Open Government Data Portal Usability: A User-Centred Usability Analysis of 41 Open Government Data Portals

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Open Government Data Portal Usability: A User-Centred Usability Analysis of 41 Open Government Data Portals

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Abstract

Open government data, as a phenomena, may be considered an important and influential innovation that has the potential to drive the creation of public value via enabling the prevention of corruption, increase in accountability and transparency, and driving the co-creation of new and innovative services. However, in order for open government data to be fully taken advantage of, it must be found, understood, and used. Though many countries maintain open government data portals, the usability of said portals can vary greatly; this is important to understand as the usability of a portal likely impacts the eventual reuse of the data made available there. Acknowledging the importance of portal usability to the data reuse process, this paper helps to elucidate some initial insights by asking two questions: "*How can the usability of open government data portals be evaluated and compared across contexts?*" and "*What are the most commonly missing usability aspects from open government data portals?*". In order to answer these research questions, a subset of 41 national open government data portals were selected for an in-depth usability analysis drawing on the feedback from 40 individual users. As a result of this analysis, the paper is able to make three primary contributions: (1) the validation of a framework for open government data portal usability analysis, (2) develops an initial comparative international ranking of open government data portal usability, and (3) identifies commonly occurring portal usability strengths and weaknesses across contexts.

HIGHLIGHTS

The paper presents a usability study of 41 different unique open government data portals

Highlights the most commonly occurring usability issues associated with open government data portals

Validates a framework for conducting open government data portal usability analysis

Provides an initial ranking of open government data portal usability

Identifies commonly occurring open government data portal usability weaknesses

Keywords— open data, open government data, open data portal, usability.

I.   INTRODUCTION

Governments around the world collect and maintain large amounts of data, but, until recently, much of these data were only accessible via statistical reports, or after requesting them via official processes, such as FOIA (*Freedom of Information Act*) (Schrock, 2016; Noveck, 2016). In order to increase the availability and ease-of-access to data, open government data (OGD) portals[1] are emerging globally at different levels of government e.g. local, state, federal. This increase in OGD initiatives happens for a variety of reasons, in part it is due to increased legal requirements to maintain and release data in an open format (Janssen, 2011), joining international agreements such as the Open Government Partnership (OGP) (Wilson, 2020), due to belief in obtaining benefits from OGD (Toots et al., 2017), or due to an increase in demand for OGD at the citizen level (Kassen, 2019). However, though the availability of OGD is increasing globally, this availability on its own is not enough, something must be done with these data. The value is only created when the data are used or transformed into something else. Thus, for this reason, support must be given to ensuring that OGD are used and transformed, not just published (Janssen et al., 2012). The publication of data should be accompanied by an infrastructure that is capable of processing data in an easy-to-use manner, thus reducing the technical knowledge threshold required to interact and use the data. By adopting a more user-friendly technical infrastructure, that lowers the barriers to participation, it should lead to an increase in usage of the data. These technical infrastructures could, for example, have the ability to aid in the discovery, planning, analysis, and visualization of data.

However, despite the fact that OGD portals are becoming increasingly common, and it is known that OGD portals serve as the primary interaction point between the data provider and the data users, these OGD portals themselves have been the subject to criticism. It has been pointed out that OGD portals offer a low level of usability for non-technical users (Osagie et al., 2017) and that the overall user-friendliness of these portals is often lacking see, for example (Nikiforova, 2020a, 2020b; Purwanto et al., 2020b; Welle Donker et al., 2017; Boychuk et al., 2016; Zuiderwijk et al., 2012; Tinholt, 2013). In order to get around rampant usability issues, many have begun to make the recommendation about user-centred design, and involving users in the development process to help increase the awareness and reuse of OGD (OECD, 2019). However, there are significant challenges to doing this, for example, culturally, there may be a lack of trust and confidence in OGD or about the need to involve users in the design process (Toots et al., 2017; Ruijer and Meijer, 2020; Meijer, 2015). Other potential challenges for usability are directly related to data quality issues which drive lack of participation with OGD (Young and Yan, 2017), e.g. if data quality is low and unusable, there is no desire to work with OGD, if there is no desire to work with OGD then there is no need to make it usable, and so it goes. On the other hand, studies have also found that the opposite is true, if there has been successful past experience with OGD, then users and providers are more likely to release and interact with OGD (McBride et al., 2019).

As the prominence of OGD continues to rise around the world, there has been a rapid development of an entire ecosystem, both private and public, focused on delivering OGD in an easy and user-friendly manner. For example, in the United States, many municipal governments have partnered with the firm Socrata to streamline their opening process (Neumaier et al., 2016). Internationally, the *de-facto* standard for OGD portals is CKAN

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[1] OGD may be understood as "data that is created and provided by a government, offered with a reusable license, is human readable, machine understandable, and released without discrimination or cost to the public" (McBride, 2020, p.8) and an OGD portal, then, is simply a website or service that makes data of this nature available publicly.

(CKAN, 2020); however, the front-end that is built on top of this varies differently across portals, leading to different levels of usability, but with similar technical baselines across portals in the backend. In practice, this ensures a high level of technical interoperability across OGD portals as CKAN has set metadata standards and tools to allow interaction amongst portals and users. This would seem to raise a hint that, when it comes to OGD portal usability, especially amongst portals using CKAN, the technical and backend usability aspects may be similar (such as metadata provision), with the real difference emerging in how the front-end is implemented.

User friendly portals, such as those offered by Socrata, are important, as they play a crucial role in the re-use of OGD (Martin et al., 2013), which logically implies that portals that are more user friendly and usable are likely to lead to higher levels of value creation and those that are less usable will lead to lower levels of value creation. To say this in another manner, it is likely to be the case that a portal with a smaller number of datasets, but which are highly relevant and easy to use, will create more public value than a portal with a larger number of datasets that are less findable and usable (McBride et al., 2020; Luthfi et al., 2020). In this case, OGD portals should not just be about the provision of large amounts of data, but should assist the user in finding the data that they need or desire. While oftentimes citizens are thought of as the primary users of OGD, they are not the only ones. Companies use OGD. Governments use OGD. NGOs use OGD. Each of these user groups are likely to have different needs and desires for OGD portal functionality, for example, to a private sector company, having easy access to an API may be of high importance, whereas a citizen user may just wish to download visualizations from a CSV. For this reason, OGD portals must ensure a high level of usability across audiences and stakeholder groups to ensure higher levels of data reuse.

While there have been some international comparisons of OGD portals, such as those offered by the European Data Portal (European Data Portal, 2020) or the Open Data Barometer (Open Data Barometer, 2018), many of these do not focus specifically on the usability of the portal itself, but, rather, take more holistic approaches also exploring the legal environment, amount of data released, etc. However, as has just been discussed, the usability of these portals is likely to be of high importance for OGD users, and, therefore, this research aimed to provide a user-centred comparative analysis of the usability of OGD portals.

For the purpose of this study, 41 different national OGD portals were selected, and then 40 participants analysed each portal using a benchmarking framework for usability as proposed by (Máchová et al., 2018). In regard to the research questions, there were primarily two: (RQ1) "*How can the usability of OGD portals be evaluated and compared across contexts*?", and (RQ2) "*What are the most commonly missing usability aspects from OGD portals*?" As for the framework used in the study to answer these questions, it consists of three primary dimensions, (1) open dataset specification, (2) open dataset feedback, and (3) open dataset request, and fourteen sub-criteria. It is hoped that by following this framework, by involving a number of participants in the evaluation process, and by comparing these across contexts it will be possible to elucidate some best practices, as well as ideas about what usability issues are currently commonly found, when it comes to the overall usability of OGD portals. An initial first step in this research has already been taken in (Nikiforova, 2020a). This paper, however, makes the following contributions: (a) it increases the understanding about the current state of OGD portals, (b) it presents the validation of the usefulness of a previously created framework for OGD portal usability evaluation, and (c) it draws out key ways to improve the usability of OGD portals.

In order to achieve these contributions and meet the aims of this research, the paper is organized in the following way: an overview of current state of the art is presented in section 2, the methodology for the research is provided in section 3, the initial results and discussion

are brought forth in section 4, and the paper concludes in section 5 highlighting future directions for research and clarifying the primary contributions of this paper.

II. BACKGROUND

A. *Benchmarks and indexes*

When it comes to evaluating the success of OGD within a specific country, a few different benchmarks and indices have been proposed and implemented, the most known of which are the Global Open Data Index, the EU Open Data Maturity Report, the OECD's OURData index, and the Open Data Barometer. Each of these studies looks at and reports the level of achievements of OGD within a specific country, while the OGD portal itself may be a part of the score, the usability of said portal is often not a specific indicator. A majority of these studies have experts who evaluate OGD initiatives or have the studied governments self-report, which is subsequently verified by experts. This leads to a situation where governments focus their OGD initiatives and portals to maximize points on these international rankings, which does not necessarily translate into portal usability. In the following paragraphs each of these ranking systems is discussed in more detail.

The Global Open Data Index (GODI) was a study conducted by the Open Knowledge Foundation and aimed to understand the global state of OGD. The study itself, though, was limited specifically to the question of "*How do governments around the world publish open data*?" (Open Knowledge Foundation, 2017). While this is an interesting question, it falls short in that it associates the publication of data as inherently *good* and the non-publication of data as inherently *not good*. However, as a recent study by Schnell (2020), pointed out that opening up of data can actually allow for autocratic regimes to "feign" openness. Thus, it is not just about what data are released or how, but what can be done with them. In any case the GODI report itself has not recently been updated, with the latest version being released in 2017 using 2016 data. There is no explicit focus on portal usability in this study, but may touch on it indirectly by giving points for up-to-date metadata, presence of a license, and availability of data.

In Europe, the European Data Portal (EDP) carries out an annual evaluation of the national open data portals. The EDP itself acts as a phonebook of sorts for OGD portals within European countries, it harvests datasets and portals and allows all of this to be searched from a single place. The EDP's open data maturity report (European Data Portal, 2020) assesses OGD initiatives on four key aspects, policy, portal, impact, and quality. Similar to the GODI, portal usability is not the explicit focus of the study, but it is touched on in the "portal" aspect of the index where four key indicators are analysed: portal features, portal usage, data provision, and portal sustainability. While *aspects* of usability are touched on here, usability of the portal is never the explicit focus of any of the questions. So, while more exhaustive and up-to-date than GODI, the EDP's evaluation also does not offer a direct way to measure portal usability.

A third OGD evaluation is that of the OECD's OURData index (OECD, 2020). This evaluation explores OGD initiatives within the OECD countries on three different categories: data availability, data accessibility, and government support for data re-use. The methodology for this evaluation is described in (Ubaldi, 2013). Similar to the other indices and measures, portal usability is only tangentially touched upon and never the focus of specific questions. However, the OECD does note that many portals are seen simply as front-end websites with no need for interaction with users, but makes the recommendation that "OECD governments should conceive OGD portals as open, democratic and diverse spaces to engage the digital community in order to fully embrace 'open by default' and 'government as a platform'

approaches" (OECD, 2020). In this way, the OECD does help to highlight the importance of portal usability and, perhaps, future studies will take this into account more directly.

A final example of an OGD evaluation is that of the Open Data Barometer, which aims to provide a snapshot of OGD practices from around the globe, and is organized by the World Wide Web Foundation (Open Data Barometer, 2018). The Open Data Barometer focuses on open data readiness, implementation, and emerging impacts and looks at these categories within 30 selected countries (these are countries that have all signed the open data charter). Here, again, the usability of the portal is never an explicit focus and, if dealt with at all, is only done so in an indirect manner.

What can be seen is that, though there are quite many different means to evaluate OGD initiatives, they do not deal directly with the usability of OGD portals themselves and focus rather on the political aspects of OGD. In this way, these evaluations are less about *how useful OGD are for its users*, but, rather about *how good of a job at making data open or making policy to support opening of data*; these are not necessarily the same thing. While many of these studies also explore the impact of OGD, such as by exploring created applications or services that use OGD, by ignoring the usability and user-centred perspective on these evaluations it is not possible to get an accurate picture of impact. Thus, it can be argued that in addition to these higher-level evaluations, a lower-level user-centred usability evaluation across countries would be of high value for governments (in line with (Osagie et al., 2017; Nikiforova, 2020a)).

B.   Relevant Background Literature

In the current scientific body of knowledge, a majority of the papers evaluate OGD from a specific perspective, such as releasing data that corresponds with a specific definition of OGD, exploring the type of data released, monitoring compliance and adherence to OGD policy commitments, or the performance of OGD portals (the definition of performance often varies, but often times it is based on some combination of OGD portal usage, visitors, data downloads, or created services, where more is considered to be a higher level of performance). Some papers often create frameworks for the assessment of concrete outcomes related to OGD, such as increased levels of transparency or accountability (Zuiderwik and Janssen, 2014; Lourenço, 2015). Many of these papers discuss how data providers have made changes to facilitate user friendliness, but have not actually consulted or discussed with users themselves, thus making it appear that there is a broad lack of a users' perspective (Osagie et al., 2017). There are some examples of the user perspective being explicitly sought after and included, such as (Zuiderwijk et al. 2012; Welle Donker and van Loenen, 2017), but these papers primarily are related to the drivers and barriers associated with the usage of OGD, and may focus more on a users' beliefs, rather than their ability.

Though there has been a high amount of research on OGD initiatives at different levels of government, according to Attard et al. (2015), a large majority of this research is focused on their own national OGD initiatives. Within this type of research, e.g. single case studies on OGD initiatives, portal usability may itself emerge as part of the study, but it is almost never the focus. Examples of this OGD initiative case study focus can be found for countries such as Australia (Liu et al., 2011), Austria (more precisely, Vienna) (Egger-Peitler et al., 2014; O'Hara, 2014), Brazil (Matheus et al., 2012a, 2012b, 2014), Colombia (Prieto et al., 2012; Rojas et al., 2014; Sanabria et al., 2014), Estonia (McBride et al., 2020), Germany (Marienfeld et al., 2013), Greece (Alexopoulos et al., 2013), India (Vasa et al., 2014), Italy (Palmirani et al., 2014), Latvia (Nikiforova, 2020b), Mexico (Arcelus, 2012), Poland (van der Waal et al., 2014), Sweden (Stockholm and Skellefteå) (Jetzek et al., 2014), and Taiwan (Lin et al., 2014).

While empirical research of this nature can be interesting, it is important to take a broader and more comparative approach to OGD to continue to move our understanding of the topic forward. Additionally, as most of these studies adopt different frameworks, there is no common or unified methodology that allows for a cross country comparison from this previous research. In regard to studies that specifically focus on OGD portals, many studies are limited to a specific aspect of the portal, for example exploring the availability of "5-star" datasets (Martin et al., 2013; Colpaert et al., 2013; Matheus et al., 2012), timeliness and machine-readability of datasets (Nikiforova, 2020c), while some studies provide a brief summary on licencing and machine processability of EU27 open data portals (Petychakis et al., 2014), or standard terms used in public data for South Korea (Kim, 2019).

When it comes to studies focusing explicitly on the usability of OGD portals, there is not a large number of studies to draw on. Some studies, such as Matheus & Janssen (2020), focus on how OGD can drive transparency and highlight on portal usability as one aspect of this, writing that portal usability is "the degree to which OGD portals are able to be used or are fit for use by citizens" and that "higher usability will result in higher levels of transparency" (p. 516). Similarly, Attard et al. (2015) in their systematic literature review of open government data initiatives explore briefly the concept of "usability", but rather focus on the usability of the data itself, not the portal that makes them available. Though these concepts may be similarly related, there are significant differences between the two that do not allow them to be compared directly. This focus on dataset usability has been adopted as well by authors such as Dawes et al. (2016) who explore usability on four primary dimensions "data format, metadata, means of access, and dataset quality" (p. 20). A final paper touching on OGD usability is that by Weerakkody et al. (2017) who acknowledge that there has been little to no empirical research on OGD usability, and aim to address this gap; that paper, though, similar to the others, does not touch on the actual usability of a portal itself.

Thus, whilst there has been empirical work studying open government data, open government data portals, and open government data usability, there is not a large volume of readily identifiable literature focusing specifically on the usability of OGD portals. In this situation, it becomes clear that there is a need for research that a) utilizes a users' perspective, b) uses a unified framework for evaluation thus allowing comparison to take place and further improve the external validity and generalizability of the research, and c) encompasses different aspects of portal usability, e.g. requiring a more holistic or systemic framework.

One such framework that appears to suit these requirements, is that of Máchová et al. (2018), which presents a user-centred methodology for evaluating the usability of OGD portals across contexts and countries. The framework offered by these authors consists of three primary dimensions and fourteen sub-criteria that are thoroughly embedded in previous academic studies thus ensuring a high level of validity.

Though the components of this were discussed earlier on in this research paper, it is important to highlight the primary reasons why it was deemed a suitable approach for answering the research questions and addressing the current gap in the field. Firstly, the proposed methodology is relatively new and therefore up-to-date, secondly, it is well cited and published in peer reviewed journals, thirdly it describes all components of the study enabling replication and validation, and finally it is a user — based analysis. By adopting this framework, it is possible to simultaneously answer the research questions posed in this paper, but also validate and replicate this proposed methodology, which, if successfully validated, strengths and justifies its continued use in future studies.

III.   METHODOLOGY

Methodologically, this paper adopted a user-centred evaluation approach based around the framework that was initially proposed by (Máchová et al., 2018). The paper itself proposed a usability evaluation framework consisting of three categories and 14 criteria, each of these is explained and shown below in Table 1. It should be also noted that the selection of criteria and measures for their framework was motivated through (a) daily tasks performed by typical OGD portal user, (b) the series of other studies heavily embedded within the work of scholars focusing on similarly related issues (e.g. website portal usability, open government data, transparency, data accessibility, etc.) such as Zuiderwijk and Janssen (2015), Alexopoulos et al. (2014), Charalabidis et al. (2014), Ubaldi (2013), Kubler et al. (2016), Kučera et al. (2013), Lourenço (2015), Maali et al. (2010), Máchová and Lněnička (2017), Petychakis et al. (2014), Heath and Bizer (2011), Millette and Hosein (2016), Hogan et al. (2017), Van der Waal et al. (2014). In the original paper by Máchová et al. (2018) the framework was tried and tested on a small subset of OGD portals: Australia, UK, India, Canada, and USA. Though the framework itself was tested, the authors themselves note that more research was needed and that it too must utilize a user-centred evaluation. Thus, building off of this, this paper aimed to take this framework, apply it at a larger scale with more participants and more countries, and discuss the validity of such an approach.

Table 1. Protocol. Source: Máchová et al., 2018

Category	Aspect	Description	Assessment *1 to 3 points fulfilled = 3, partially fulfilled = 2, unfulfilled = 1*
Open dataset specification	**a) Description of dataset**	Portal provides datasets together with their description and how and for what purpose they were collected	
	b) Publisher of dataset	Portal provides information about organization that published datasets	
	c) Thematic categories and tags	Portal provides thematic categories of datasets to address the main topics covered. It distinguishes categories (themes) from tags (keywords)	
	d) Release date and up to date	Datasets are associated with a time or period tag, that is, date published, date updated and its frequency	
	e) Machine-readable formats	Portal provides datasets formats that are machine-readable and allow easy re-use	
	f) Open data licence	Portal provides license information related to the use of the published datasets	
	g) Visualization and statistics	Portal provides visualization and analytics capabilities to gain information about a dataset, e.g. in charts or visualizations in maps.	
Open dataset feedback	**a) Documentation and tutorials**	Portal provides high quality of documentation and tutorials to help users	
	b) Forum and contact form	Portal provides an opportunity to submit feedback on a dataset from the users to providers and forum to discuss and exchange	

		ideas among the users	
	c) User rating and comments	Portal provides capabilities allowing the collection of user ratings and comments	
	d) Social media and sharing	Portal provides the integration with social media technologies to create a distribution channel for open data and sharing feedback	
Open dataset request	a) Request form	Portal provides a form to request or suggest new type or format type of open data	
	b) List of requests	Portal provides a list of requests received from users, including the current state of request processing	
	c) Involvement in the process	Portal provides capabilities allowing the involvement in the same dataset	

The research in this paper included the five countries used by Máchová et al. (2018), but also included in the evaluation the portals included in the analysis of the European Data Portal (EU 28+), and countries that have been identified as having achieved a high level of usability on their OGD portals (Taiwan, Colombia, Russia, New Zealand, and Japan) for a total of 41 countries to be analyzed. In order to test the usability of each respective OGD portal, a total of 40 participants were used. These participants were approached via a non-probability sampling approach according to "consecutive sampling" in which participants are selected for the purpose of the study if they meet certain practical criteria. For this study, having an IT background was an inclusion criteria until the required sample size was achieved - in the case of the study, 40 individuals were chosen as such an experimental design normally requires 30 participants or more to allow drawing objective conclusions (Roscoe, 1975).

The participants all attended a workshop on Open Data and Data Quality delivered by one of the authors of this study and a majority are students in the Faculty of Computing for bachelors degree studies working in the IT industry for at least 1 year ranging to very experienced IT-specialists; these participants could be said to have a high level of domain knowledge. This also means that the sampling had also "convenience sampling" characteristics. All participants contributed on a voluntary basis and the group was largely heterogenous in terms of both age and gender. Before the evaluation took place, each participant was given the same overview of the framework so that all concepts were understood and clear before the evaluation took place. This was done during a 45 minutes session addressing framework to be applied in terms of the categories, aspects, and evaluation method. This session was followed with a Q&A session during which participants were able to ask their question. As a typical user of an OGD portal tends to be more inclined to and experienced with IT (Young and Yan, 2017), students (and IT experts) were viewed as a highly relevant target user group for OGD portals, that is also in line with (Máchová et al., 2018). Keeping this in mind, this paper could then be considered a user-centred usability study, as proposed by (Nielsen, 1994).

As for the set of portals addressed by every participant, this was prepared considering randomization in terms of the sequence of portals to be addressed by participants. This was done because it is known that repeated-measures designs have such disadvantages as "carry-on", biasing, order effects from one condition to another and participants can become fatigued or bored. To avoid mentioned effects therefore all stimuli, which are portals to be assessed in this case, were randomized. This also allows to avoid so-called "learning effect", which can be caused by previously taken assessment.

As described in (Máchová et al., 2018), this paper also used a three-level Likert scale (fulfilled = 3, partially fulfilled = 2, and unfulfilled = 1) for each of the tasks in the framework. By combining the scores across categories and criteria it is possible to: (1) rank the usability of countries' OGD portals, (2) conduct the relevant statistical analysis, and (3) explore and orient the discussion and analysis at different levels of abstraction (e.g. at the categorical and criterial level).

Every participant was asked to fill a prepared protocol for every portal participant has assessed (Table 1). As a result, a set of 1640 (40 participants x 41 portals with one protocol per portal per participant) protocols were obtained and were further processed to get the summarised results per portal (see [dataset: Nikiforova, 2020]).

The overall level of satisfaction with the experiment was high, with 95% of the 40 participants rating the experience as both useful and interesting with some participants also highlighting that the knowledge gained from their participation was valuable for their future work and research. In regard to the actual analysis of the portals, the mean time for completion of one protocol was 37.5 minutes. However, when portals were not available in English, it slowed down the analysis of the portals; this was particularly apparent in Iceland, Croatia, Sweden, Taiwan, and Japan. In these instances, the assessment of the portals took up to two hours. While the absence of English would not be an issue for a native citizen's use of their own countries portal, this does significantly hamper the usability of the portal for other stakeholder groups (for example, expats, international stakeholders, speakers of other languages, etc.).

Naturally, there are some potential limitations with the current study. Firstly, due to using students who self-selected into the workshop it could be argued that there are issues with objectivity. However, for the aforementioned reasons on the size of the study, randomization of portal analysis, a pre discussion with the participants, and their expertise and knowledge, it is possible to help ensure higher levels of objectivity. Secondly, the (Máchová et al., 2018) framework seems to provide a subjective view of each individual involved and, in some cases, the assessment may not be objective. In addition, there is no mechanism to control whether certain aspect is not covered in the portal as the individual has assessed it, or the individual simply did not find where and how it is implemented. However, considering that this is a usability evaluation, such cases are acceptable and should be taken into account, since a low assessment may indicate aspects that are unlikely to be found by "normal/ typical" portal user. Thirdly, as mentioned above, language could play an issue, as well as the evaluators being unfamiliar with the local context. However, the use of outsiders for a usability analysis may actually be a positive as it removes potential bias and, additionally, if outside users are able to manage to quickly understand and use the portal, it would highlight the usability of the portal even more so. Finally, it must be pointed out that in this analysis each category and measure is given equal weight in the analysis, in the future, it may well be of interest for scholars to attempt to discern how different aspects and measures influence the overall usability of the portal, however this is beyond the scope of this current research.

The analysis of the results was done in a quantitative and statistical manner. The respective scores for each category were summed to get an absolute score, but also across portals the average was calculated. By adopting the discussed approach, it allows for both RQ1 and RQ2 to be addressed, explored, answered, and discussed in detail and back up with the appropriate statistical and quantitative evidence. The results of the analysis of this study are presented in the following section.

IV. RESULTS AND DISCUSSION

The overall score for a given country's OGD portal could range from 14 to 42 points. As a result of the conducted usability evaluation, the mean score was 29.77 out of 42 points, the median was 30.13, the maximum score was 38.07 in Cyprus, and the minimum was 22.58 points in Malta. With no portal scoring a perfect number of points, and with the average portal receiving a score of around 71%, there is a clear need for improvement when it comes to portal usability.

Figure 1 shows the average score breakdown by category i.e. **(1) open dataset specification, (2) open dataset feedback**, and **(3) open dataset request**. As can be seen, the category with the poorest performance is that of **open dataset request** (Figure 1, "AVG category III"). This is fairly expected and logical because, as previously noted, many OGD portals and initiatives are simply about making data available, not ensuring interactivity or use. This is partly a flaw with how OGD initiatives are regulated, where priority is given to simply increasing the number of datasets available. However, it is also important that OGD users have the ability to interact with the datasets, request data, and see what other data have been requested.
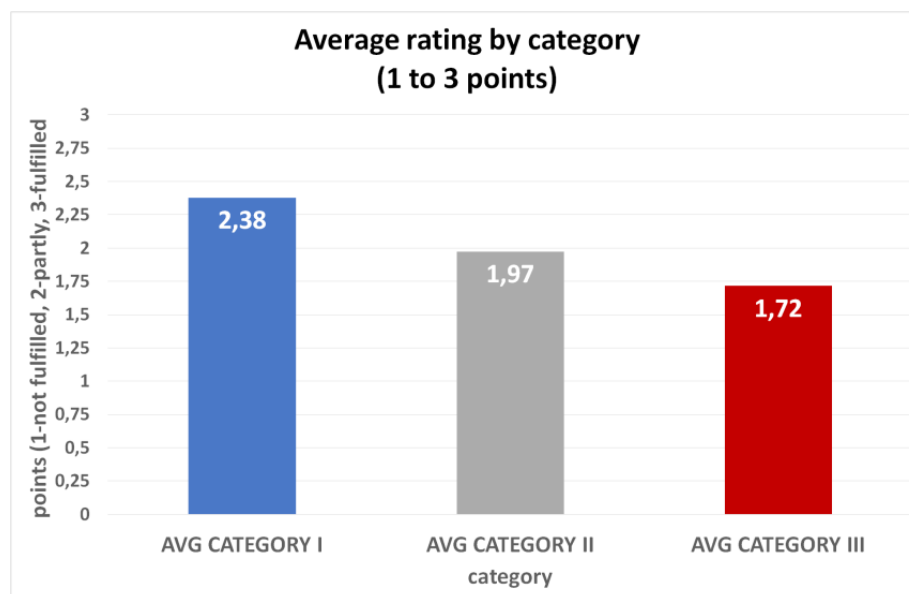

Fig. 1. The average score breakdown by category

On the other hand, the best performing category, **open dataset specification** (Figure I, "AVG category I"), has a fairly high average score of 2.38 out of 3 points; within this category, the highest scoring country was Cyprus with a score of 2.88 out of 3, whereas Malta scored the lowest with 1.77 out of 3 points. The high level of performance in open dataset specification is, once again, something that could be somewhat expected, especially given the selection of portals primarily coming from the EU, where there are set standards for metadata which are used for regulating OGD. However, though certain requirements may be met, the quality behind them is not necessarily there. For example, during the course of the analysis, many dataset descriptions, though present, were deemed to be not sufficient. Oftentimes the dataset description simply was the title of the dataset pasted into the description field or was extracted from the dataset itself and not given any context, thus limiting its usability and understandability (this is in line with (Nikiforova, 2020b)). The worst scoring aspect of category one was related to "*Visualization and Statistics*", receiving an average score of 1.75 out of 3. This is unfortunate as allowing the direct visualization and analysis of statistics on the portal itself is one way in which it is possible to drastically improve the usability of the data itself, but also the interaction and uptake of OGD use by OGD users, especially those

who are not highly technically inclined. The absence of visualization and statistics could be due for technological reasons, for example the portal has no technical capability to do it, or data quality issues, perhaps a large set of datasets are not machine readable.

A country by country scoring of category one and its components is showed below in Figure 2, where the blue zone indicates a portal that has scored an average of more than 2.6 out of 3 points (more than 87%), the grey zone is for countries that are better than average, but below 2.6, and the red zone is for countries that are below average.
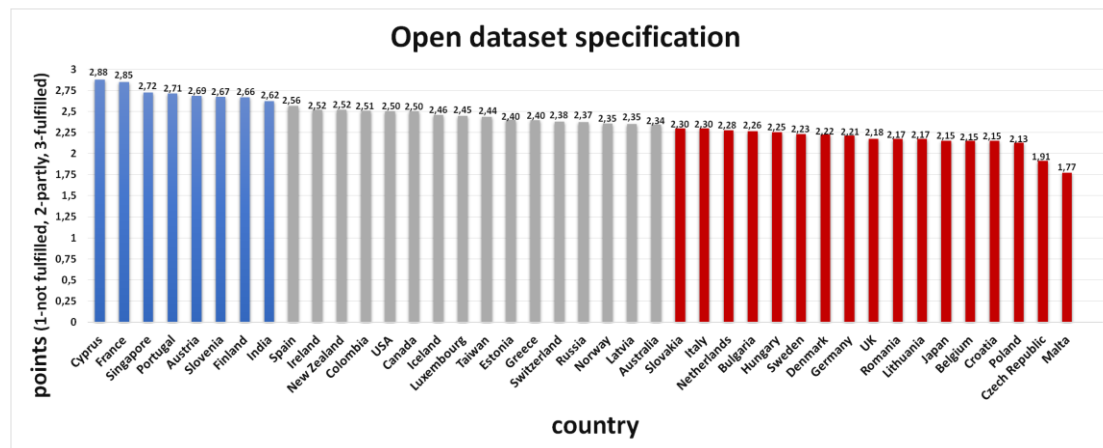

Fig. 2. The score breakdown of "Open dataset specification" category by country

In regard to the second category, **open dataset feedback**, an average score of 1.97 out of 3 was received, the scores ranged from a low of 1.22 in Bulgaria to a high of 2.89 in Austria. The OGD portals had the highest average score for *"Documentation and Tutorials"* (2.19 out of 3) and the lowest score for *"Social Media and Sharing"* (1.16 out of 3). In some situations, OGD portals may have documentation available, especially for government users to add or access data, or, at the very least, some sort of contact page about where to get more information. Some portals have specific documentation pages, such as *data.gov.uk*, whereas other portals simply offer FAQs and small descriptions about what OGD are. For portals that scored poorly, the most common reason was due to not having clearly defined documentation pages and/or documentation that was not able to be understood (e.g. only technical documentation is published, which is targeted at data providers, rather than data users). Generally speaking, there is a lack of tutorials about portal usage and OGD usage across a majority of the portals.

In regard to the lower performing score, related to *"social media and sharing"*, there is little integration between social media and many of the OGD portals. Some portals, such as Estonia, have links on every dataset that allow users to share directly to Facebook or tweet to Twitter, but it is limited in that it is not possible to follow the social media discussion on the OGD portal or monitor who or how often these share objects have been used. Interestingly, though one of the most frequently discussed challenges for OGD portals is the lack of feedback between OGD users and OGD providers (Smith et al., 2018), many of the studied OGD portals had direct mechanisms in place to contact the holder or publisher of each dataset. However, though it is possible to initiate this contact, it is not clear whether users receive feedback after making a request, or how data providers / holders handle this feedback; feedback for a specific dataset was not available to the public. This is something that should and could be changed as it is one way to both simultaneously increase the usability of the OGD portal, but, also help increase citizens' trust in the OGD portal itself (Purwanto et al., 2020a, 2020b). A country by country ranking for category two is shown below in Figure 3.
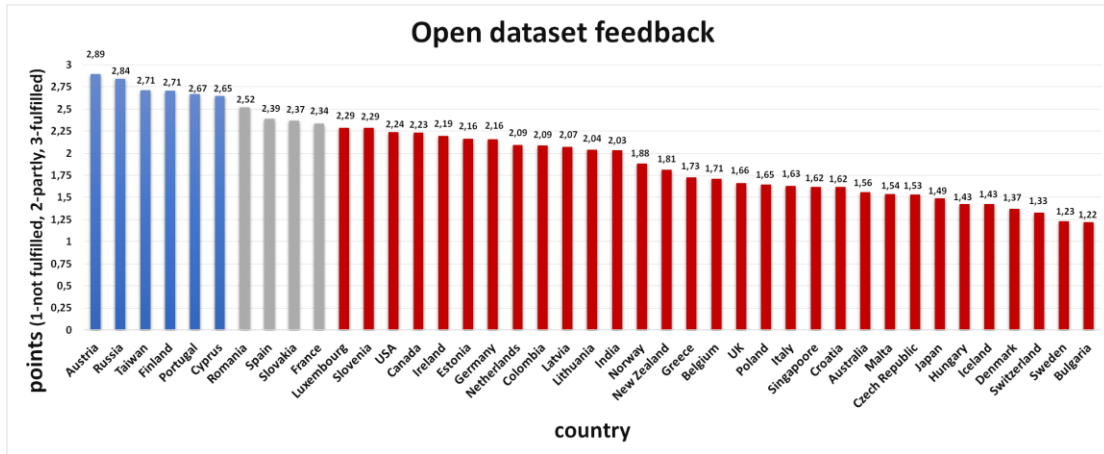
Fig. 3. The score breakdown of "Open dataset feedback" category by country

The final category, **open dataset requests**, had an average score of 1.72 and ranged with a low of 1.0 in Hungary and Denmark to a high of 2.92 in New Zealand. Within this category the highest average score was 2.06 out of 3 for *"Request Form"* and the lowest was 1.54 out of 3 for *"Involvement in the Process"* as this third category is the category that is most heavily related to direct involvement with OGD users, and it is known from the literature that OGD users and OGD providers tend to have little interaction, it makes sense that the lowest score here would be related to the involvement in the process. In essence, the scoring associated with "*Involvement in the Process*" was looking for when users were allowed to be directly involved with a dataset, for example helping move the dataset from request through to availability, commenting directly on specific data points, or helping even to gather data. However, as can be seen from the analysis, there is little effort currently being given to helping datasets be requested and other ways of involving the user in the OGD process. In fact, in majority of the 41 portals analysed, there was no option to request a dataset. One positive example to highlight that stands apart from this trend, is that of Ireland, which allows for data requests to be sent and also allows for these requests to be commented on, thus OGD providers can have discussions directly on the portal with the OGD requester(s)/user(s). Figure 4 shows the country by country score for category three of the analysis.
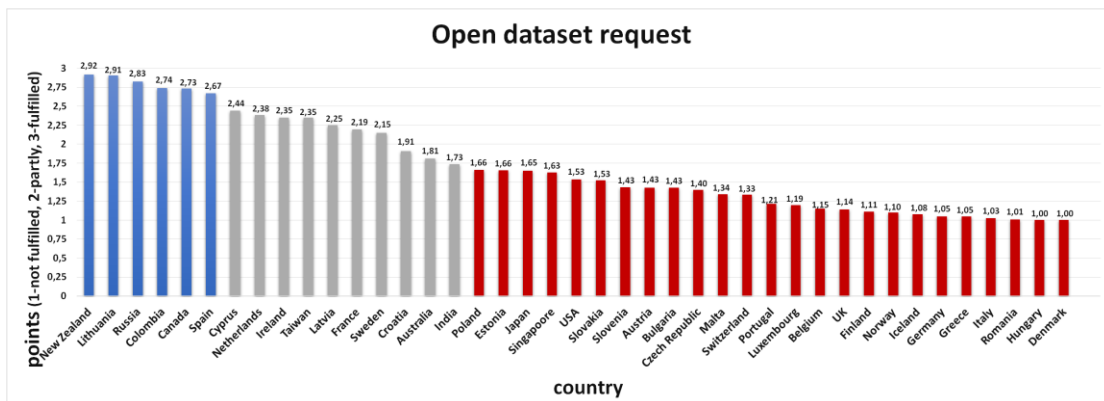

Fig. 4. The score breakdown of "Open dataset request" category by country

An additional table, Table 2, has also been generated and shows the top 5 countries for each category of the analysis. No country appears in the top five for all three categories, but Austria, Russia, and Portugal all appear in two out of the three categories in the top 5.

Table 2. The TOP-5 portals by the category

Category	TOP 5
I. Open dataset specification	*Cyprus, France, Singapore, Portugal, Austria*
II. Open dataset feedback	*Austria, Russia, Taiwan, Finland, Portugal*
III. Open dataset request	*New Zealand, Lithuania, Russia, Colombia, Canada*

Table 3 summarises the results of the analysis for all countries that were gathered by following the analysis framework (for all data see [dataset: Nikiforova, 2020]). The only deviation is in the second column, where data regarding available languages with notation corresponding with ISO 639-1 (two-letter codes) has been included. This was not addressed in the (Máchová et al., 2018) framework, however, as according to (Attard et al., 2015) and (Zuiderwijk et al., 2015), language is an important success factor associated with OGD initiatives and is directly related to usability and the facilitation of data reuse, it was decided to include it in this study as well. In this study, 39% of the portals analysed were available in only one language and 43.75% of them were available in English. Though some portals were multilingual, it should be noted that even if the portal was available in more than one language, only part of its content is sometimes translated, most of the information was still provided in the main language.

Table 3. The results of the analysis for all countries

Country	Language	Total	AVG	1a	1b	1c	1d	1e	1f	1g	AVG I	2a	2b	2c	2d	AVG II	3a	3b	3c	AVG III
Cyprus	EL, EN	38,08	2,72	2,90	3,00	3,00	2,83	2,68	2,88	2,88	2,88	2,80	2,00	2,90	2,90	2,65	2,83	2,53	1,98	2,44
Russia	RU, EN	36,45	2,60	2,05	2,70	3,00	2,20	2,90	2,10	1,65	2,37	2,60	2,95	2,90	2,93	2,84	2,88	2,80	2,80	2,83
France	EN, FR, ES	35,88	2,56	3,00	2,98	2,93	3,00	2,98	3,00	2,08	2,85	2,23	2,95	2,93	1,25	2,34	1,80	2,25	2,53	2,19
Spain	ES, CA, GL, EU, EN	35,51	2,54	2,88	2,18	3,00	2,90	2,10	2,73	2,18	2,56	2,58	2,00	2,05	2,93	2,39	2,73	2,69	2,59	2,67
Taiwan	EN, TW, CN	34,95	2,50	2,15	2,33	2,28	2,78	2,30	3,00	2,23	2,44	2,82	2,78	2,75	2,50	2,71	2,53	2,28	2,25	2,35
Austria	AU	34,66	2,48	2,75	2,33	3,00	2,98	2,83	3,00	1,93	2,69	2,78	2,98	2,83	3,00	2,89	2,03	1,09	1,18	1,43
Canada	EN, FR	34,65	2,48	2,23	2,50	2,68	2,98	2,15	2,93	2,08	2,50	2,08	2,15	2,90	1,80	2,23	2,88	2,58	2,75	2,73
Colombia	ES, EN	34,13	2,44	2,85	2,28	2,78	2,68	1,95	2,75	2,28	2,51	2,30	2,10	1,93	2,03	2,09	2,80	2,85	2,58	2,74
New Zealand	EN	33,65	2,40	2,83	2,90	2,98	2,05	2,03	3,00	1,88	2,52	2,65	1,05	1,00	2,55	1,81	2,95	2,93	2,88	2,92
Ireland	EN, GA	33,48	2,39	2,90	2,20	2,55	2,55	2,35	2,90	2,20	2,52	1,98	2,73	2,15	1,93	2,19	2,93	2,08	2,05	2,35
Portugal	EN, FR, ES, PT	33,29	2,38	2,65	2,93	3,00	2,63	2,00	3,00	2,78	2,71	3,00	3,00	2,25	2,43	2,67	1,24	1,10	1,30	1,21
Finland	FI, SV, EN	32,80	2,34	2,83	2,28	2,93	2,85	2,23	2,73	2,83	2,66	2,90	2,88	2,18	2,88	2,71	1,28	1,03	1,03	1,11
Slovenia	SL +in-built Google Translate	32,15	2,30	2,98	2,78	2,78	3,00	2,93	2,93	1,33	2,67	2,25	2,00	1,97	2,93	2,29	1,53	1,00	1,78	1,43
Lithuania	LT, EN	32,07	2,29	2,33	2,30	2,80	1,83	2,15	2,05	1,75	2,17	2,13	1,93	1,83	2,28	2,04	2,95	2,90	2,87	2,91
India	EN	31,68	2,26	3,00	2,28	2,98	2,13	2,90	2,88	2,20	2,62	2,00	2,05	1,18	2,90	2,03	3,00	1,03	1,18	1,73

Country	Lang																			
Latvia	LV, EN	31,48	2,25	2,07	2,74	2,36	2,90	2,10	3,00	1,26	2,35	1,98	2,02	1,76	2,52	2,07	2,83	1,88	2,05	2,25
Netherlands	NL	31,45	2,25	2,78	2,23	2,68	2,13	2,00	2,80	1,33	2,28	2,43	2,00	1,15	2,80	2,09	2,75	2,23	2,18	2,38
USA	EN	31,08	2,22	3,00	2,30	3,00	2,33	2,00	2,85	2,05	2,50	2,88	2,05	1,03	3,00	2,24	2,30	1,23	1,08	1,53
Estonia	EE, EN	30,41	2,17	2,00	2,03	2,03	3,00	2,05	2,97	2,73	2,40	2,08	2,85	1,05	2,68	2,16	2,15	1,08	1,74	1,66
Singapore	EN	30,40	2,17	2,93	2,65	2,38	3,00	2,23	3,00	2,88	2,72	1,58	1,73	1,00	2,18	1,62	2,18	1,60	1,10	1,63
Slovakia	SK, EN	30,13	2,15	2,00	2,20	2,18	2,80	2,03	2,90	1,98	2,30	2,28	1,93	2,30	2,98	2,37	1,83	1,15	1,60	1,53
Luxembourg	EN, FR	29,86	**2,13**	2,80	2,93	2,90	2,90	2,00	2,48	1,13	2,45	2,18	2,88	2,28	1,83	2,29	1,18	1,15	1,26	1,19
Romania	RO, EN +23 more*	28,30	**2,02**	2,00	2,70	2,05	2,13	2,03	2,80	1,50	2,17	1,40	2,93	2,83	2,93	2,52	1,03	1,00	1,00	1,01
Australia	EN	28,06	**2,00**	2,97	2,59	2,00	2,05	2,18	2,44	2,15	2,34	2,05	2,00	1,18	1,00	1,56	3,00	1,00	1,44	1,81
Norway	NO	27,30	**1,95**	2,98	2,25	2,35	2,20	2,15	2,90	1,65	2,35	2,33	2,00	1,80	1,40	1,88	1,15	1,00	1,15	1,10
Germany	DE	27,25	**1,95**	2,60	1,93	3,00	2,88	2,00	2,05	1,03	2,21	2,90	2,20	1,28	2,25	2,16	1,05	1,03	1,08	1,05
Croatia	CR	27,25	**1,95**	2,05	2,60	2,50	2,00	2,03	2,88	1,00	2,15	1,13	1,40	1,00	2,95	1,62	2,70	2,03	1,00	1,91
Sweden	SW	26,98	**1,93**	3,00	2,10	2,68	2,15	2,00	2,58	1,10	2,23	1,73	1,05	1,00	1,15	1,23	2,93	2,25	1,28	2,15
Greece	GR	26,84	**1,92**	2,78	3,00	3,00	2,28	2,00	2,56	1,15	2,40	1,69	1,15	1,55	2,51	1,73	1,13	1,03	1,00	1,05
Poland	PL, EN	26,46	**1,89**	2,00	2,78	2,93	2,95	2,00	1,20	1,05	2,13	2,28	2,03	1,18	1,10	1,65	2,75	1,10	1,13	1,66
Iceland	IS, EN	26,12	**1,87**	2,73	2,80	2,30	2,53	2,82	2,30	1,73	2,46	1,58	1,03	1,00	2,10	1,43	1,03	1,08	1,13	1,08
Japan	JP, EN	25,98	**1,86**	2,03	2,68	3,00	2,00	2,10	1,90	1,38	2,15	1,78	2,05	1,00	1,13	1,49	2,03	1,88	1,05	1,65
Switzerland	EN	25,95	**1,85**	2,98	2,75	2,50	2,63	2,10	2,00	1,70	2,38	2,28	1,03	1,00	1,00	1,33	2,00	1,00	1,00	1,33
Italy	IT	25,68	**1,83**	2,75	2,03	2,15	2,15	2,18	2,83	2,00	2,30	2,18	1,15	1,05	2,15	1,63	1,08	1,00	1,00	1,03
Belgium	EN, NL, FR, DE	25,35	**1,81**	2,73	2,28	2,08	1,93	2,00	2,93	1,13	2,15	2,25	1,55	1,90	1,15	1,71	1,40	1,00	1,05	1,15
UK	EN	25,30	**1,81**	2,58	2,18	2,20	2,18	2,00	2,55	1,55	2,18	2,93	1,73	1,00	1,00	1,66	1,25	1,00	1,18	1,14
Bulgaria	BG, EN	25,00	**1,79**	2,13	2,75	2,38	2,00	2,80	2,80	1,00	2,26	1,30	1,03	1,03	1,53	1,22	2,23	1,05	1,00	1,43
Hungary	HU +37 more	24,48	**1,75**	2,73	2,28	2,98	1,80	2,05	2,28	1,68	2,25	1,35	1,03	1,00	2,33	1,43	1,00	1,00	1,00	1,00
Denmark	DA	24,03	**1,72**	3,00	2,00	3,00	1,18	2,05	3,00	1,33	2,22	1,48	1,00	1,00	2,00	1,37	1,00	1,00	1,00	1,00
Czech Republic	CZ, EN	23,70	**1,69**	2,30	2,00	2,83	1,63	2,00	1,63	1,00	1,91	2,75	1,33	1,00	1,05	1,53	2,20	1,00	1,00	1,40
Malta	EN, MT	22,58	**1,61**	1,00	2,00	2,48	1,95	1,65	2,10	1,23	1,77	2,08	1,80	1,03	1,25	1,54	2,03	1,00	1,00	1,34
TOTAL		**29,77**	**2,13**	**2,57**	**2,45**	**2,65**	**2,41**	**2,22**	**2,62**	**1,75**	**2,38**	**2,19**	**1,96**	**1,66**	**2,13**	**1,98**	**2,06**	**1,56**	**1,54**	**1,72**

Moving inwards from the three overarching categories, it is possible to examine each of the fourteen criteria in more detail. Figure 5 shows the average score by criteria across all studied countries. In the figure, the red bars represent categories that, from the users' perspective, were implemented poorly, e.g. were given an assessment range from 1 to 2.2 out of 3 points, corresponding in text to "not fulfilled" or "partly fulfilled". The grey bars indicate categories that received an average score of between 2.2 and 2.6 and the blue bars were given above average score, i.e. above 2.6. It can be seen that of the fourteen categories, only two were perceived to have been well implemented, three were perceived as average, and 9 were viewed as being insufficiently implemented.
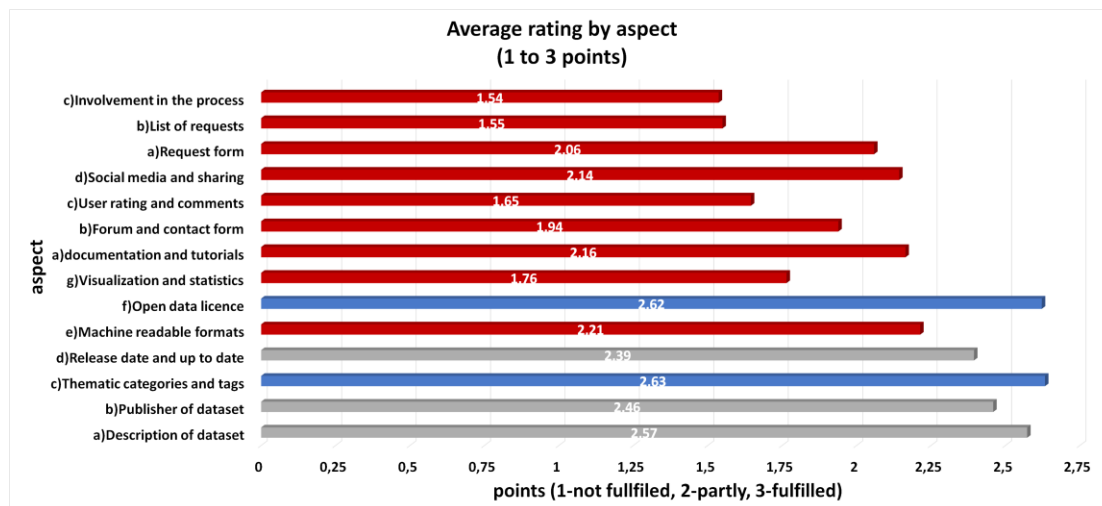
Fig. 5. The average score breakdown by aspect

The two highest scoring aspects, *"Thematic categories and tags"* and *"Open data license"*, are also those aspects that are most closely associated with the technical implementation of OGD portals. That is to say, OGD portals will make this information a mandatory field when data are uploaded, or there is a license applied to all datasets on a portal as a default if no other license is visible. At the EU level there are, for example, explicit requirements for dataset metadata that dictate category names and appropriate licenses. Similarly, the three aspects implemented with a score of "*average*" i.e. "*Release data and up to date*", "*Publisher of dataset*", and "*Description of dataset*" are all metadata associated attributes and, as before, are normally required information on major OGD platforms such as CKAN. Even though this is the case, some countries still did not have accurate license information or had license information that was confusing to users; this was the case in Poland, Czechia, Japan, Switzerland, Germany, Lithuania, Russia, Malta, Hungary, and Iceland.

In regard to the worst aspects from a usability perspective, it is important to point out that almost the entirety, with the exception of "*Machine-readable formats*", are directly related to interaction and cooperation between data user and data provider. As the components that received high scores are directly related to technical development of the portal, it follows that many government agencies simply focused on having an OGD portal that works and can provide data, without investing or devoting time to the actual usability, usefulness, or data quality available on the portal. This could be for a variety of reasons. For example, there could be a technocentric approach to OGD in government, e.g. build it and they will come, while ignoring the arguably more important social aspects to OGD. It could also point to an issue with procurement, perhaps the government procures the development and implementation and maintenance of an OGD portal, but then does not also procure the development or sustainability of the OGD ecosystem. A third potential reason could be related to just not fully understanding the need of OGD, if the government makes an OGD portal, but has data that are not machine readable and users cannot actively interact with data providers, they may see low usage, which subsequently lowers the desire for government to spend time or invest in their OGD initiative. There are likely other reasons why this may occur as well. However, previous research has explored this in a bit more detail and identified that one of the best ways to improve the usability of OGD is through the active development and fostering of the OGD ecosystem, the portal is only a (minor) part of the overarching system (McBride et al., 2020).

Reflecting back on the most commonly occurring usability weaknesses, Table 4 has been created to highlight them (those that gained less than 2.6 out of 3 points and were therefore assessed as either not fulfilled or only partially fulfilled) that were discovered as a result of the analysis. The Table shows the total number of portals that scored between 1 and 2.6 points, shows how these portals are divided amongst the score range, and then demonstrates the average score for each weakness.

Table 4. The weakest aspects by the number of portal gained less than 2.6 out of 3 points

Aspect (category)	1 point	1 to 2 points	2 to 2.6 points	AVG
involvement in the process (IIIc - open dataset request)	10	21	7	1.54
list of requests (IIIb - open dataset request)	12	17	8	1.55
user rating and comments (IIc – open dataset feedback)	12	17	6	1.65
visualisation and statistics (Ig – open dataset specification)	3	23	11	1.76
forum and contact form (IIb – open dataset feedback)	1	16	14	1.94
request form (IIIa - open dataset request)	2	14	11	2.06
social media and sharing (IId – open dataset feedback)	3	12	13	2.14
documentation and tutorials (IIa – open dataset feedback)	-	13	18	2.16
machine-readable formats (Ie – open dataset specification)	-	2	32	2.21

It should be noted that no portal scored a perfect score of 42 points and many portals may score well in some aspects, but not others. Thus, it is important that OGD portals continue to invest and develop their usability. Similarly, it is impossible to learn from other portals to see what has worked well and what could be done better. In order to highlight which portals performed the best amongst the different aspects, Table 5, highlights the top five performing countries by usability aspect. As in the case of top-5 by category, no country appears in the top five for all aspects, but there are countries appearing more frequently compared to their competitors. These countries are France, Austria and Portugal.

Table 5. Top-5 OGD portals by aspect

Aspect	Top 5
1a) Description of dataset	*Sweden, India, USA, Denmark, France*
1b) Publisher of dataset	*Greece, Cyprus, France, Luxembourg, Portugal*
1c) Thematic categories and tags	*Germany, Portugal, Greece, Austria, USA*
1d) Release date and up to date	*Slovenia, Singapore, France, Estonia, Austria*
1e) Machine readable formats	*France, Slovenia, India, Russia, Austria*
1f) Open data licence	*Latvia, Portugal, Austria, Denmark, Singapore*
1g) Visualization and statistics	*Cyprus, Singapore, Finland, Portugal, Estonia*

2a) Documentation and tutorials	*Portugal, UK, Germany, Finland, USA*
2b) Forum and contact form	*Portugal, Austria, Russia, France, Romania*
2c) User rating and comments	*France, Canada, Cyprus, Russia, Romania*
2d) Social media and sharing	*Austria, USA, Slovakia, Croatia, Slovenia*
3a) Request form	*India, Australia, Lithuania, New Zealand, Sweden*
3b) List of requests	*New Zealand, Lithuania, Colombia, Russia, Spain*
3c) Involvement in the process	*New Zealand, Lithuania, Russia, Canada, Spain*

Overall, whilst the technical aspects of OGD portals tended to have a high level of associated usability, user-focused aspects tended to score poorly, moving forward it would be of great benefit to data providers and OGD portal owners to invest, study, and understand how to better improve their portals.

V. CONCLUSIONS

The conducted research aimed to answer two primary research questions, mainly, 1) "*how can the usability of OGD portals be evaluated and compared across contexts?*" and 2) "*what are the most commonly missing usability aspects from OGD portals?*". In regard to the first research question, the paper follows a model put forth by (Máchová et al., 2018), and validates its usefulness in quantifying the level of usability from a users' perspective of an OGD portal. Furthermore, the framework was applied to a large number of countries, 41, and allowed for a cross comparative analysis amongst the portals. Moving forward, it would be interesting to expand the analysis and check a larger number of countries, especially non-EU countries since this study has already covered all EU countries, to see how this may or may not affect the level of usability of the OGD portal. It may be the case that non-EU countries have much lower levels of usability of their OGD portals due to less stringent metadata and openness requirements. On the other hand, the opposite may be true as well; if portals are initiated from bottom up initiatives (as opposed to top down regulation) they may be more social and usable, though future research would be needed to explore this further.

In regard to the second research question, the portal finds that purely technical aspects appear to be well implemented and usable across the studied countries. However, the poorest aspects from a usability perspective were most commonly related to more social aspects of OGD portals, dissemination of OGD use cases, or interaction between OGD users and OGD providers. Thus, moving forwards, governments and OGD maintainers should focus as well on developing OGD ecosystems and interaction on their OGD portal.

Outside of answering the research questions, this paper also presents an initial ranking of OGD portal usability. As this does not currently exist in the scholarly literature or in any currently used international index, it makes a contribution by compiling this initial list. Thus, this paper is likely to be of interest to the owners, funders, or users of OGD portals in the studied countries. Additionally, those in countries who were not included in the study may apply the methodology to understand better the usability of their portal.

Though this research did study a large number of countries, moving forwards future research is needed. For example, it would be important to study a more diverse group of countries to

better understand how context influences the usability of OGD portals. Future research could also go into more detail about each of the three categories and fourteen aspects analysed and begin to understand how to better implement each to improve usability. Furthermore, it is important that more criteria be developed so that a comprehensive heuristic analysis could be conducted in a systematic and objective manner.

References

Alexopoulos, C., Zuiderwijk, A., Charapabidis, Y., Loukis, E., & Janssen, M., 2014. Designing a second generation of open data platforms: Integrating open data and social media. In International Conference on Electronic Government (pp. 230-241). Springer, Berlin, Heidelberg.

Alexopoulos, C., Spiliotopoulou, L., & Charalabidis, Y., 2013. Open data movement in Greece: a case study on open government data sources. In Proceedings of the 17th Panhellenic Conference on Informatics (pp. 279-286).

Arcelus, J., 2012. Framework for useful transparency websites for citizens. In Proceedings of the 6th International Conference on Theory and Practice of Electronic Governance (pp. 83-86).

Attard, J., Orlandi, F., Scerri, S., & Auer, S. (2015). A systematic review of open government data initiatives. *Government Information Quarterly*, *32*(4), 399–418. https://doi.org/10.1016/j.giq.2015.07.

Boychuk, M., Cousins, M., Lloyd, A., & MacKeigan, C., 2016. Do we need data literacy? Public perceptions regarding Canada's open data initiative. Dalhousie Journal of Interdisciplinary Management, 12(1)

Charalabidis, Y., Loukis, E., & Alexopoulos, C., 2014. Evaluating second generation open government data infrastructures using value models. In 2014 47th Hawaii International Conference on System Sciences (pp. 2114-2126). IEEE.

Colpaert, P., Joye, S., Mechant, P., Mannens, E., & Van de Walle, R., 2013. The 5 stars of open data portals. In Proceedings of the 7th International Conference on Methodologies, Technologies and Tools Enabling E-Government (MeTTeG13), University of Vigo, Spain (pp. 61-67).

Dawes, S. S., Vidiasovab, L., Parkhimovichc, O., Dawesa, S., Vidiasovab, L., Parkhimovichc, O., Dawes, S. S., Vidiasova, L., & Parkhimovich, O. (2016). Planning and designing open government data programs: An ecosystem approach. Government Information Quarterly, 33(1), 15–27. https://doi.org/10.1016/j.giq.2016.01.003

Egger-Peitler, I., & Polzer, T., 2014. Open data: European ambitions and local efforts. Experiences from Austria. In Open government (pp. 137-154). Springer, New York, NY.

Heath, T., & Bizer, C., 2011. Linked data: Evolving the web into a global data space. Synthesis lectures on the semantic web: theory and technology, 1(1), 1-136.

Hogan, M., Ojo, A., Harney, O., Ruijer, E., Meijer, A., Andriessen, J., Pardijs, M., Boscolo, P., Palmisano, E., Satta, M., Groff, J., Baker, M., Détienne, F., Porwol, L., Scarano, V., Malandrino, D., 2017. Governance, transparency and the collaborative design of open data collaboration platforms: understanding barriers, options, and needs. In Government 3.0–Next Generation Government Technology Infrastructure and Services (p. 299-332). Springer, Cham.

Janssen, M., Charalabidis, Y., & Zuiderwijk, A., 2012. Benefits, adoption barriers and myths of open data and open government. Information systems management, 29(4), 258-268.

Janssen, K., 2011. The influence of the PSI directive on open government data: An overview of recent developments. Government Information Quarterly, 28(4), pp.446-456.

Jetzek, T., Avital, M., & Bjørn-Andersen, N., 2014. Generating sustainable value from open data in a sharing society. In International Working Conference on Transfer and Diffusion of IT (p. 62-82). Springer, Berlin, Heidelberg.

Kassen, M., 2019. Open data and e-government–related or competing ecosystems: a paradox of open government and promise of civic engagement in Estonia. Information Technology for Development, 25(3), p.552-578.

Kim, H., 2019. Analysis of standard vocabulary use of the open government data: the case of the public data portal of Korea. Quality & Quantity, 53(3), p.1611-1622.

Kubler, S., Robert, J., Neumaier, S., Umbrich, J., & Le Traon, Y., 2018. Comparison of metadata quality in open data portals using the Analytic Hierarchy Process. Government Information Quarterly, 35(1), p.13-29.

Lin, C. S., & Yang, H. C., 2014. Data quality assessment on Taiwan's open data sites. In International Conference, MISNC (p. 325-333). Springer, Berlin, Heidelberg.

Liu, Q., Bai, Q., Ding, L., Pho, H., Chen, Y., Kloppers, C., McGuinness, D.L., Lemon, D., de Souza, P., Fitch, P., Fox, P., 2011. Linking australian government data for sustainability science-a case study. In Linking Government Data (pp. 181-204). Springer, New York, NY.

Lourenço, R.P., 2015. An analysis of open government portals: A perspective of transparency for accountability. Government information quarterly, 32(3), pp.323-332.

Luthfi, A., Janssen, M., & Crompvoets, J. (2020, July). Stakeholder Tensions in Decision-Making for Opening Government Data. In International Symposium on Business Modeling and Software Design (pp. 331-340). Springer, Cham.

Maali, F., Cyganiak, R. and Peristeras, V., 2010, Enabling Interoperability of Government Data Catalogues, in Wimmer, M.A., Chappelet, J.L., Janssen, M. and Scholl, H.J. (Eds), Proceedings of the 9th IFIP WG 8.5 International Conference, Springer, Berlin and Heidelberg, pp. 339-350.

Máchová, R., Hub, M., & Lnenicka, M., 2018. Usability evaluation of open data portals. Aslib Journal of Information Management, 70(3), p.252-268.

Máchová, R., & Lnenicka, M., 2017. Evaluating the quality of open data portals on the national level. Journal of theoretical and applied electronic commerce research, 12(1), p.21-41.

Marienfeld, F., Schieferdecker, I., Lapi, E., & Tcholtchev, N., 2013. Metadata aggregation at govdata. de: An experience report. In Proceedings of the 9th International Symposium on Open Collaboration, p. 1-5.

Martin, S., Foulonneau, M., & Turki, S., 2013. 1-5 stars: Metadata on the openness level of open data sets in Europe. In Research conference on metadata and semantic research (p. 234-245). Springer, Cham.

Matheus, R., Vaz, J. C., & Ribeiro, M. M., 2014. Open government data and the data usage for improvement of public services in the Rio de Janeiro City. In Proceedings of the 8th International Conference on Theory and Practice of Electronic Governance (p. 338-341).

Matheus, R., Ribeiro, M. M., Vaz, J. C., & de Souza, C. A., 2012. Anti-corruption online monitoring systems in Brazil. In Proceedings of the 6th International Conference on Theory and Practice of Electronic Governance (p. 419-425).

Matheus, R., Ribeiro, M. M., & Vaz, J. C., 2012. New perspectives for electronic government in Brazil: the adoption of open government data in national and subnational governments of Brazil. In Proceedings of the 6th international conference on theory and practice of electronic governance (p. 22-29).

Matheus, R., Janssen, M. (2020). A Systematic Literature Study to Unravel Transparency Enabled by Open Government Data: The Window Theory. *Public Performance & Management Review*, *43*(3), 503–534. https://doi.org/10.1080/15309576.2019.1691025

Meijer, A., 2015. E-governance innovation: Barriers and strategies. Government Information Quarterly, 32(2), 198–206. doi:10.1016/j.giq.2015.01.001

Millette, C., & Hosein, P., 2016. A consumer focused open data platform. In 2016 3rd MEC International Conference on Big Data and Smart City (ICBDSC) (pp. 1-6). IEEE.

McBride, K., Aavik, G., Toots, M., Kalvet, T. and Krimmer, R., 2019. How does open government data driven co-creation occur? Six factors and a 'perfect storm'; insights from Chicago's food inspection forecasting model. Government Information Quarterly, 36(1), p.88-97, https://doi.org/10.1016/j.giq.2018.11.006.

McBride, K., Toots, M., Kalvet, T. and Krimmer, R., 2019. Turning Open Government Data into Public Value: Testing the COPS Framework for the Co-creation of OGD-Driven Public Services. In Governance Models for Creating Public Value in Open Data Initiatives (p. 3-31). Springer, Cham.

McBride, K., Olesk, M., Kütt, A. Shysh, D., 2020. Systemic change, open data ecosystem performance improvements, and empirical insights from Estonia: A country-level action research study. Information Polity, 25(3), p.377-402, DOI: 10.3233/IP-190195

McBride, K., 2020. Open Government Data Driven Co-Created Public Services (Doctoral dissertation). Available at: https://digikogu.taltech.ee/et/Item/e75082ae-9115-48c0-9526-09466e8a6698

Neumaier, S., Umbrich, J. and Polleres, A., 2016. Automated quality assessment of metadata across open data portals. Journal of Data and Information Quality (JDIQ), 8(1), pp.1-29.

Nielsen, J., 1994. Usability engineering. Morgan Kaufmann Publishers Inc., CA, United States

Nikiforova, A., 2020a. Comparative analysis of national open data portals or whether your portal is ready to bring benefits from open data. In IADIS International Conference on ICT, Society and Human Beings, p.81-88.

Nikiforova A., 2020b. Assessment of the usability of Latvia's Open Data Portal or how Close are We to Gaining Benefits from Open Data. In IADIS International Conference on Interfaces and Human Computer Interaction, p.81-88.

Nikiforova A., 2020c. Timeliness of open data in open government data portals through pandemic-related data: a long data way from the publisher to the user. In Fourth International Conference on Multimedia Computing, Networking and Applications (MCNA) (in press)

Noveck, B.S., 2016. Is Open Data the Death of FOIA. Yale LJF, 126, p.273.

Osagie, E., Waqar, M., Adebayo, S., Stasiewicz, A., Porwol, L., & Ojo, A., 2017. Usability evaluation of an open data platform. In Proceedings of the 18th Annual International Conference on Digital Government Research (p. 495-504).

O'Hara, K., 2014. Enhancing the quality of open data. In The Philosophy of Information Quality (p. 201-215). Springer, Cham.

Palmirani, M., Martoni, M., & Girardi, D., 2014. Open government data beyond transparency. In International Conference on Electronic Government and the Information Systems Perspective (p. 275-291). Springer, Cham.

Petychakis, M., Vasileiou, O., Georgis, C., Mouzakitis, S., & Psarras, J., 2014. A state-of-the-art analysis of the current public data landscape from a functional, semantic and technical perspective. Journal of theoretical and applied electronic commerce research, 9(2), p.34-47.

Prieto, L. M., Rodríguez, A. C., & Pimiento, J., 2012. Implementation framework for open data in Colombia. In Proceedings of the 6th International Conference on Theory and Practice of Electronic Governance (p. 14-17).

Purwanto, A., Zuiderwijk, A., & Janssen, M., 2020a. Citizens' Trust in Open Government Data: A Quantitative Study about the Effects of Data Quality, System Quality and Service Quality. In The 21st Annual International Conference on Digital Government Research (p. 310-318).

Purwanto, A., Zuiderwijk, A., & Janssen, M., 2020b. Citizen engagement with open government data. Transforming Government: People, Process and Policy, 14(1), p.1-30.

Rojas, L. A. R., Bermúdez, G. M. T., & Lovelle, J. M. C., 2014. Open data and big data: A perspective from Colombia. In International Conference on Knowledge Management in Organizations (p. 35-41). Springer, Cham.

Roscoe, J. T., 1975. Fundamental research statistics for the behavioral sciences [by] John T. Roscoe.

Ruijer, E. and Meijer, A., 2020. Open government data as an innovation process: Lessons from a living lab experiment. Public Performance & Management Review, 43(3), p.613-635.

Sanabria, P., Pliscoff, C., & Gomes, R., 2014. E-government practices in South American countries: Echoing a global trend or really improving governance? The experiences of Colombia, Chile, and Brazil. In Open Government (p. 17-36). Springer, New York, NY.

Schnell, S., 2020. Vision, Voice, and Technology: Is There a Global "Open Government" Trend?. Administration & Society, 52(10), p.1593-1620, https://doi.org/10.1177/0095399720918316.

Schrock, A.R., 2016. Civic hacking as data activism and advocacy: A history from publicity to open government data. New Media & Society, 18(4), p.581-599.

Smith, G., & Sandberg, J., 2018. Barriers to innovating with open government data: Exploring experiences across service phases and user types. Information Polity, 23(3), 249-265.

Susha, I., Zuiderwijk, A., Janssen, M., & Grönlund, Å., 2015. Benchmarks for evaluating the progress of open data adoption: Usage, limitations, and lessons learned. Social Science Computer Review, 33(5), 613-630.

Tinholt, D., 2013. The Open Data Economy: Unlocking Economic Value by Opening Government and Public Data. Capgemini Consulting.

Toots, M., Mcbride, K., Kalvet, T. and Krimmer, R., 2017. Open data as enabler of public service co-creation: exploring the drivers and barriers. In 2017 Conference for E-Democracy and Open Government (CeDEM) (p. 102-112). IEEE, doi: 10.1109/CeDEM.2017.12.

Ubaldi, B., 2013, Open Government Data: Towards Empirical Analysis of Open Government Data Initiatives, OECD Working Papers on Public Governance, No. 22, OECD Publishing, Paris, https://doi.org/10.1787/5k46bj4f03s7-en.

Umbrich, J., Neumaier, S., & Polleres, A., 2015. Quality assessment and evolution of open data portals. In 2015 3rd international conference on future internet of things and cloud (p. 404-411). IEEE.

van der Waal, S., Węcel, K., Ermilov, I., Janev, V., Milošević, U., & Wainwright, M., 2014. Lifting open data portals to the data web. In Linked Open Data--Creating Knowledge Out of Interlinked Data (p. 175-195). Springer, Cham.

Vasa, M., & Tamilselvam, S., 2014. Building apps with open data in India: An experience. In Proceedings of the 1st International Workshop on Inclusive Web Programming-Programming on the Web with Open Data for Societal Applications (p. 1-7).

Weerakkody, V., Irani, Z., Kapoor, K., Sivarajah, U., & Dwivedi, Y. K. (2017). Open data and its usability: an empirical view from the Citizen's perspective. *Information Systems Frontiers*, *19*(2), 285–300. https://doi.org/10.1007/s10796-016-9679-1

Welle Donker, F., & van Loenen, B., 2017. How to assess the success of the open data ecosystem?. International Journal of Digital Earth, 10(3), 284-306.

Wilson, C., 2020. The socialization of civic participation norms in government?: Assessing the effect of the Open Government Partnership on countries'e-participation. Government Information Quarterly, 37(4), p.1-8, 101476, https://doi.org/10.1016/j.giq.2020.101476.

Young, M. and Yan, A., 2017. Civic hackers' user experiences and expectations of seattle's open municipal data program. In Proceedings of the 50th Hawaii International Conference on System Sciences, 10.24251/HICSS.2017.324, p. 2681-2690.

Zuiderwijk, A., Susha, I., Charalabidis, Y., Parycek, P., & Janssen, M., 2015. Open data disclosure and use: Critical factors from a case study. In CeDEM15: Conference for E-Democracy and Open Government (Vol. 197), 197-208. MV-Verlag.

Zuiderwijk, A., & Janssen, M., 2015. Participation and data quality in open data use: Open data infrastructures evaluated. In Proceedings of the 15th European Conference on E-Government (p. 351-359).

Zuiderwijk, A. and Janssen, M., 2014. Open data policies, their implementation and impact: A framework for comparison. Government Information Quarterly, 31(1), p.17-29.

Zuiderwijk, A., Janssen, M., Choenni, S., Meijer, R., Alibaks, R.S. and Sheikh_Alibaks, R., 2012. Socio-technical impediments of open data. Electronic Journal of e-Government, 10(2), p.156-172.

CKAN, https://ckan.org/, accessed: 10.09.2020

[dataset] Nikiforova, 2020. User-centered Usability Analysis of 41 Open Government Data Portals. Zenodo, v01. http://dx.doi.org/10.5281/zenodo.4022573

Open Data Barometer, 2018, Report – From promise to progress, https://opendatabarometer.org/leadersedition/report/, accessed: 10.09.2020

European Data Portal, 2020, Open Data Maturity, https://www.europeandataportal.eu/en/impact-studies/open-data-maturity, accessed: 10.09.2020

E-Estonia, How to make infrastructures safer through satellites' data, https://e-estonia.com/how-to-make-infrastructures-safer-data/, accessed: 10.09.2020

Open Knowledge Foundation, 2017, Global Open Data index, Methodology, https://index.okfn.org/methodology/, accessed: 10.09.2020

OECD, 2020, Open Government Data, https://www.oecd.org/gov/digital-government/open-government-data.html, accessed: 10.09.2020