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How to assess the success of the open data ecosystem?

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ABSTRACT

Open data are currently a hot topic and are associated with realising ambitions such as a more transparent and efficient government, solving societal problems, and increasing economic value. To describe and monitor the state of open data in countries and organisations, several open data assessment frameworks were developed. Despite high scores in these assessment frameworks, the actual (re)use of open government data (OGD) fails to live up to its expectations. Our review of existing open data assessment frameworks reveals that these only cover parts of the open data ecosystem. We have developed a framework, which assesses open data supply, open data governance, and open data user characteristics holistically. This holistic open data framework assesses the maturity of the open data ecosystem and proves to be a useful tool to indicate which aspects of the open data ecosystem are successful and which aspects require attention. Our initial assessment in the Netherlands indicates that the traditional geographical data perform significantly better than non-geographical data, such as healthcare data. Therefore, open geographical data policies in the Netherlands may provide useful cues for other OGD strategies.

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Open data; geodata; assessment framework; open data governance; open data maturity

1. Introduction

Open data are currently a hot topic. Around 2009, open government data (OGD) initiatives started to emerge with, for example, the 2009 Obama Executive Order,¹ the 2010 Digital Agenda of the European Commission,² the 2011 Open Government Partnership (OGP) Initiative,³ and the 2013 G8 Open Data Charter.⁴ OGD are associated with realising ambitions, such as a more transparent and efficient government (e.g. Huijboom and van den Broek 2011), reducing corruption (e.g. Granickas 2014; David-Barrett, Heywood, and Theodorakis 2015), improving citizens' participation (Jetzek 2013), solving societal problems (e.g. Uhler 2009; Attard et al. 2015), increasing economic value due to companies creating innovative products and services with open data as a resource (e.g. Vickery 2011; Omidyar Network 2014), and efficiency improvements (e.g. McKinsey Global Institute 2013; WISE Institute 2014).

Open data should comply with 10 principles formulated in 2010. Government data shall be considered open if they are complete, primary, timely, accessible, machine processable, non-discriminatory, non-proprietary, permanent, licence-free, and preferably free of charge (Sunlight Foundation 2010). Open data are not limited to government data as the private sector also recognises the

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potential benefits of making their datasets available as open data (Welle Donker, van Loenen, and Bregt 2016).

For this article, we consider open data to be all data that can be reused without financial and legal restrictions, including data available with a licence requiring attribution, for example, a Creative Commons Attribution (CC-BY)⁵ licence.

1.1. Open data benefits yet to materialise

Open data initiatives in Europe were initially driven by the potential transparency and economic benefits (European Commission 2011). However, in spite of more OGD made available, the predicted effects appear not to have materialised to date. Although a literature review by the authors demonstrated that there is ample anecdotal evidence of a positive impact of open data (e.g. Vickery 2011; de Vries et al. 2011), in practice it is difficult to measure the actual socio-economic impact of open data (Koski 2015).

Research indicates that more OGD does not automatically lead to more transparency and increased trust in government (e.g. Gurstein 2011; Grimmelikhuijsen 2012; dos Santos Brito et al. 2015) or to a surge of value-added products and services based on OGD (e.g. Rhind 2014). This may be due to a number of reasons, for example, a mismatch between the datasets supplied and the actual dataset demand (IRM 2015), a lack of cooperation by government agencies (Peled 2011), or not enough care is taken when publishing datasets (Janssen, Charalabidis, and Zuiderwijk 2012). If governments cannot see a positive impact of open data, high-level political commitment may reduce and open data programmes may stall or even go backwards (World Wide Web Foundation 2015). Therefore, it is vital that a positive impact of open data is demonstrated. However, before we can assess the success of the impact of open data, we need to assess the current state of open data as a benchmark.

1.2. Assessment of open data initiatives

To improve the uptake of open data and successful embedding in society, an assessment and evaluation of the maturity of open data is a useful tool. Assessment frameworks are used for different reasons, such as benchmarking and comparing between different sectors and between countries, or to provide tools to improve the quality and governance of open data. Although already a number of open data assessment frameworks have been developed around the world, these models tend to focus on only one perspective of the open data ecosystem. To determine and assess the success factors of open data requires a holistic approach. Therefore, we have developed a holistic assessment framework to assess and to evaluate open data initiatives from multiple perspectives.

Our research methodology consisted of a literature study and interviews with users, providers, and open data policy-makers. We used a literature review on open data assessment frameworks to draft the first model. During the interviews, users and providers were asked to reflect on the first draft and to assess the applicability to their situation. The resulting framework was fine-tuned and applied to the open data ecosystem in the Netherlands.

In this article, we apply our holistic open data assessment framework to provide a snapshot of the Dutch open data 'State of the Nation'. In Section 2, we describe assessment framework theory and provide an overview of six open data assessment frameworks. Section 3 describes the holistic framework components of data accessibility, data governance, and user characteristics. In Section 4, we apply our framework to assess the data supplier's perspective of the 'State in Open Data Land' of the Netherlands. The maturity of open data governance is assessed in Section 5. Section 6 describes the user characteristics required to develop and successfully market value-added products and services based on open data. Section 7 concludes with our analysis and recommendations for open data assessment.

2. Open data ecosystem assessment

The key to a well-functioning open data ecosystem is accessibility from a technical, legal, and organisational perspective. Therefore, it is important that there are policies in place that define the legal context, standards to facilitate data interoperability, and a stable and sustainable network for users of the data, as illustrated in [Figure 1](#). Such data ecosystems are often created by governments to facilitate access to sharing and (re)using of government data.

To facilitate open data accessibility, governments worldwide are developing open data platforms in varying forms and functionality (cf. [Zuiderwijk 2015](#)). In recent years, there has been a number of international open data assessment frameworks developed, most of which focus on implementation of open data strategies. Below, six of these assessment models are summarised and reflected upon.

2.1. Existing open data assessment frameworks

Open Knowledge International (OKI) developed a Global Open Data Index⁶ to track the state of government open data, that is, which countries are publishing data in the right way and in a timely way. In 2014, 97 countries were included in the index of 10 key datasets,⁷ with only 11% of the dataset entries were open according to their Open Definition.⁸ The Index does not provide an insight into the quality of the data, however.

The World Wide Web Foundation developed the Open Data Barometer⁹ to provide a snapshot of OGD practices. The Barometer focusses on open data readiness, implementation, and emerging impacts. The second edition of the Open Data Barometer assessed these aspects for a sample of 86 countries. The Open Data Barometer found that countries having open data initiatives that receive both senior-level government backing *and* sustained resources are much more likely to achieve impact. Only a low percentage of the countries included in the Barometer publish open data related to government transparency and accountability. Just over 10% of the surveyed datasets conformed with their open data criteria (published in bulk, machine-readable formats, and under an open licence) ([World Wide Web Foundation 2015](#)). The Barometer provides an insight into the maturity of open data governance from a data provider's perspective only.

Independent Reporting Mechanism (IRM) developed a tagging framework to assess the extent to which the OGP commitment addresses both supply and demand for open data in their action plans. Their framework used 26 tags grouped into three clusters: Data Supply/Infrastructure, Environment/Context (legal and institutional conditions), and Data Use. Of the 92 OGP countries assessed, IRM ([2015](#)) found that 53% of OGP commitments relate to Data Supply, 21% to Context (legal and

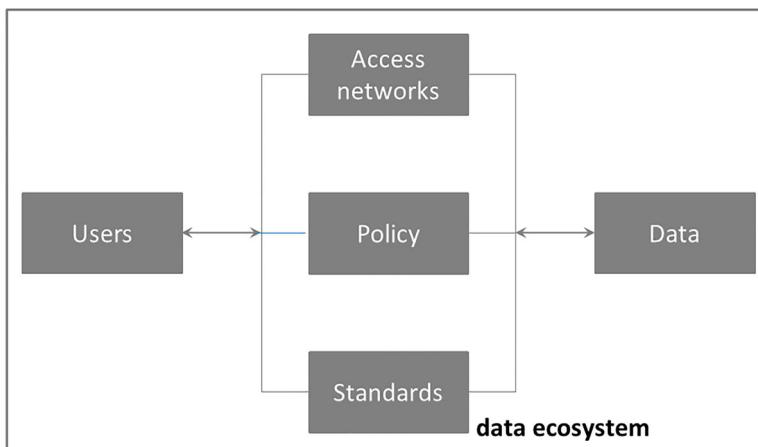


Figure 1. Key components of the open data ecosystem (after [Rajabifard, Feeney, and Williamson 2002](#)).

institutional conditions), and 26% to Data Use. IRM concluded that there appears to be a misalignment between providers publishing ‘low hanging fruit’ and users wanting high-value data (see also Davies 2014). IRM assessed the governance of open data initiatives are being carried out but IRM did not include the user’s perspective.

The Public Sector Information (PSI) Scoreboard is a ‘crowd-sourced’ tool to measure the status of open data and PSI reuse throughout the EU. The PSI Scoreboard measures 7 aspects of PSI reuse, based on 25 indicators. The PSI Scoreboard focusses on the EU PSI Directive¹⁰ implementation and other aspects, such as availability of local government data and events organised to promote open data. The Scoreboard does not include other governance aspects or the user’s perspective.

The United Kingdom Open Data Institute (ODI) developed a Maturity Framework to assess how well an organisation publishes and consumes open data. The model consists of 15 organisational activities grouped into 5 themes and 5 progress levels to assess and monitor organisational performance (Dodds and Newman 2015). The model focusses on organisational processes and data governance from a data provider perspective.

The Capgemini Consulting Open Data Benchmark researched 23 open data portals in the EU and found that only 22% of countries shared data that can be classified as comprehensive. Almost all (96%) countries share data which are not regularly updated; over 60% of the countries lacked enhanced search capabilities; and 87% of the countries are not utilising user participation capabilities (Tinholt 2013). Most countries (87%) have an open data portal but only 33% of the portals support feedback mechanisms for users to give their opinion and only 11% offer a contribution feature (Capgemini Consulting 2015). The Benchmark assessed data availability, political, leadership, and data portal usability from the data provider’s perspective.

2.2. Summary existing open data assessment frameworks

These frameworks assess open data from a specific perspective, such as releasing data conform an open data definition, the type of data released, adhering to open data policy commitments, or open data portal performance. Some of these frameworks assess a specific outcome, such as government transparency. Although these assessment frameworks provide interesting insights, they all focus on data supply and data environment, see Figure 2. Even IRM (2015) only considered what data providers had done to facilitate users but had not actually consulted users. Thus, the user’s perspective appears to be missing in all these frameworks.

To include the user’s perspective, we have developed a new multi-dimensional holistic assessment framework that builds on a variety of existing frameworks. Our framework not only adds the user characteristics to the existing frameworks, but also provides a holistic comprehensive approach to open data assessment building on existing frameworks, which only deal with single components of the open data ecosystem. Our holistic approach reuses elements of the existing frameworks. For example, our framework includes access through a portal (part of CapGemini’s framework) as part of the indicator ‘recognisable’, and the openness aspect of a dataset of the OKI framework, and some of the parts of the maturity framework of ODI. We do this, however, from a user perspective. A user needs to know that a dataset exists and where it can be accessed. This knowledge can be provided through a data portal, but also through a general search engine. Therefore, we do not limit ourselves to portal assessment but also include other relevant aspect for this specific indicator ‘recognisable’. In the next section, we will describe the new framework.

3. Open data maturity assessment framework

There are several ways to assess the effect of a policy regulation. A commonly used method is to develop an assessment framework using indicators, whereby it is important that the indicators reflect the organisation’s mission and core activities. We distinguish four elements: *activity* (action of an organisation), *output* (products/services of an organisation), *outcome* (results of an action), and

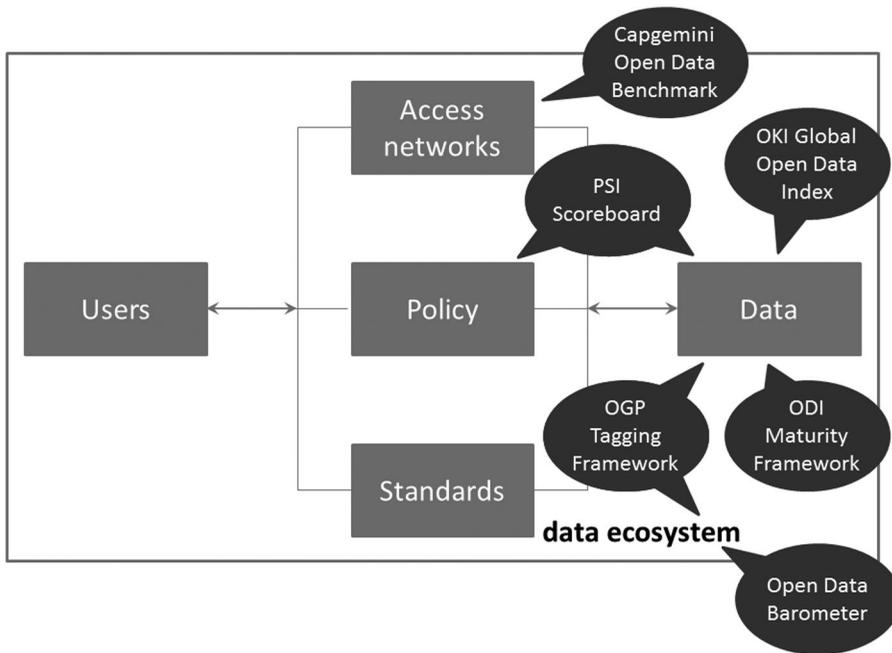


Figure 2. Focus of existing open data assessment frameworks.

impact (the way in which an outcome contributes to a strategic goal of the organisation) (Environment Canada 2000). For instance, a government agency releases the national roads dataset as open data (*activity*), which results in open road data (*output*). A company uses the dataset to improve a car navigation system, (*outcome*) thus enabling drivers to avoid roads under repair and make more effective use of the roads infrastructure (*impacts*) (see also Helbig et al. 2012).

For our research, we use three output indicators as conditions for a successful open data ecosystem, namely:

- (1) Data supply: the way in which data are provided as open data;
- (2) Data governance: the way in which governance aspects are organised;
- (3) User characteristics: the way in which the user characteristics enable the user to innovate with open data.

In this section, we will describe these three components.

3.1. Open data supply indicators

The concentric shell model of Backx (2003) illustrates the open data supply from a user perspective, see Figure 3. This model provides a good insight into the steps a user has to follow to assess if data may be suitable for his requirements (van Loenen and Grothe 2014). The data should be:

- (1) known to the user (are the data identifiable and where can data be obtained?)
- (2) attainable by the user (can the user obtain the data, and under what conditions?)
- (3) usable for the intended purpose of the user (can the user assess the quality of the data)?

For a user to be able to reuse data, these three conditions must be satisfied.

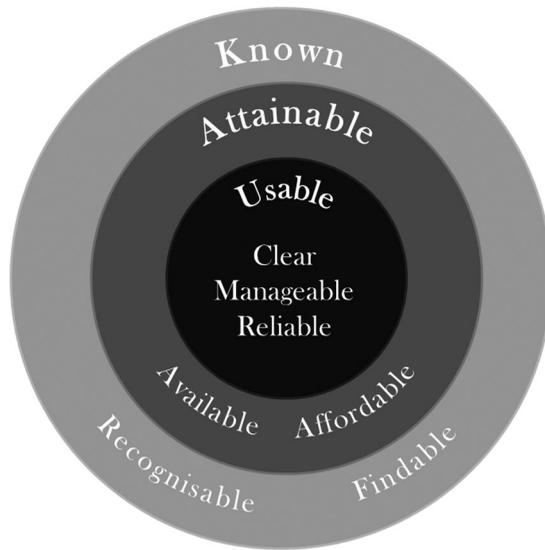


Figure 3. Concentric shell model. Source: Backx (2003).

Appendix 1 details the data supply indicators. Below, we provide the main characteristics of each shell.

3.1.1. *Known*

The user has to know that a certain dataset exists: the user has to be able to recognise, that is, identify the dataset. This can be achieved through resource metadata, for example, resource titles or abstracts, through tags, for example, Internet bookmarks or textual keywords, or, for linked data, resource description framework resources.

In addition, a user has to know where to find the dataset. A user may either use a search engine or go to a data portal. If an open dataset is published but this is not clear to the public and cannot be found through a simple search, then the data can easily be overlooked and not put to good use (Open Knowledge International 2014). The chance that data are discovered may increase if the data are published in a well-known and accessible portal. Government information portals have been around for several decades, however, these are often poorly stocked, obsolete, and particularly user-unfriendly (cf. van Loenen, Crompvoets and Poplin 2010).

3.1.2. *Attainable*

Once a dataset is found, it has to be attainable, that is, a user has to be able to physically access the dataset (to viewing and/or to download via services, or on request), to be allowed to (re)use the data (licences), and to be able to afford the data (fees). Unclear licence conditions, especially when combining multiple datasets, and high up-front fees may form a barrier for potential users (cf. Fornefeld et al. 2008).

3.1.3. *Usable*

A user will only be able to assess if the data are suitable to his/her needs after the data can be (physically) inspected. Aspects within this shell relate to data quality, for example, available data formats, available documentation/metadata, level of coverage, timeliness, and update frequency. Other key aspects are the presence of a helpdesk or forum for questions related to the data and guarantees for continuous availability of the data. Without such guarantees, a user may be hesitant to invest precious resources into developing a derivative product.

3.2. Data governance

In addition, open data governance is relevant for facilitating open data use. We consider governance to be the interaction between public sector entities and/or private sector entities with the ultimate goal to realise common goals (Termeer et al. 2011). Governance is a framework of policies, processes, and instruments that structure this interaction in order to enable parties to reach their common goals. Governance of open data not only provides a framework to facilitate the shells of Backx's model but also establishes who will assist the user when he/she stumbles over one of the shells. For the governance part of our open data assessment framework, we use the five elements for assessing the governance of geographical information infrastructures identified by Kok and van Loenen (2005). Although this model was developed to assess the maturity of geographical information infrastructures, it can equally be applied to open data ecosystems. The aspects that help to determine the functionality of a data infrastructure are vision, leadership, communication, self-organising ability, and long-term financing, see Figure 4. In Section 5, we explain these aspects in detail.

In addition, there are other important aspects, such as legal and policy frameworks (e.g. a right to (re)use PSI, a right of redress to reinforce good governance values (Brewer 2007), and a clear demarcation between public tasks and private sector activities (Janssen, Cromptvoets, and Dumortier 2011)).

3.3. User characteristics

Having data supply and governance ticked off does not automatically mean that data will be re-used. Our assessment framework distinguishes itself by not only assessing open data readiness but also including the user's perspective, as 'users will probably be the most mentioned group and yet actually the least considered' (McLaughlin and Nichols 1994, 72).

Next to data accessibility and governance, there are other factors that will enable the re-use of open data, such as technical connectivity, user capabilities, and resources (e.g. OECD 2011; Jetzek, Avital, and Bjørn-Andersen 2014). However, it may be that the user cannot or will not use the data, does not have enough technical knowhow and/or creative skills to transform the data, does not have access to sufficient capital or other resources, may not want to invest in a risky open data product, or be unfamiliar with the opportunities (e.g. Gurstein 2011; McClean 2011; Janssen, Charalabidis, and



Figure 4. Aspects of government data infrastructure governance.

Zuiderwijk 2012). These aspects, directly related to the user characteristics and his environment, are categorised as user characteristics.

People use open data for a number of reasons: maybe for personal reasons to address a certain (societal) issue or to fill a specific niche, or to experiment with data. However, to mature from hobbyist to developing a sustainable business model requires more than just a good idea. Apart from being in touch with societal issues, one has to have knowledge of the supply market and of the needs of the end-market (cf. Osterwalder and Pigneur 2010). To develop a marketable product or service, a right marketing mix of the right product sold at the right price at the right place using suitable promotion is required (Business Case Studies 2016). As open data are available to everybody, everybody could theoretically create similar derivative products. The challenge is to develop a product or service that stands out from the crowd.

The characteristics someone should have to be innovative vary. You need a question or a problem that needs solving. This may stem from one's own motivation (*what if I*) or from a broader societal aspect (*what if we*). Therefore, a user should be in close touch with societal issues, as well as having good domain knowledge. As one of the interviewed users stated: 'It is pointless to develop a multimodal route planner without intrinsic knowledge of the local infrastructure and bottlenecks or if there is already a well-functioning multimodal route planner on the market.'

Figure 5 shows the links between the elements of our assessment framework. The outcomes of the Governance model (data governance) and the Data Accessibility model (data supply) become inputs – next to other user characteristics – required for successful reuse of government open data. The impact of open data reuse could be measured using 'traditional' outcome indicators, such as company turnover.

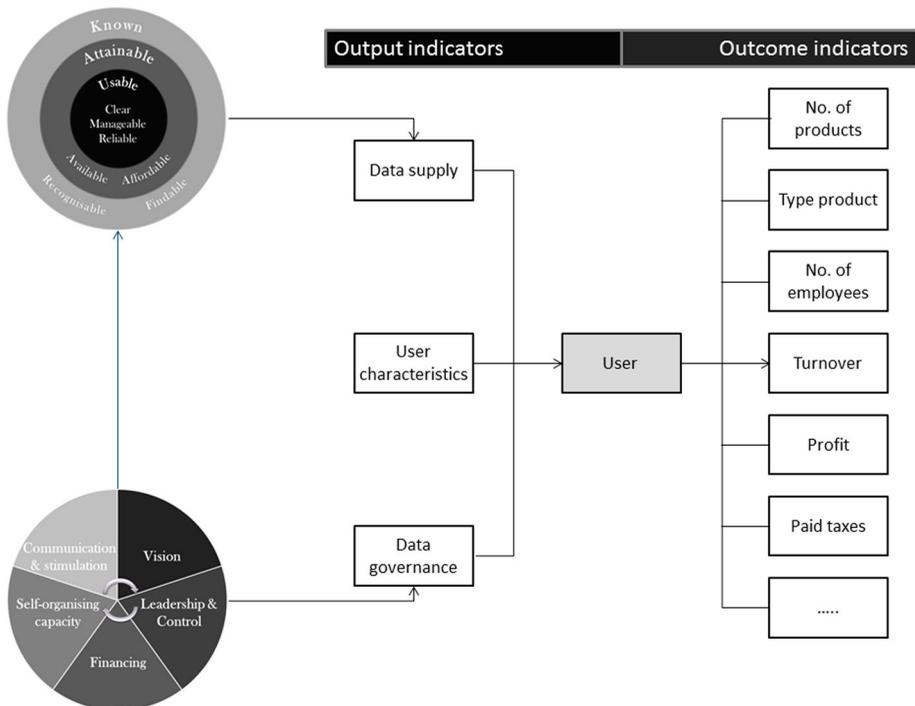


Figure 5. Output and outcome indicators of the holistic open data assessment framework.

4. Application of the framework to open data in the Netherlands: supply

Using the indicators identified in Section 3, we assessed the maturity level of data supply by using a scale of 1–5, 1 being the lowest score.

In this section, we will apply the developed framework to the Dutch open data ecosystem. We will do this for each part of the ecosystem: the data supply, the data governance, and the user characteristics. For each indicator we provide how the assessment was performed.

4.1. Indicators for ‘Known’

To assess the first sub-indicator ‘Known’, we used a profile-free search engine (<https://ixquick.com/>) to avoid the search engine adapting its behaviour to the used search terms.

4.1.1. Recognisable

To assess if a dataset is recognisable, that is, identifiable, we used a generic search term, for example, ‘elevation data’. If that did not result in a hit, we subsequently used the official name of the dataset, for example, ‘Actual Heights Model Netherlands’ and finally the official acronym, for example, ‘AHN’. A score of 1 indicates that the dataset was either not published or not identifiable; a score of 5 indicates that using a general search term provided the dataset as first hit.

4.1.2. Findable

To assess if the dataset could actually be found, we used the official OGD portal data.overheid.nl (data.gov.nl) as well as the National Geodata Register (NGR) and, if applicable, the data provider’s website, again using varying search terms. A score of 1 indicates that the dataset could not be located; a score of 5 indicated that the dataset could be located via ixquick.com (2), the data provider (3), as well as via NGR (4), and data.overheid.nl (5).

4.2. Indicators for ‘Attainable’

To assess if a dataset is attainable from a financial, legal, and practical aspect, we have used sub-indicators for finances (are tariffs, if applicable, published online?), licences (online, standardised licence), and service level (active/passive publication, type of data service, e.g. viewing/download/application programming interfaces [API]) and delivery time if dataset is not available online.

4.3. Indicators for ‘Usable’

There are many sub-indicators to assess the usability of a dataset. Below, we describe the selected sub-indicators.

4.3.1. Reliable

To assess the reliability of a dataset, a user should be able to check the quality of the data. As sub-indicators, we have checked the presence of metadata, their comprehensiveness, and standardisation and if metadata are available in more than one language. A score of 1 indicates no metadata or documentation; a 5 indicates complete and standardised metadata.

In addition, we considered if the dataset is published in a reliable way, that is, the data should not produce dead links, be available in the long term, and not be removed without a warning in advance to the users.

4.3.2. Clear

Not all users have sufficient expertise to (re)use data (cf. Gurstein 2011; Janssen, Charalabidis, and Zuiderwijk 2012). To assess if it is clear to the user how to use the dataset, we have researched if additional documentation, such as (multi-lingual) manuals and a FAQ platform are available.

4.3.3. Manageable

A user should be able to use the data with available resources and for the goal the user has in mind. As there is a large variation in different user needs (Bemelmans 1994, 186), see Figure 6, we could not develop an exact indicator to assess the manageability of the dataset. Instead, we quantified the manageability with a score of 1 for datasets published without options (only one version and format), and 5 to indicate more than three options.

4.3.4. Communication

For this indicator, we only researched if there is a helpdesk facility available with the data provider. The scope of our desk research did not extend to checking the response time and the level of knowledge of helpdesk staff, therefore, this indicator is only included in the user's perception part of our framework.

4.3.5. Up-to-date data

We researched the actuality and the update frequency of the dataset. A score of 1 indicates that a version was published once off and never updated; a score of 5 indicates that the most recent version (near real-time) is timely published.

- | | |
|-----|---|
| 1. | Coverage of required area:
local \leftrightarrow global |
| 2. | Actuality of data:
historical \leftrightarrow real-time |
| 3. | Data:
thematic \leftrightarrow Geodata Top 20 |
| 4. | Aggregation level:
1:1,000 \leftrightarrow 1:10,000,000 |
| 5. | Data formats:
choice between propriety \leftrightarrow open |
| 6. | Type of data:
static \leftrightarrow dynamic |
| 7. | Data service level:
viewing – download – API |
| 8. | Dataset size
kilobytes \leftrightarrow terrabytes |
| 9. | Completeness of data:
only most recent version \leftrightarrow time series |
| 10. | Data consistency:
consistent formats, location (URIs), etc. |
| 11. | Metadata:
standardised and complete |
| 12. | Language / semantics:
only in Dutch \leftrightarrow multi-lingual |

Figure 6. Variation in the user needs.

4.3.6. Long-term availability of data

We researched if a legal or policy commitment is published guaranteeing continuous availability of the dataset, for updates as well as historical versions. In addition, we assessed the technical sustainability of data availability, that is, at which level are the data published. We used the five-star model of Tim Berners-Lee (TBL)¹¹ whereby a score of 1 indicates that a dataset is published with an open licence, but not in a structured or open format, a score of 2 means that the data are available as machine-readable structured data, a score of 3 implies that the dataset has also a non-proprietary format. A score of 4 stands for dataset using open standards from W3C and a score of 5 indicates that the dataset is published as linked open data.

4.4. The assessment framework applied to top 20 most wanted datasets

To assess the open data supply part of our framework, we researched 20 datasets in the Netherlands.¹² The datasets were selected by using a ‘Top 20 Most Wanted datasets’ originally compiled by GeoBusiness Netherlands, an umbrella organisation for geographic information companies, in 2007 (ref. Groot et al. 2007) and updated in 2014 by GeoBusiness Netherlands and by the interviewed users. Whereas the 2007 Top 20 contained mostly geographical data (geodata), the 2014 version reflected a desire for other data, including healthcare data and energy data: a trend also reported by the OECD (Ubaldi 2013).¹³ Our desk research of the Top 20 Most wanted resulted in 27 assessed datasets, of which 19 are managed by national government bodies, 3 by municipalities, and 5 by non-government organisations (NGOs). Seventeen datasets were published as open data, six as non-open data, and four datasets were not accessible at all.

In addition to desk research, we used the experiences of open data users to assess the data supply. We selected our interviewees from a diverse group of users with diverse backgrounds. The interviewees represented companies of varying sizes (from one-person start-ups to large companies; from fulltime professionals to active amateurs; from geographical information/IT specialists to non-experts) and requiring open data for various purposes (value-added services, information intermediary, consultancy, and civil activism). In total, we interviewed nine users using structured interviews with semi-closed questions. We asked the users through open questions to reflect on the draft assessment framework and to apply the framework to their specific situation. In Table 1, we provide the resulting scores per category.

The table demonstrates that geodata score higher than non-geo data, that open data score better than fee-based data, and that national data score higher than municipal data and NGO data.

Table 1. Data supply scores (scale: 1 (low)–5 (high)).

	National geodata	National non-geodata	Municipal data	Open data ^a	Fee-based data	NGO data
Recognisable	3.85	2.75	1.67	3.29	4.13	3.00
Findable	4.45	2.75	2.33	4.53	3.38	3.00
Known	4.15	2.75	2.00	3.68	3.75	3.00
Affordable	4.20	1.25	2.00	4.65	2.00	1.60
Licences	3.80	1.00	2.33	4.47	1.38	1.20
Service level	3.80	1.00	2.33	3.94	2.50	1.40
Delivery time	4.35	1.25	2.00	4.65	2.38	1.80
Attainable	4.04	2.25	3.25	4.18	2.75	2.50
Reliability	2.55	0.75	1.33	2.71	1.50	1.00
Clear	2.80	0.75	1.33	2.82	1.88	1.20
Manageable	3.40	0.50	1.00	3.18	2.38	1.00
Up-to-date	3.30	0.50	1.00	3.12	2.25	0.80
Continuity	3.20	0.25	1.67	2.94	2.50	0.60
TBL score	1.95	0.75	0.33	2.53	0.00	0.60
Usable	3.05	1.10	1.90	2.79	2.80	1.53
Average score for Known, Attainable and Usable	3.75	2.31	2.03	3.46	3.13	2.47

^aTwo datasets were excluded from the categories ‘open data’ and ‘fee-based data’ as their status was unknown.

4.4.1. Known

The researched datasets scored 3.8 overall for 'Known'. As seen in [Table 1](#), national datasets already available in the traditional geographical information (geodata) domains scored better than non-geodata (healthcare and energy) for being recognisable and findable. Most of the researched datasets were recognisable but not findable unless the correct acronym was used or the data holder was known. Data that had only recently been available as OGD provided mainly search engine hits for private sector information services rather than links to the public data source. Municipal data scored only on average 2.0 as not all researched datasets could be found.

We found that using general search terms in the data portals [data.overheid.nl](#) and NGR resulted in non-related data and/or the search facility took a long time. Moreover, the researched local government open datasets were not registered in [data.overheid.nl](#), and only one out of eight energy network administrators published their energy usage data as open data. The researched municipal websites offered even poorer search facilities than the national data portals. Our desk research findings were confirmed by the user interviews.

From interviews, it emerged that users use various strategies to find data: general search engines, data catalogues, social media, and professional networks were all named as strategies. Users will contact the data holder directly if the data holder is known rather than using a data portal link. However, users indicated that it is hard to find out which government organisation holds which datasets. Especially municipal data are difficult to locate. Often, data holders cite protection of personal data as a reason for not publishing data. However, most users perceive this to be a fallacy because any personal data can be aggregated, anonymised, or removed in the end-product.

4.4.2. Attainable

The attainability of the researched datasets scored 3.9 overall, however, there were some points of concern.

Licences: Seventeen datasets were available as open data, however, two of which were published without a licence and three with a licence limiting re-use. Only one energy dataset was published with an open licence, the other two energy datasets were not public, as were the locations of healthcare providers. Not knowing which conditions apply creates uncertainty as not all open licences are equal (van Loenen, Janssen and Welle Donker 2012). The interviewed users confirmed they were hesitant to combine open datasets because of the uncertainty what can and cannot be done with the end-product. For instance, some health data may not be reused for commercial products but the intended end-product will be a free app. In one case, the licence conditions were hidden in a disclaimer.

Fees: We found that for one open dataset administration fees were applicable. Although these fees are only marginal, some interviewed users, mainly start-ups and activists, indicated that any charges pose a barrier to their use. Others, often professional users, indicated that paying a fee was not a barrier as long as the fee was in proportional to the business case of the end-product. For fee-based data, often tariffs (fees per unit, object, km²) are published online but no tariff for the entire (land-covering) dataset.

Services: For open geodata, we found that in most cases viewing services and download services were available and some data available via APIs, resulting in a score of 3.8. However, we found that for many geo-datasets clicking the download button of [data.overheid.nl](#) could result in an error message if one did not have appropriate software, as many datasets are linked to geo-web services of the PDOK Portal.¹⁴ Similar research found that 14% of all datasets released via the Dutch open data portal are not accessible because of broken links (Open State Foundation 2015). Non-geodata and municipal data scored, respectively, 1.0 and 2.3 with often no download services or APIs available at all.

Delivery time: Open data are often downloadable directly. Fee-based data scored 2.4 as the time to respond to a data request varied from 1 to 5 working days. For data that are not published, a user has to make a formal request according to the Public Information Act procedures. This procedure can

legally take up to 8 weeks, although appeal cases have been known to take years. Most users indicated that any delivery time of over 5 days is too long.

4.4.3. Usable

The usability of the researched datasets scored 2.9 overall. Our desk research resulted in significant differences between the usability of traditional geodata and non-geodata.

Reliability and clarity: In general, we found only limited metadata (if any) available and often only in Dutch. Most data suppliers provide additional documentation online but only in Dutch. Because of limited metadata, users find it difficult to check the quality of the data; however, this is alleviated to some extent by additional documentation. Apart from incomplete metadata, users perceived problems with no metadata updates, metadata not machine-readable, or not describing the data content.

Manageable: For most geodata there are multiple web services and versions available (e.g. area selection and different formats), with most often, two or three options available. For some open data, there is a limit to the maximum number of objects that may be downloaded ('fair use policy'). The researched healthcare data were published as an 'as-is' data dump without options and only available as viewing service. Viewing services developed by local governments or NGOs lacked user-friendliness and speed as such services use an open source interface developed some time ago, whereas most users are more familiar with 'Google-like' interfaces. Users perceive the level of detail not always to be sufficient or experience gaps in land-covering data.

Up-to-date: We found that for all researched datasets, a recent version was published, although the interviewed users indicated that often, the most recent version is not timely published. For some datasets, for example, aerial photography, historical versions were also available. We could not find any online commitment to ensure the (long-term) availability of the researched datasets, although the interviewed users assume this the case for key register data. For fee-based data, there is often a contractual clause pertaining to data availability.

Sustainable publication: Most of the researched open datasets were published in a structured format, although not always in an open format. Some of the open data, for example, health data tables, are only published in PDF format. Fee-based data are often available in an open format as well as propriety format. Thus, the researched data scored either 0, 1, or 3 stars in the TBL model. A number of users indicated that open geo-formats (e.g. GML or XML) were useful, whereas other users indicated that these formats were too complicated and preferred either a general open format (CSV) or a propriety format (shape files). The lack of URIs and linked open data were perceived to be a missed chance.

Figure 7 provides a summary of our findings.

5. Application of the framework to open data in the Netherlands: governance

In this section, we describe our findings of applying the governance part of our assessment framework. To assess the governance aspects of open data, we interviewed seven OGD holders¹⁵ using semi-closed questions related to governance and their experiences with user interaction. The interviewees were managers on operational level in charge of implementing open data policies. In addition, we asked the interviewed users what their experiences were related to communication with the government and their involvement in policy-making.

For the governance part of our assessment framework, we adapted the five elements of the maturity matrix for geographical infrastructures (cf. van Loenen 2006) to determine the governance of open data provision (see Appendix 2 for the detailed indicators):

- (1) Vision: to provide a common goal, to avoid a fragmented approach and to stimulate cooperation between stakeholders.
- (2) Leadership and control: open data need to have a problem owner who will stimulate and coordinate open data activities. Awareness creation and capacity-building may lead to political

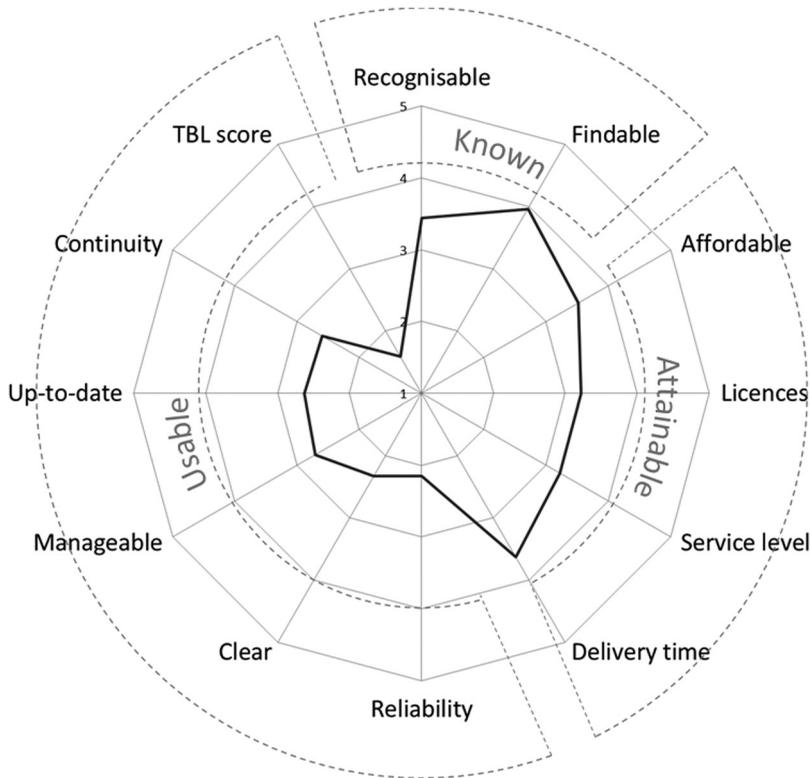


Figure 7. The open data state of the Netherlands in 2014 for the top 20 most wanted datasets.

support for open data, which is an important success factor (Craglia et al. 2002), as is work floor support.

- (3) Communication channels: with *whom*, *how*, and *what* is communicated. In the initial stages, this will be mostly internal communication and in later stages, also external communication.
- (4) Self-organising capacity: the way in which supply matches demand. In the initial stages, it will be mostly data providers requiring answers to specific questions and pro-actively promote open data. In later stages, matching supply and demand will increasingly become a part of the organisation's culture.
- (5) Sustainable financing: should extend beyond the initial stages and become embedded in the organisation's budget for data management and infrastructures.

5.1. Vision

The general vision of the Dutch national government is formulated in the 'Vision Open Government and Action Plan' policy document, based on the OGP framework of 'open, unless' for data that are already public. The Ministry of the Interior and Kingdom Relations (BZK) is responsible for the open data agenda. The Ministry of Infrastructure and the Environment (I&M), holder of many open datasets, has formulated a more extended open data policy for its agencies. Not only the most recent version must be published but also a minimum of four previous versions (if applicable); once-off published datasets are to be maintained for at least five years; and a deadline set for publishing all suitable data as open data.

We found that open data policies are firmly established within the government organisations and that there is broad political support. We also found that most government organisations follow the

extended policy of the Ministry of I&M rather than the general open data policy, although each organisation had their own interpretation of ‘open, unless’. There are variations in the decision on *how* to publish (pro-actively versus passively); *what* (all data versus only data not affecting the financial model); and *which licence conditions* (CC0 declaration, CC-BY licence or a non-standard ‘open’ licence).

5.2. Leadership

Open data are promoted for different reasons and consequently, there are vast variations in the perception of which organisation is actually providing leadership. The Ministry of BZK promotes open data from a transparency view, whereas the Ministry of I&M advocates open data to improve their data quality and more effective reuse between the agencies, and the Ministry of Economic Affairs (EZ) promotes open data to stimulate economic value-adding. Most users perceived the Ministry of I&M to provide leadership because of their extended open data policy, whereas most data holders considered their own organisation to be a leader in the open data field, or pointed to specific open data champions or open data activist. It was conspicuous that none of the other organisations viewed the Ministry of BZK as an open data leader although this Ministry is responsible for the open data agenda.

Although there is some cooperation on strategic level between government organisations with similar public tasks (e.g. between Provinces and Water District Boards for water management), there is almost no coordinated cooperation between ministries and between the municipalities.

5.3. Self-organising capacity

To determine the self-organising capacity, we have assessed which strategies are employed to promote/stimulate open data and match supply and demand of open data. The interviewed data holders are all involved in open data stimulation activities, such as conference presentations, organising workshops and hackathons, and offering innovation prizes. The Ministry of Economic Affairs organises so-called Open Data Relay events centred on specific themes, for example, Energy or Agro-food, in cooperation with the private sector. The aim of an Open Data Relay event is to match specific questions to available data.

The employed strategies concentrate on matching open data supply to demand or to improve internal data sharing. None of the data providers mentioned the government as a launching customer – as suggested by a number of users – as a potential stimulation measure. However, this may in part be due to governments having to adhere to the legal framework for public procurement conform the EU Public Contracts directives,¹⁶ which data holders view to be complex and a barrier to outsourcing.

5.4. Communication

Within the various government departments and agencies communication about open data takes place both on formal (ad hoc) and informal level during domain-specific meetings, via personal contacts, social media (Twitter and LinkedIn), and during open data events. Most communication concerns legal issues, best practices, and exchange of experience and knowledge. A point of concern is that announcements of specific open data research commissioned by one government organisation and the ensuing results are not disseminated to other government organisations.

Communication between government and external users occurs both formally via user group meetings held on a regular basis, usually annually, with professional users of a specific dataset, and informally via personal contacts, social media, and meetings. On formal level, there is ad hoc communication related to strategic level goals. On operational level, there is no formal communication with the exception of a few municipalities cooperating closely with the private sector. Most

of the communication concerns data updates, open data best practices, and event announcements. Users indicated that they appreciated this form of communication.

5.5. Financing

Development and implementation of open data require on-going resources. Although government organisations all faced budget cuts across the board, all interviewees indicated that open data processes are financed as part of their primary processes. However, interviewees of self-funding organisations, having to generate revenue to cover part of their operating costs, expressed their concern about the long-term/sustainable financing for key register datasets scheduled to be published as open data in the future instead of current fee-based data.

5.6. User perspective of open data governance

Some users (mostly large companies) use open data to provide an added level of service to their current customers. Other users/developers are still struggling to develop a sustainable open data business model. These users, often start-ups and small companies, would prefer the government to act as a launching customer. Their message to the government is to stop organising hackathons, with data only being available during the hackathon, and to stop waiting for the 'killer app' to be developed. Instead, the government should commission them to develop open data tools and applications required for a successful open data ecosystem. Users feel that they are better equipped to do so as they have closer ties to end-users and actually perceive the government's current initiatives to develop open data platforms and tools, etcetera to be unfair competition. Municipalities were perceived to be re-inventing the wheel related to open data platforms rather than reusing existing knowledge. Furthermore, if there was a platform/app store on data.overheid.nl showing products based on open data, users could see what had already been developed and, thus, save precious time.

Users perceived communication, both between government organisations and with the users, to be a key success factor for open data development. Although some professional users already participate in formal user group meetings for specific datasets, users indicated they would prefer to be included in more formalised and centralised communication with the government. This could be via a national open data user group, via an open data community, although social media are preferred for help on the fly.

Figure 8 provides a summary of the maturity level of open data governance in the Netherlands.

6. Application of the framework to open data in the Netherlands: user characteristics

Part of our research was to explore the resources and characteristics users need to create and market a successful product based on open data. As this part of the research was qualitative, we have not developed quantitative indicators to assess the maturity of the user. From the interviews held with users, we found that most users finance their own activities, sometimes aided by subsidies. Most users indicate that open data apps do not generate revenue (yet) but may serve as calling cards for made-to-order applications. Large(r) companies often use open data to improve existing products and services.

Users also indicated that, depending on the type of product, having knowledge of geographical data formats and geocoding is a prerequisite, as are general ICT skills to process database extractions and transformations, and to develop programming code and scripts.

Most users indicated that the most important characteristics are the ability to think outside the box, be creative, and, above all, have perseverance. Part of that perseverance is the ability to accept that data are often imperfect and incomplete and, therefore, a user has to work with the data that are available.

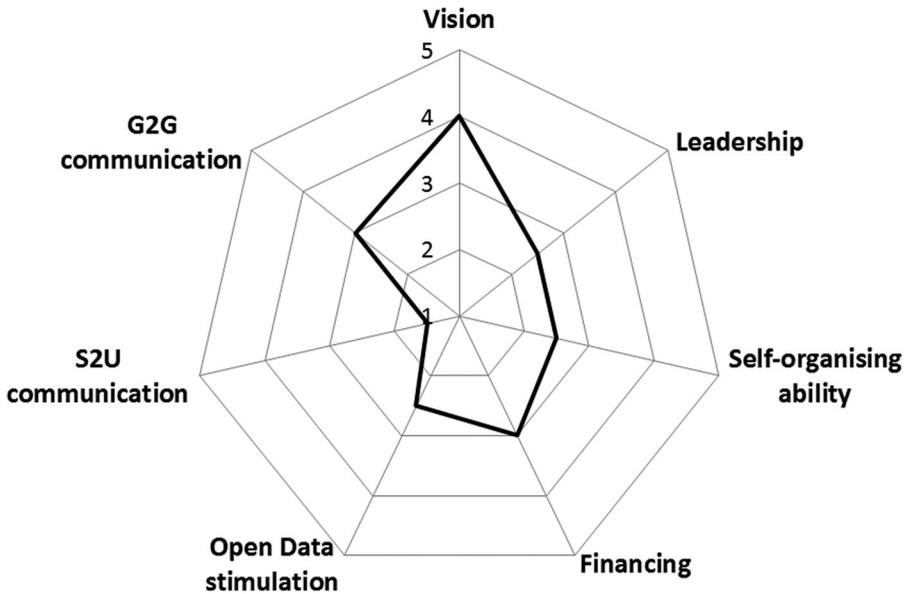


Figure 8. The maturity level of open data governance in the Netherlands in 2014.

7. Conclusions and recommendations for further research

This article presented a holistic open data assessment framework addressing the quality of open data supply, open data governance, and the user perspective of the open data infrastructure. By adding the user's perspective to our framework, a holistic comprehensive approach to open data assessment is provided. Our holistic approach reuses elements of existing open data assessment frameworks, such as access through a portal, highlighted in the CapGemini framework, the openness aspect of a dataset of the OKI framework, and some of the parts of the maturity framework of ODI. We do this, however, from a user perspective. We found that in 2014 in the Netherlands, the supply side of open data scored, on a scale of 1 (low)–5 (high), an average 3.41 and the governance of open data on average 2.71. These scores should be used as an indication to compare the maturity of the open data ecosystem over time and not as an absolute score.

In general, open data governance is well organised in some aspects but lagging in others. Although there is an open data vision on strategic level and the concept of open data no longer a point of discussion, there is no clear leadership outside each organisation. On an operational level, government organisations are struggling to apply the 'open data, unless' policy to their specific data and would benefit if one organisation took control. This organisation should provide advice and hands-on tools to other organisations to make data suitable for open data and to coordinate consistency. Many organisations currently do not publish high-value data because they lack knowledge on how to adapt sensitive data suitable for open data publication. In addition, formal and structural communication (both intra-governmental and with users) should be established to match open data supply to demand as most of the current communication occurs on an ad hoc and informal basis.

We applied the assessment model to the Dutch open data ecosystem to evaluate the state of the open data nation and to provide valuable information on (potential) bottlenecks. The model showed that 'traditional' geodata scored significantly better than other government data. It maybe that the standardisation and implementation rules laid down by INSPIRE Directive may have been a catalyst for moving geodata to a higher maturity level (see van Loenen and Grothe 2014). The assessment model provided policy-makers with useful inputs for further development of the open data ecosystem and well-founded strategies, to ensure the full potential of open data will be reached. Since the

publication of the State of the Nation in 2014, a number of the recommendations have already been implemented.

However, the assessment framework needs to be fine-tuned and made more user-friendly. The currently defined maturity stages need to be translated into concrete questions. Our results were based on researching a limited number of datasets and on a limited number of interviews. Therefore, the outcomes of the assessment may rely on some subjectivity. Although we considered the sample to be representative, the assessment model should be applied to assess more datasets. In addition, more users from a broader target group and more data providers, especially lower governments and NGOs, should be involved to validate the model. Once fine-tuned, organisations can use the model as a self-assessment tool to monitor the state of their open data ecosystem in cooperation with the actual users.

Assessing user needs in itself is complex and especially assessing user needs in open data since there is not one single user goal. As provided in the article, open data serves many masters and it is difficult if not impossible to model these masters in a single user need indicator. Therefore, we limited the indicators for communication as well as for usability to a generic, but still informative level.

The extent to which the Dutch case adheres to the ideal is informative for the specific data holder, but indeed questionable for the state of a country since we only obtained the data of nine interviewees. A survey approach may be needed to address this issue properly. We have added this issue in the recommendations.

Although the holistic framework was only applied to the Netherlands, its set-up is such that it can also be applied to other context and in other countries.

A further remark is that also the presented holistic assessment framework does not explain why open data cannot live up to its expectations. The addition of the user perspective including user characteristics is relevant for this assessment, but possibly also other aspects such as a critical mass of well-equipped users is equally of importance. Further research should look into this aspect of user (group) characteristics and its role in the performance of open data ecosystems.

Notes

1. <http://www.whitehouse.gov/open/documents/open-government-directive>.
2. [http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52010DC0245R\(01\)&from=EN](http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52010DC0245R(01)&from=EN).
3. <http://www.opengovpartnership.org/>.
4. <https://www.gov.uk/government/publications/open-data-charter>.
5. <http://creativecommons.org/licenses/>.
6. <http://index.okfn.org/>.
7. These datasets are: Election Results; Company Register; National Map (1:250,000 or better); Government Spending; Government Budget; Legislation; National Statistical Office Data; National Postcode Data; Public Transport Timetables; and Pollutant Emissions.
8. 'Open means anyone can freely access, use, modify, and share for any purpose (subject, at most, to requirements that preserve provenance and openness).' (<http://opendefinition.org/>)
9. <http://opendatabarometer.org/>.
10. Directive 2013/37/EU of the European Parliament and of the Council of 26 June 2013 amending Directive 2003/98/EC on the re-use of public sector information.
11. See <http://5stardata.info/en/> for an explanation.
12. The 2014 'Top 20 Most Wanted' datasets were: Key Registration Topography (1:10,000), Company Register, Statistical information related to local areas, Key Registration Large Scale Base Map, municipal information, aerial photography, Key Registration Addresses & Buildings, cadastral information, energy usage data, energy labels of dwellings, soil information, national railway data, national roads data, real-time traffic information, spatial planning, digital elevation map, national waterways data, water levels (real-time), health risk areas, and healthcare information.
13. See also the European Commission which ranked these datasets as the highest priority for being made available for reuse due to the high demand from re-users across the EU (see European Commission 2014; see also The Cabinet Office 2013).

14. PDOK (Public Services on the Map) was established as national geographical data portal for viewing, invoking and downloading services, part of the INSPIRE Directive 2007/2/EC requirements. Although primarily established for the public sector, anyone may view geodata and download if data are available as open data.
15. These data holders represented the Ministry of the Interior and Kingdom Relations; Ministry of Education, Culture and Science, the Netherlands' Cadastre, Land Registry and Mapping Agency; the Province of South-Holland; the Municipality of Rotterdam; and the Water Information House, a portal for water information of the provinces, water councils, and the Department of Public Works and Water Management.
16. Directive 2014/23/EU of the European Parliament and of the Council of 26 February 2014 on the award of concession contracts, Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC, and Directive 2014/25/EU of the European Parliament and of the Council of 26 February 2014 on procurement by entities operating in the water, energy, transport and postal services sectors, and repealing Directive 2004/17/EC.

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Appendix 1: Indicators used for 'Top 20 Most Wanted Datasets' desktop research



Appendix 2: Indicators used for assessment of Governance

