minimize it."*

6 municipalities agreed that this might be the case in their organization that people **fear that openly shared government data will not be reused (RB3)**. For example, LG3 pointed out that: *"…it could be from this view that who needs them at all and why we should do it."*

Four respondents did not see this fear as a barrier to openly sharing data, for example LG6 mentioned: *"…I think we are not afraid of this, as we have offered data and it is up to users to do something with it".* Two municipalities mentioned that the "fear" is not relevant, but "belief" that OGD will not be reused is relevant (covered in previous section on value barriers).

Majority of interviewed municipalities (10) agreed that the **fear of violating data protection legislation when openly sharing government data (RB4)** exists in their organization, especially amongst officials dealing with personal data. The reasons and additional fears mentioned by respondents are:

- the boarders of what is personal data are very delicate or blurred (LG11, LG4);
- fear of the injunction (by the inspectorate) (LG12);
- people fear to process data due to data protection (LG4);
- some previous cases/negative experience has made people cautious (LG7);
- document management system is the main source where data, that should be not openly shared, could be exposed (LG7, LG9).

Two municipalities felt confident that this fear is not widespread in their organization, as the understanding of what to restrict exists.

The respondents were more ambivalent about the **fear that sensitive data will be exposed as a result of opening its data (RB5)**. Half of them agreed with it and some referred that it is connected to the previous question, and this might be relevant to their organisation. But some respondents commented that sensitive information is usually removed from data during the preparation of opening data and it cannot be the case that, for example *"…data of disabled persons is accidentally exposed"* (LG4).

Less than half of the municipalities (5) agreed or somewhat agreed with the **fear of making mistakes when preparing data for publication (RB6).** For example, LG10 mentioned: *"…it is also feared, but maybe less than compared to the previous two [fears]"* and LG1 complemented: *"…as we cannot be sure about the quality of our data, then the fear is automatically there."* LG7 pointed out, that this is not a widespread fear, but some people are more worrying. Two respondents did not see it applicable to their organization, as this fear could be relevant if they would process and share more data than today.

The **fear that users will find existing errors in the data (RB7)** received mixed feedback. One respondent mentioned that it is probably the biggest fear related to data (LG5) and two municipalities acknowledged that this fear might be relevant, but not to the extent that it forms a barrier to share data (LG1, LG4). This fear could be related to the problems with quality of data (LG11) and human fear of making mistakes (LG3, LG6).

To the contrary, nearly half of respondents were in the opposite mind, for example LG12: *"…if somebody finds mistakes, it's good, we'll find out there's something wrong. That's the feedback, that's good,"* and LG8: "*…it's overall positive, then we know that somebody uses it."*

Majority of municipalities do not find the **fear that openly sharing its data will reduce its gains (RB8)** relevant as they cannot see the possibility, how municipality could sell the data or whether it is even possible by law. One respondent provided an interesting example, how

companies are gathering data of procurements from municipalities' websites and then offer this data for the service provides, who have joined their procurement/tender platforms.

The **fear that openly sharing organization's data will allow its competitors to benefit from this data (RB9)** was found irrelevant, as municipalities are public sector bodies and could not see, who the competitors in their territory might be. The local governments are watching each other's initiatives and, in some cases, compete over residents, but in terms of data there is no competition.

Other risks or fears mentioned by respondents that might form a barrier for the municipality to openly share its data are provided in table 12.

Table 12. Other risk barriers

Risk barrier	**Description or example of the barrier**
Security issues	Publishing of some type of data might be used for criminal motives (e.g., cyber-attacks, security breach) (LG1, LG2)
General fear of the unknown	LG3: "Lack of data awareness creates fears, as everything unknown seems scary to some people"
Lack of resources	Overall lack of resources (LG7)

6.6 Tradition barriers

Tradition barriers were considered somewhat less relevant by respondents compared to usage and value barriers. The interviewed municipalities split in thirds in responses regarding the belief that **Freedom of information requests are sufficient for the public to obtain government data (TB1)**. The respondents who were subtle commented, that *"…this might be the case of some fields of activity, but not a widespread belief"* (LG5). Two municipalities brought out that if enough data is already published, then there are less information requests, and it means less work with them.

The **reluctancy to implement the culture change required for openly sharing data (TB2)** was not seen as a barrier by most of the respondents. LG9 and LG10 pointed out that major cultural shift was done during the administrative reform[19] and LG3 commented they are on the transition point, where the readiness for change is somewhat there, but the traditions also prevail. LG5 commented: "*It depends greatly on management and politicians…in our case there is rather desire to publish more*". LG2 and LG7 admitted that there might be

[19] Estonian administrative reform was implemented in 2015-2017, for further information access: https://www.agri.ee/en/administrative-reform-2015-2017

some people in organization who are reluctant to change, but this cannot be applied to the entire organization.

Half of the respondents (6) agreed that **employees in their municipality lack the skills required for openly sharing data (TB3)**. Three municipalities thought that the basic skills exist, but there might be some specific skills that need development. LG1 broadened the issue: *"…starting with the notion of what value the data carries… it is viewed as only in the context of their own department and no one can assess in the context of an organization or the customer point of view."* Some respondents referred to the national OD portal and admitted that they have no experience with it, but it would probably be only the first time a new thing to learn.

The respondents understood the question about **lack of the skills required for maintaining openly shared data (TB4)** differently. Most referred to the overall data maintenance and did not see a problem with it, as this is done within daily practices. Some municipalities, who answered from the perspective of maintaining data in national portal admitted that if it is done manually, somebody has to look after the data in it (e.g., it is up-to-date) and it takes time.

Most municipalities rather would not agree that **organization is reluctant to radically change the organizational processes that would enable openly sharing government data (TB5).** The arguments were following: (a) the management is positive about the change, but some employees are reluctant (LG10), (b) the desire for change is there, but lack of financial and human resources are the barriers for change (LG3, LG11), (c) open data is not valued and not prioritized (LG5).

Other tradition barriers mentioned by respondents that might form a barrier for the municipality to openly share its data are provided in table 13. Interestingly, although most municipalities have not confirmed the reluctance for change in culture or processes as a barrier (TB2), several of them highlighted during the discussion of other tradition barriers the overall reluctance to changes as a barrier, e.g., people in the organisation having negative attitude towards any kind of changes.

Table 13. Other tradition barriers

Tradition barrier	**Description or example of the barrier**
Open data is not a priority	- There are main functions that people are used to doing, open data is something new (LG1); - Open data is not valued (LG5).
Reluctance/resistance to change	- Habit of doing things the same way as done previously (LG2); - Negative attitude towards change (LG3);

	- It is difficult to change the mindset of people, who are used to do things as always (LG5).
Technophobia - irrational fear of technology	Fear that digitalisation brings more work than savings (LG9).
Lack of data management processes	Estonian data management Framework is difficult to understand and implement at local level (LG6).

6.7 Image barriers

Majority of the interviewed municipalities (8) consider that their **organization do not have negative image of open government data (IB1)**. Two respondents mentioned that the image is neutral, as LG10 commented: *"[The negative image] may be a case for some data…as time goes on, the more people want their work to have a meaning…time resource versus the benefits of it is being considered in their work."*

Half of the respondents agreed or rather agreed that their organization **believes that open government data is not valuable for users (IB2)**. 4 municipalities rather did not agree, they acknowledged that there might be a few people who believe it (LG6) or it might be relevant in case of some datasets (LG4). LG8 commented: *"…rather they fear it or do not know, whether the data is valuable or not."*

The municipalities split into two regarding the **fear that openly sharing government data will damage the reputation of their municipality (IB3)**. Half of them disagreed, for example, LG7 commented: *"…rather, we strive for such a reputation that it shows us in a better light."* The other half of respondents rather agreed that: (a) this fear might be the case for some data (LG1), (b) it could be connected to the fear of making mistakes and data quality issues (LG10), (c) data can reveal the "real picture", which is not as good as expected (LG3, LG9). LG5 pointed out that some employees fear that open data related to their work might show them in a poor light.

Majority of the respondents (9) admitted that the **fear that the accidental publication of low-quality data will damage the reputation of their municipality (IB4)** may be applicable to them. Two of them specified that this is more a risk they must mitigate.

Half of the municipalities agreed that their organization **fears that associating them with incorrect conclusions drawn from OGD analysis by OGD users will damage its reputation (IB5)**. The examples given by respondents:

- wrong conclusions based on document register (LG10);
- media makes wrong interpretations (LG11, LG9);
- it is difficult to disprove the incorrect conclusions (LG9).

Most interviewees did not see any other image barriers for their municipalities to openly share its data. But LG9 raised an interesting point: *"The topic of open data is not one that receives significant public credit, and therefore, it is not given excessive attention. ...if it were something exciting, there might be a desire to support those who are considered cool… this kind of order would probably change a lot and a lot of data would come on the market."*

6.8 Other barriers

Half of the respondents pointed out other barriers, but most of them fell into the barrier types covered by the model utilized for the interviews, mainly falling into usage and value barriers. However, Estonian municipalities raised some barriers not included in the initial IRT-derived model that could be taken into account when refining the model, namely:

1) lack of data awareness – people working in local authorities are not aware of the concept of open data or overall understanding of data is lacking;
2) lack of data competence – lack of knowledge and skills to work with data, e.g., data governance or management, data analytics, data quality management;
3) lack on human resources - no distinguished function or person, who is responsible for open data and/or data management;
4) lack of financial resources – overall lack of funds to meet all obligations imposed on local governments;
5) lack of clarity, what data to publish – which data would be most valuable for users;
6) difficult to prioritize data - which data should be published first.

6.9 Open data ecosystem

The final part of the interview covered overall open data ecosystem – its actors, the benefit of open data, measures to improve the current situation and the awareness of policy documents and initiatives.

All the respondents were able to point out at least two **open data ecosystem actors**: the data owners (e.g., municipalities, state agencies) and the data users/ consumers (e.g., private sector, academia, other public agencies). Half of the interviewees also mentioned some kind of mediator – a platform, portal, or solution, where consumer can access/view or download or request data. Two municipalities brought out yet another actor - regulatory body and Data Protection Inspectorate, who create regulations and verify compliance to them. One respondent mentioned stakeholders, who might benefit from open data.

Most of the respondents of top-level management were not aware of any **policy documents or initiatives guiding developments in the field of open data** at Estonian or European level (e.g., Estonian Digital State 2030). However, some of them specified that employee responsible for this area probably know about them. Three municipalities pointed out that these documents do not cover local government level at sufficient level and are often more "at the level of slogans or for the good reputation of digital state".

Several **actions that should be taken at the national level** (e.g., Ministry) to help municipalities disclosing more open data and comply with the requirements related to open data were proposed, namely:

- **most important or valuable datasets that municipalities should prepare and share** on national portal should be defined (LG1, LG12, LG6). This could be a good starting point for open data initiatives amongst local level;
- the question of LG revenue base must be resolved, as it is difficult to think about respective required changes, if the basic municipal services are lacking resources (LG11, LG3);
- problems with compatibility and interfaces, for example, the same data is obtained from one database and inserted manually into another database, and then a part of this data is used by some statistical form etc. (LG10);
- more practical guidance, training and help for municipalities from the state agencies, not just overall documentation and information events (LG12, LG11, LG6, LG7);
- direct application programming interfaces (API) between standard software (used by LGs) and national open data portal (LG12, LG5);
- the benefits and value of municipal open data should be evidenced (LG5, LG1);
- specific measures for municipalities that would motivate them to publish more open data should be defined (e.g., the portal minuomavalitsus.ee[20]).

Majority of respondents (8) agreed that average and smaller municipalities cannot probably handle this topic on their own and cooperation between them is inevitable. The respondents pointed out several **actions that could be taken by local governments**:

- the information systems should be uniformed to get the uniformed data from municipalities (LG5, LG12);
- the awareness of LG employees should be increased (LG2, LG9);
- the knowledge exchange about data analytics developments should be facilitated (LG1);
- data management/governance must be properly implemented, then it is easier to publish open data (LG5, LG6, LG7);
- Association of Estonian Cities and Municipalities could offer guidance or training (LG8, LG11, LG12);
- datasets related to the same municipal functions could be harmonized/uniformed making them as similar as possible by defining uniform requirements towards their collection and processing (e.g., the granularity level), so that they can be used together amongst municipalities (LG4);
- data management should be connected with strategic management and use more data in decision making (LG5).

Based on the barriers identified in the previous sub-sections, awareness-raising and competence-building regarding the municipal data should be addressed first. As LG2 highlighted:

[20] https://minuomavalitsus.ee/en

"*Awareness needs to be significantly increased to truly understand the data that local governments produce themselves. That's where the focus should be directed…it doesn't make sense to hold or duplicate data that already exists elsewhere in the country, which I see happening frequently. By doing so, the work itself becomes more focused".*

–Despite challenges faced by municipalities and barriers they are experiencing with the studied context and often lack of awareness of data value, many municipalities do see the **benefit or value of open data**, which are provided in Table 14.

Table 14. Opinions on benefit or value of open data

Benefit or value	**Description or example**
Increase of service quality	- The quality of some services might increase due to the analysis made by combining open data (LG1); - Use of geospatial information by architects, planners etc. makes processes faster and of higher quality (LG2).
Public value creation	- Even if the value is not seen now, there might be someone there who already foresees it (LG7)
New services	- New services created by private or third sector (LG4, LG6, LG7)
Proactive services and prevention activities	- Linked data could be a basis for proactive services and prevention activities, e.g., road closures in Waze application (LG10)
Smarter decisions	- Open data can be helpful in the decision processes, e.g., designing public services or business (LG8, LG12); - The biggest value comes from knowledge and correct/accurate conclusions that are drawn on data (LG3, LG5, LG9);
Less referrals from residents	- Residents have more data available, and the number of referrals decreases because of it (LG2)
Prevent the spread of misinformation	- It is possible to rely on data in case of intentional dissemination of misinformation (LG3)
Rise of data awareness	- Enables to increase data awareness and data literacy, e.g., data analysis skills (e.g., already on lower levels of education) LG4

6.10 Recommendations for ecosystem improvements

Based on the interviews with LGs, several barriers considered most relevant by respondents were identified. Based on these barriers, recommendations derived from the interviews to overcome or mitigate the barriers as suggested by interviewees were identified.

Based on the results of the interviews, there are 18 barriers of the IRT model, with which at least half of the respondents agreed, with the highest number (6) related to value barriers category, 4 - to both risk and usage barriers, 3 - image barriers and 1 - tradition barrier. As such, all IRT barriers categories are relevant for LGs, although at different extent. Table 15 provides (1.1) the barriers not included in the initial model utilized for the interviews and (1.2) the most relevant barriers already included in the model, where barriers addressing similar or overlapping issues are combined, (2) the recommended measures for ecosystem improvement at (2.1) national level (e.g., policymakers, portal owner) and (2.2) local level (individual or LGs collectively) are provided.

Table 15. Most relevant barriers and recommendations for improvements

Barrier	**Measures at national level (e.g., policymakers, portal owner)**	**Measures at local level (individual LG or collectively)**
Lack of data awareness/ competence Lack of skills for openly sharing data (TB3)	Practical guidance, training and help for municipalities	Guidance and training offered by Association of Estonian Cities and Municipalities, knowledge exchange about data governance and analytics developments, e.g., best practices
Lack of human and financial resources	Revision of the revenue base of local governments Specific measures for municipalities that would motivate them to allocate resources there	Increase awareness of existing employees, identify "data enthusiasts" within organization
Lack of clarity, what data to publish	Centrally agree upon the most relevant/valuable datasets, that LGs must publish themselves (e.g., initiated by ministry in cooperation with LGs)	
Inappropriate data quality (UB1, IB4, VB3)	Adaption of central data governance guidelines (including data quality) for municipalities	Implementation of data management/governance & automated data quality management procedures
Complexity of data preparation (for reuse) (UB2, UB3)	Solutions that would make the data processing more convenient (augmentation and automation), enhancement of OD portal	Publishing of data in formats that require minimal additional work

Barrier	**Measures at national level (e.g., policymakers, portal owner)**	**Measures at local level (individual LG or collectively)**
Resource intensity of data preparation (VB6)		
No semi-automate process to publish data (UB7)	Direct application programming interfaces (API) between standard software (used by LGs) and national open data portal	
Lack of OGD value awareness for public/ users (VB1, IB2, VB8)	Benefits and value of municipal open data should be evidenced by use-cases; make usage statistics of datasets available to publishers	Uniformed information systems that provide more uniformed data
Datasets not appropriate for reuse (VB2)	Datasets related to the same municipal functions could be harmonized/uniformed by defining uniform granularity level	
Public gains lower than costs (VB4)	Demonstrate the impact of open data through showcases/ use-cases/re-uses, success stories	Testimonials about OGD use-cases,
Fear of misuse and misinterpretation (RB1, RB2)	n/a	n/a
Fear of violating data protection regulations and exposure of sensitive data (RB4, RB5)	Clear guidelines and examples of different cases	Implement processes that mitigate the risks
Incorrect conclusions drawn from OGD (IB5)	Improvement of overall data analytics skills (e.g. in general education, adult training)	

For some of the barriers (indicated as n/a in the table 15) countermeasures/activities were not revealed during the interviews with LGs. This refers to fear of misuse and misinterpretation (RB1, RB2), where, in turn, measures for overcoming this fear might include (1) improvement of overall data literacy for both open data ecosystem actors (e.g. seminars, workshops, courses), (2) feedback mechanisms, exchange of practices, (3) development and raising awareness of data governance policies.

The qualitative analysis also revealed the main user groups and some use-cases of local level open data that are known to local governments, namely students, journalists, entrepreneurs, local residents, spatial planning actors, council' members. This can be a good starting point for exchange of experience amongst municipalities and for a deeper analysis of the users' needs.

7 Discussion

This thesis aimed to examine Estonian OGD development at the national and local level, by identifying the main barriers municipalities face when openly sharing data and defining corrective actions to improve the situation.

The first research question (RQ1) sought to explore how the Estonia's position within open data rankings has evolved and to what extent the local administrative level is covered by them. To this end, first the historical performance of Estonian OGD through various rankings and benchmarks was analysed, and then the Estonian OGD portal and policymaking developments were explored, which served as a fundamental framework for more comprehensive understanding. The analysis revealed significant progress in Estonia's standing, particularly in the European Open Data Maturity, WJP Open Government Index and OURdata Index. However, the latter benchmark indicated availability of high-value datasets and impact monitoring as somewhat lower scored, which is also an issue faced by other countries though [58]. The Open Data Inventory (ODIN) evaluation, based on data from Statistics Estonia, identified coverage as a key area for improvement, particularly in social statistics and subnational data availability, addressing the deficiencies with local level data. This is also compliant with current global trend, where the potential of local level data is not utilized. These findings indicated that while Estonia has made significant strides in several open data rankings, local governments are still trailing.

The largest cities, Tallinn, and Tartu, unsurprisingly dominate as major data publishers on Estonian open data portal, yet 85% of municipalities haven't contributed any data to the national portal. The survey about open data and national OD portal awareness[21] revealed that this topic is relatively unknown for public and might also be a constraint on local administrative level. Recognizing the growing significance of local and smart city open data portals within the broader ecosystem, it is important to address the current limitations in local open data provision and enhance the visibility of local OGD in the national portal.

The second research question (RQ2) aimed to establish the current state of art of the open (government) data ecosystem at both the local and regional levels in Estonia that was later expanded to Europe due to the lack of evidence for Estonian case. To fulfil this step, SLR approach was utilized, to systematically examine and synthesize existing research. The objective of the SLR was to: (1) review existing academic literature pertaining to Estonia's open (government) data ecosystem, (2) determine the context of previous studies concerning the local and regional levels of Europe, (3) compare of results from research on Estonia's open data ecosystem with broader European perspectives. The SLR revealed that studies focused on the Estonian case, particularly those published between 2018 and 2020, underscore the slow progress of Estonia's open data ecosystem despite its advanced e-government. Notably, none of the previous studies delved into the local government level of Estonia. The primary themes identified in European studies at regional or local levels included open data

[21] https://avaandmed.eesti.ee/datasets/%22avaandmed-ja-andmete-uhekordse-kusimise-pohimote%22-uuringu-alusandmed

portals, open data usage and sharing, digital maturity assessments of municipalities, data interoperability and linked data, transparency, citizen trust, Society 5.0, and the intersection of public administration and services with OGD. However, no empirical evidence of the barriers the (potential) publishers face when opening governmental data was provided.

To identify the main barriers and enablers for Estonian local governments to openly share and maintain data, and the possible measures to overcome these barriers **(RQ3)** qualitative analysis was conducted. To this end, the OGD-adapted Innovation Resistance Theory model [8] was expanded by tailoring it to the specific objective of the thesis to analyse barriers and enablers associated with the OGD publishing and maintenance at local level of Estonia conducting interviews with 12 local governments.

The results of the interviews revealed that municipalities collect and process various types of data, including data collected into national registers (e.g., population register, education system), document register data, data collected by providing services, geospatial data etc. Data sharing on municipal websites/portals varied, with most complying with the Public Information Act's obligations, and some of the LGs have created distinct portals for publishing geospatial data. The main driver for openly sharing data was legal obligation, but other motives included transparency, publication of publicly funded output, and facilitating citizen autonomy. Challenges faced in openly sharing data on their websites included lack of human resources, technical platform issues, lack of data competencies, and difficulties in preparing data to be shared as open data due to the format in which they are stored. Municipalities indicated various users of their data, such as students, journalists, spatial planners, entrepreneurs, residents, and council members. Some municipalities were aware of specific reuse cases, such as applications in the public transportation domain and minuomavalitsus.ee as a systematized overview of local government services. However, understanding of both re-users and use-cases was lacking in half of LGs.

Regarding the Estonian open data portal, local governments faced several challenges in sharing data there: (1) the inability to get usage statistics for datasets, (2) the time-consuming process of filling metadata fields with lack of automation of the process, (3) difficulty in creating APIs and getting data transferred between the systems, (4) preparation of data in appropriate formats, (5) difficulty in prioritizing and identifying high-value datasets for their further publication. Seven of the interviewed municipalities had not shared any data on the national portal at the time of the interview due to lack of awareness or lack of resources as the main reason for not disclosing data there. However, after the interview, some municipalities expressed the intent to do this in the nearest future or pay more attention to this issue in their organization. Another challenge mentioned was the difficulty in obtaining data from information systems located at service providers, which is not foreseen in service level agreements.

The barrier types covered by the IRT-derived model included different usage, value, risk, tradition, and image barriers. The research of Estonian municipalities raised some barriers not included in the initial model but falling into the categories of usage and value barriers. These implications can serve as possible additions for the OGD-adapted Innovation Resistance Theory model refinement.

The most relevant barriers for openly sharing the data include: (1) lack of awareness and skills for open data sharing (TB3), (2) insufficient human and financial resources, (3) uncertainty about what data to publish, (4) concerns about data quality (UB1, IB4, VB3), (5) the complexity and resource intensity of data preparation for first-time publishing and further re-use (VB6, UB2, UB3), (6) lack of data publishing process automation (UB7), (7) lack of understanding of the value of open data for the public/users (VB1, VB2, VB8, IB2) and belief that public gains are lower than costs of data opening (VB4), (8) fears about misuse and misinterpretation of opened data (RB1, RB2), (9) fear of potential violations of data protection regulations (RB4, RB5), and (10) the possibility of incorrect conclusions being drawn from the data (IB5).

The interviewees indicated several measures to overcome these barriers both at national and local levels. Some of these recommendations can be utilized as input for developing specific action plan to support local governments in the open data domain, e.g., awareness raising activities, practical guidance and training, automation, motivation measures for LGs etc. The analysis also revealed that although data governance guidelines have been developed by central government, they are not easily applicable for municipalities and require adaptation to local context with practical sample procedures. The solutions that make data processing more convenient (augmentation, automation, APIs) would also be helpful and decrease the need for manual work.

As value and benefit of open data was found to be the highest barrier type, it is imperative to focus more attention to evidence and demonstrate the value of local level open data by use-cases, re-uses, testimonials, and success stories. This is also in line with research paper [48], indicating the need to explore the various types of data users, their motives and role in creating valuable impact with open data. Also, detailed usage statistics/analytics of datasets on national portal should be made available to data publishers thereby allowing to monitor the user interest of their data.

One of the key measures that could alleviate the current situation involves a central consensus on the most relevant/valuable datasets, that LGs must publish themselves. It is also important to consider and clarify the security aspect of open data, e.g., spatial data. These actions require cooperation with LGs and the national level, i.e., ministry. As the main functions of the municipalities are the same, the datasets related to specific service could be harmonized, e.g., defining a uniform granularity level and data dictionary.

The fear of violating data protection regulations and expose sensitive data is strongly represented among municipalities, which seems to indicate active monitoring by the Inspectorate and implementation of GDPR. Here the clear guidelines and application of processes to mitigate the risks could be helpful.

However, this study has several limitations. First, the main results of the study rely on qualitative analysis conducted through interviews with local, which inherently introduces subjectivity into the findings. This choice, however, was made intentionally, as qualitative approaches allow to get a more depth, context, and rich insights into the subjective experiences of individuals understanding and identifying context-specific causes, allowing identifying unforeseen factors.

The sample size is limited to 15% of Estonian municipalities (12 out of 79), potentially affecting the generalizability of the results. In the future, conducting a study using a quantitative approach and covering all Estoian municipalities, could be beneficial thereby contributing to the generalizability and more objective insights on the phenomenon.

As the research is focused on Estonian local governments, and as the administrative system varies across countries, the results are not directly transferable to other contexts and must be viewed in the context of specific country.

8 Conclusions and future research directions

This thesis contributes to the theoretical framework for determining barriers to open data sharing based on the case of local authorities in Estonia and highlights the importance of local level open data as an integral part of the OD ecosystem. It also provides insight into the root causes, why local governments are lagging behind central government as indicated by Estonian Digital Agenda 2030[22]. This was achieved through three research questions that explored the evolution of Estonia's position within open data rankings and the extent of local administrative level coverage (RQ1), the current state of art regarding the open data ecosystem at both local and regional levels in Estonia and Europe (RQ2), and the main barriers and enablers for Estonian local governments to openly share and maintain data, together with potential solutions to overcome these barriers (RQ3).

The results of the study contribute to better understanding of Estonian open data ecosystem and can serve as valuable input for data governance and open data policies. The practical implications emerge from the interviews with the representatives of LGs highlighting specific measures that can be undertaken by national agencies and local authorities to move towards a more sustainable open data ecosystem.

The study identifies main barriers and enablers faced by municipalities in sharing and maintaining open data and suggests corrective actions to overcome these barriers. Although the research shows that many interviewed local governments do not or cannot see great value in the data they could openly share, most of them could indicate the benefits or value of open data in general. This suggests that the overall attitude towards open data is predominantly positive and favourable circumstances exist for enhancing the OGD provision by municipalities. The study also revealed some simple steps for improvement, e.g., publishing open data of LG document management systems on national portal. Furthermore, one of the municipalities in the qualitative analysis sample had already published data after the interview.

Given that several databases the municipalities are using for data collection, are centralized or national, it is crucial to study, which municipal data should be published by LGs themselves and in which cases the central register/body should be the publisher. This requires cooperation between LGs and the national level and could be one of the future research directions.

[22] https://www.mkm.ee/en/e-state-and-connectivity/digital-agenda-2030

In addition, as the quality of open data and metadata were often named during interviews as potential barriers preventing data opening or complicating it, as well as data maintenance, , the future studies could take this into focus , including considerations of integrating of respective mechanisms for their control and improvement into the OGD portal. However, while the topic of open data and metadata quality is recognized as one of central topics for a wealthy open data ecosystem, a recent study [27] that examined 28 portals did not find a clear positive relationship between data sets usage and metadata quality and suggests not to assume such relationship for granted.

The study implicated gaps in knowledge about the actual users and their needs, thus mapping the main user groups of local-level OGD and developing detailed use-cases of data reuse would be valuable to bring more comprehensive view. The qualitative analysis on local level OGD provision barriers and enablers could be complemented with quantitative analysis, to validate the relevant barriers identified by this thesis.

Results of this thesis (RQ1 and RQ2) have been accepted for a presentation at 25th Annual International Conference on Digital Government Research (DGO 2024) and will be published in ACM Digital Library [59] with an extended version submitted to a journal.

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Appendices

I. Protocol of systematic literature review

No	Protocol item	Description
1	Type of paper	Journal article/ conference paper/ book section
2	Year published	The year in which the study was published
3	Author	Names of the authors
4	Title	Full title of the paper
5	URL	Link to the website of the study
6	Scope and keywords	Keywords of the paper and scope of study (e.g. Estonia, European Union)
7	Brief description/ objective	The main objective and/ or primary research questions
8	Theory used/ methodology	The research methodology and/ or theory/ theoretical concepts used in the study
9	Main results	The main results/ contributions of the study
10	Relevance	The relevance of the paper for SLR (e.g. relevant, partially relevant, irrelevant)
11	Comments	Comments by the author of the thesis

II. Interview protocol

Opening Statement

Thank you for participating in this international study on open government data. This study is being conducted by Anastasija Nikiforova, and Katrin Rajamäe-Soosaar from the University of Tartu and Anneke Zuiderwijk from Delft University of Technology.

The purpose of our study is to empirically identify predictors affecting public agencies' difficulties in openly sharing government data by developing and applying an open government data-adapted Innovation Resistance Theory (IRT) model.

As with any online activity, the risk of a breach is always possible. To the best of our ability, your answers in this study will remain confidential. We will minimize any risks by further using the collected data in an anonymized way, where only the general characteristics of the organization under consideration can be revealed. We will delete your personal data (i.e. your name and signature on the consent form and your e-mail address) within six months after data collection.

Your participation in this study is entirely voluntary and you can withdraw at any time. You are free to omit any questions.

This interview will take approximately 50 minutes to complete. We will be asking you 32 questions, starting with general questions describing the organization you belong to, and continuing with open-ended questions concerning the identified barriers towards openly sharing government data for your organization. The interview will end with some overall questions about open data ecosystem.

In case of questions, please contact the involved researchers:

Katrin Rajamäe-Soosaar – katrin.raja@gmail.com

Anastasija Nikiforova – nikiforova.anastasija@gmail.com

Anneke Zuiderwijk – a.m.g.zuiderwijk-vaneijk@tudelft.nl

Informed consent

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICIPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information dated 06/03/2024 or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
3. I understand that taking part in the study involves an audio-recorded interview, which is further transcribed, and once this is done, the audio recording will be destroyed.	☐	☐
4. I understand that the study will end after a sufficient number of interviews across different countries have been conducted to refine the model with its further application. The expected end date of this interview study is May/June 2024.		
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
5. I understand that taking part in the study also involves collecting specific personally identifiable information (PII) (i.e., your name and signature on this consent form and your e-mail address if you decide to provide this to receive our study's results) and associated personally identifiable research data (PIRD) (i.e., your organization) with the potential risk of my identity being revealed.	☐	☐
6. I understand that the following steps will be taken to minimize the threat of a data breach, and protect my identity in the event of such a breach by anonymizing the data and mostly using them in an aggregated manner. Audio records will be transcribed (only accessible to the study team), while audio recordings will be deleted after transcription. Transcriptions will be anonymized and stored locally and secured. We will only report about organizations where interviewees are employed in an aggregated way and quotes in our publications will be anonymized.	☐	☐
7. I understand that personal information collected about me that can identify me, such as my name will not be shared beyond the study team.	☐	☐
8. I understand that the (identifiable) personal data I provide will be destroyed by the end of the research.	☐	☐

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
C: RESEARCH PUBLICATION, DISSEMINATION AND APPLICATION		
9. I understand that after the research study the de-identified information I provide will be used for reports, publications, websites, as well as the development of policies to improve the current state of the art of government data sharing. In specific cases we expect to cite provided answers (anonymized quotes) to ensure accurate references to particular issues.	☐	☐
10. I agree that my responses, views or other input can be quoted anonymously in research outputs.	☐	☐

Signatures

_____	_____	_____
Name of participant	Signature	Date

I, as researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____	_____	_____
Researcher name	Signature	Date

Study contact details for further information: Katrin Rajamäe-Soosaar,

phone: +372 513 8333, e-mail: katrin.raja@gmail.com

Interview questions

Your organization

We will now start the interview with some questions about the organization you are working for.

Q1. By what local government are you employed? (name, domain)
Q2. What is your role in this municipality?
Q3. What type of data does your municipality collect? (structured/unstructured, sensitive/non-sensitive, topics, ownership?)
Q4. How aware you and your organization are with the concept of "open data"?

Your organization and open data

Public sector institutions increasingly share their data on the internet so that citizens, companies, other institutions, researchers, and other actors can freely reuse this data. In the following questions, we refer to this process as openly sharing or providing government data, or simply 'open data'. In Estonia, the Public Information Act regulates, how access to open data must be ensured by holders of information.

Open government data principles[23]:

- Public data is data that is not subject to valid privacy, security or privilege limitations.
- Data is as collected at the source, with the highest possible level of granularity, not in aggregate or modified forms.
- Data is timely - made available as quickly as necessary to preserve the value of the data.
- Data is available to the widest range of users for the widest range of purposes.
- Data is machine processable and available to anyone, with no requirement of registration.
- Data is available in a format over which no entity has exclusive control.
- Data is not subject to any copyright, patent, trademark or trade secret regulation.

Q5. Has your municipality ever openly shared its own data or the data it collected from other sources on **municipal website/portal**? ➔ If yes, go to question 6 ➔ If no, go to question 11
Q6. What were the drivers for your municipality to openly share its data?
Q7. What type of data did your municipality share openly and how often?
Q8. Could you explain how the process of openly sharing data worked and who within your municipality was or were involved? (please refer to roles of colleagues without mentioning names)
Q9. What challenges did your municipality face in openly sharing data?
Q10. Are you aware of specific cases, where your municipality's open data was reused by third party? If yes, please describe briefly, who was the user of open data and what was the outcome?
Q11. What were the reasons for your municipality not to share data openly?

[23] https://public.resource.org/8_principles.html

Q5. Has your municipality ever openly shared its own data or the data it collected from other sources on **national portal avaandmed.eesti.ee**? ➔ If yes, go to question 6 ➔ If no, go to question 11
Q6. What were the drivers for your municipality to openly share its data?
Q7. What type of data did your municipality share openly and how often?
Q8. Could you explain how the process of openly sharing data worked and who within your municipality was or were involved? (please refer to roles of colleagues without mentioning names)
Q9. What challenges did your municipality face in openly sharing data?
Q10. Are you aware of specific cases, where your municipality's open data was reused by third party? If yes, please describe briefly, who was the user of open data and what was the outcome?
Q11. What were the reasons for your municipality not to share data openly?

Barrier-related questions

We will now discuss various types of barriers for openly sharing government data. We would like to know whether and how they are relevant for your organization.

We will start discussing ***usage barriers***. Usage barriers relate to the degree to which publishing your organization's data requires changes in your organization's routines.

Q12. Are there any usage barriers related to the required changes in your organization's routines that form a challenge for openly sharing your municipality's data? (UB)
Q13. To what extent do the following situations form a barrier to openly sharing your municipality's data:
- an inappropriate quality level of your organization's data? (UB1)
- a complicated process to prepare data for sharing? (UB2)
- a complicated process to make your municipality's data reusable by others? (UB3)
- a complicated process to publish your municipality's data on an open data portal? (UB4)
- an unclear process of publishing your municipality's data on an open data portal (UB5)
- limited functionality of open data portals? (UB6)
- no possibility to semi-automate my organization's process to openly share its data? (UB7)
- the need and a complicated process to maintain data once published (UB8)
Q14. Are there any other usage barriers that form a barrier for your municipality to openly share its data? (UBn)

We will now discuss ***value barriers*** for openly sharing government data. We would like to know whether and how these barriers are relevant for your organization. Value barriers refer to the degree to which a value-to-price ratio is perceived in relation to other product substitutes (e.g., OGD do not always provide value to users, datasets may be incomplete, there may be concerns about the quality of open data, Openly sharing government data requires resources, including time and costs, it is impossible to sell the data when it is openly available, data providers are usually the ones who invest

the most effort and time in publishing data, while businesses and citizens as data users profit the most)

Q15. Are there any value barriers related to the required changes in your organization's routines that form a challenge for openly sharing your municipality's data? (VBn)
Q16. To what extent do the following situations form a barrier to openly sharing your municipality's data. The belief of people in your organization that:
- openly sharing government data is often not valuable for the public? (VB1)
- many open government datasets are not appropriate for reuse? (VB2)
- many open government datasets suffer from data quality issues (completeness, accuracy, uniqueness, consistency, etc.)? (VB3)
- the public gains of openly sharing government data are often lower than the costs (VB4)
- your organization's gains of openly sharing government data are often lower than the costs (VB5)
- data preparation is too resource-consuming for your organization? (VB6)
- open government data do not provide any value to your organization? (VB7)
- open data that your organization can openly share will not provide value to users? (VB8)
- the number of resources to be spent to prepare, publish and maintain open government data outweigh the benefit my organization gains from it? (VB9)
Q17. Are there any other value barriers that form a barrier for your municipality to openly share its data? (VBn)

We will now discuss ***risk barriers*** to openly sharing government data. We would like to know whether and how they are relevant to your organization. Risk barriers refer to the degree of uncertainty regarding financial, functional, and social consequences of using an OGD (publishing) (e.g., misuse, false conclusions, privacy concerns, mistakes when preparing data for publication, data quality etc.)

Q18. Are there any risk barriers related to the required changes in your organization's routines that form a challenge for openly sharing your municipality's data? (RBn)
Q19. To what extent do the following situations form a barrier to openly sharing your municipality's data:
- the fear of the misuse of openly shared government data? (RB1)
- the fear the misinterpretation of openly shared government data? (RB2)
- the fear that openly shared government data will not be reused? (RB3)
- the fear violating data protection legislation when openly sharing government data? (RB4)
- the fear that sensitive data will be exposed as a result of opening its data? (RB5)
- the fear making mistakes when preparing data for publication? (RB6)
- the fear that users will find existing errors in the data? (RB7)
- the fear that openly sharing its data will reduce its gains (otherwise the municipality could sell the data or use it in another beneficial way)? (RB8)
- the fear that openly sharing its data will allow its competitors to benefit from this data? (RB9)
Q20. Are there any other risk barriers that form a barrier for your municipality to openly share its data? (RBn)

We will now discuss ***tradition barriers*** for openly sharing government data. We would like to know whether and how they are relevant for your organization. Tradition barriers refer to the degree to which an innovation forces consumer to accept cultural changes.

Q21. Are there any tradition barriers related to the required changes in your organization's routines that form a challenge for openly sharing your municipality's data? (TBn)
Q22. To what extent do the following situations form a barrier to openly sharing your municipality's data:
- your municipality believes that Freedom of information requests are sufficient for the public to obtain government data? (TB1)
- your organization is reluctant to implement the culture change required for openly sharing government data? (TB2)
- employees in your municipality lack the skills required for openly sharing government data? (TB3)
- employees in your municipality lack the skills required for maintaining openly shared government data? (TB4)
- your organization is reluctant to radically change the organizational processes that would enable openly sharing government data? (TB5)
Q23. Are there any other tradition barriers that form a barrier for your municipality to openly share its data? (TBn)

We will now discuss ***image barriers*** to openly sharing government data. We would like to know whether and how they are relevant to your organization. Image barriers refer to the degree to which an OGD publishing is perceived as having an unfavorable image (e.g., reputation will be damaged due to the publication of low-quality data, associated with incorrect conclusions drawn from OGD analysis etc.)

Q24. Are there any image barriers related to the required changes in your organization's routines that form a challenge for openly sharing your municipality's data? (IBn)
Q25. To what extent do the following situations form a barrier to openly sharing your municipality's data:
- your organization has a negative image of open government data. (IB1)
- your organization believes that open government data is not valuable for users. - (IB2)
- your organization fears that openly sharing government data will damage the reputation of your municipality. (IB3)
- your organization fears that the accidental publication of low-quality data will damage the reputation of your municipality. (IB4)
- your organization fears that associating them with incorrect conclusions drawn from OGD analysis by OGD users will damage its reputation. (IB5)
Q26. Are there any other image barriers that form a barrier for your municipality to openly share its data? (IBn)

Q27. Are there any other barriers that form a barrier for your municipality to openly share its data (not limited to the categories above)?

Open data ecosystem related questions

I will now ask some questions about overall open data ecosystem and potential improvements.

Q28. How do you see the whole open data ecosystem – which actors and what does it include?
Q29. Are you aware of any policy documents or initiatives guiding developments in the field of open data on Estonian or European level (e.g. Estonian Digital State Development Plan)?
Q30. Which actions should be taken at the national level (e.g. Ministry) to help municipalities disclose more open data and comply with the requirements related to open data?
Q31. Which actions should be taken by local governments themselves to improve the publication of open data? (individually or in cooperation)
Q32. What could be the benefit or value of open data in your opinion?

Closing question	yes	no
Would you like to get informed about the results of this study?	☐	☐

Thank you for your participation in this study! We appreciate your time!

III. Codes used in NVivo to analyse the interviews

Table 16. Interview codes used in NVivo

Name	Description	Files	References
Image barriers		12	56
IB1. Negative image of OGD	-your municipality has a negative image of open government data. (IB1)	10	11
IB2. Belief that OGD is not valuable for users	-your municipality believes that open government data is not valuable for users. (IB2)	11	11
IB3. OGD damages reputation of LG	your municipality fears that openly sharing government data will damage the reputation of your municipality. (IB3)	10	10
IB4. Accidental publication of low-quality data damage reputation	-your municipality fears that the accidental publication of low-quality data will damage the reputation of your municipality. (IB4)	11	12
IB5. Incorrect conclusions drawn from OGD	your municipality fears that associating them with incorrect conclusions drawn from OGD analysis by OGD users will damage its reputation. (IB5)	9	9
Other image barriers		3	3
OD ecosystem	questions about overall open data ecosystem and potential improvements	12	66
Actions by LG individually or in cooperation	Q30. Which actions should be taken by local governments themselves to improve the publication of open data? (individually or in cooperation)	12	13
Actions on national level	Which actions should be taken at the national level (e.g. Ministry) to help municipalities disclose more open data and comply with the requirements related to open data?	11	13
Benefit or value of OD	What could be the benefit or value of open data in your opinion?	11	20
OGD ecosystem actors	How do you see the whole open data ecosystem – which actors and what does it include?	10	12
Policy documents or initatives of OGD	Are you aware of any policy documents or initiatives guiding developments in the field of open data on Estonian or European level? Are you aware of Estonian Digital State Development Plan?	8	8
Organization and municipal portal		12	75
Cases of reuse of OD	specific cases, where your municipality's open data was reused by third party	11	21
Challenges of sharing data	. What challenges did your municipality face in openly sharing data	11	15
Drivers to share data on municipal portal		8	8
Process of sharing data	how the process of openly sharing data worked and who within your municipality was or were involved?	11	12
Type of data on municipal portal	What type of data did your municipality share openly and how often?	12	19

Name	Description	Files	References
Organization and national portal		12	28
Cases of reuse of OD	specific cases, where your municipality's open data was reused by third party	1	1
Challenges of sharing data	What challenges did your municipality face in openly sharing data	4	6
Drivers to share data on national portal		3	3
Process of sharing data	how the process of openly sharing data worked and who within your municipality was or were involved?	3	3
Reasons for not sharing data		7	11
Type of data on national portal	What type of data did your municipality share openly and how often?	3	4
Organization of the interviewee	some questions about the organization you are working for	12	33
Role of respondent in LG	What is your role in this municipality?	12	13
Type of data LG collects	What type of data does your municipality collect	12	20
Overall barriers	Are there any other barriers that form a barrier for your municipality to openly share its data (not limited to the categories above)?	9	12
Overall understanding of OD		10	12
Risk barriers		12	94
Other risk barriers		8	8
RB1. Fear of misuse of OGD	-the fear of the misuse of openly shared government data? (RB1)	11	11
RB2. Fear of misinterpretation of OGD	-the fear the misinterpretation of openly shared government data? (RB2)	11	12
RB3. Fear that OGD not reused	the fear that openly shared government data will not be reused? (RB3)	11	11
RB4. Fear of violating data protection	-the fear violating data protection legislation when openly sharing government data? (RB4)	12	13
RB5. Fear that sensitive data is exposed	-the fear that sensitive data will be exposed as a result of opening its data? (RB5)	9	9
RB6. Fear of making mistakes	the fear making mistakes when preparing data for publication? (RB6)	9	9
RB7. Fear that users find errors in data	the fear that users will find existing errors in the data? (RB7)	11	11
RB8. Fear that OGD reduces gains	the fear that openly sharing its data will reduce its gains (otherwise the municipality could sell the data or use it in another beneficial way)? (RB8)	6	7
RB9. Fear that OGD allows competitors benefit	the fear that openly sharing its data will allow its competitors to benefit from this data? (RB9)	3	3
Tradition barriers		12	65
Other tradition barriers		7	9
TB1. Information requests are sufficient	-your municipality believes that Freedom of information requests are sufficient for the public to obtain government data? (TB1)	11	11

Name	Description	Files	References
TB2. Reluctancy to implement culture change	-your municipality is reluctant to implement the culture change required for openly sharing government data? (TB2)	12	13
TB3. Lack of skills for openly sharing data	-employees in your municipality lack the skills required for openly sharing government data? (TB3)	11	12
TB4. Lack of skills to maintain OGD	-employees in your municipality lack the skills required for maintaining openly shared government data? (TB4)	10	10
TB5. Reluctancy to change organisational processes	-your municipality is reluctant to radically change the organizational processes that would enable openly sharing government data? (TB5)	10	10
Usage barriers		12	113
Other usage barriers		11	13
UB1. Inappropriate quality	-an inappropriate quality level of your municipality's data? (UB1)	12	13
UB2. Preparation of data complicated	a complicated process to prepare data for sharing? (UB2)	12	12
UB3. Make data reusable complicated	complicated process to make your municipality's data reusable by others? (UB3)	10	12
UB4. Publishing in OD portal complicated	complicated process to publish your municipality's data on an open data portal? (UB4)	12	13
UB5. Publishing of OD unclear	unclear process of publishing your municipality's data on an open data portal (UB5)	10	11
UB6. Limited functionality of OD portal	limited functionality of open data portals? (UB6)	11	14
UB7. Semi-automate process to share OD	no possibility to semi-automate my municipality's process to openly share its data? (UB7)	12	12
UB8. Maintain data once published	the need and a complicated process to maintain data once published (UB8)	11	13
Value barriers		12	113
Other value barriers		8	9
VB1. OGD not valuable for public	openly sharing government data is often not valuable for the public? (VB1)	12	12
VB2. Datasets not appropriate for reuse	-many open government datasets are not appropriate for reuse? (VB2)	12	12
VB3. Datasets have quality issues	many open government datasets suffer from data quality issues (completeness, accuracy, uniqueness, consistency, etc.)? (VB3)	11	11
VB4. Public gains are lower than costs	the public gains of openly sharing government data are often lower than the costs (VB4)	12	13
VB5. Org. gains are lower than costs	your organization's gains of openly sharing government data are often lower than the costs (VB5)	7	9
VB6. Data prep. too resource-consuming	data preparation is too resource-consuming for your organization? (VB6)	11	11
VB7. OGD provides no value to org.	open government data do not provide any value to your organization? (VB7)	11	11
VB8. Org. OGD provides no value to users	open data that your organization can openly share will not provide value to users? (VB8)	10	13
VB9. Spent resources vs benefits to organization	number of resources to be spent to prepare, publish and maintain open government data outweigh the benefit my organization gains from it? (VB9)	12	12

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15/05/2024