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Benchmarks for Evaluating the Progress of Open Data Adoption: Usage, Limitations, and Lessons Learned

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Abstract

Public organizations release their data for use by the public to open the government. Various benchmarks for evaluating the progress of open data adoption have emerged recently. In order to help bring about a better understanding of the common and differentiating elements in open data benchmarks and to identify the methodologies and metrics affecting their variation, this article compares open data benchmarks and describes lessons learned from their analysis. An interpretive meta-analysis approach was used and five benchmarks were compared with regard to metadata (key concepts, themes, and metaphors), meta-methods (methodologies underlying the benchmarks) and metatheories (theoretical assumptions at the foundation of the benchmarks). It was found that each benchmark has its strengths and weaknesses and is applicable in specific situations. Since the open data benchmarks have a different scope and focus and use different methodologies, they produce different results in terms of country ranks. There is an obvious gap in both the literature and benchmarks regarding the evolution of end-user practices and individual adoption of open data. Furthermore, lessons are drawn for the development of more comprehensive open data benchmarks and open government evaluation in general.

Introduction

Transparency of government information and operations is the foundational pillar of the open government ideal and a prerequisite for its two other pillars—participation and collaboration (Obama, 2009). Data openness is a crucial component to realize transparency and is an operational

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path of the open government strategy (Sandoval-Almazán, 2011). That is why one might even say that open data has defined the open government movement to a certain degree (Veljković, Bogdanović-Dinić, & Stoimenov, 2014). Besides, open data can as well be viewed as an example showing how the main values of open government can materialize: open data is a demonstration of transparency, it might create new opportunities for participating and engaging with government, and it offers new grounds for collaboration between diverse stakeholders.

Open data has recently become one of the high-priority issues on the agendas of government organizations at all levels in many countries. The directives on the reuse of Public Sector Information (PSI) of the European Commission (2003, 2013), Obama's Open Government Directives and policies (2009, 2013), and the development of national and local open data policies (e.g., Cameron, 2011) have contributed to the open data debate and aimed at stimulating governmental data publication. Open data is often viewed as a more proactive approach to releasing government information than passive approaches based on Freedom of Information legislation. It can be viewed in the broader scope of enhancing governmental openness (Luna-Reyes, Bertot, & Mellouli, 2014; McDermott, 2010) and it can potentially generate benefits for the economy, society, democracy, and governance. More specifically, open data has been hailed for its ability to increase transparency (Bertot, Jaeger, & Grimes, 2010); increase participation of citizens (McDermott, 2010); increase democratic accountability (van Veenstra & van den Broek, 2013); enhance and improve governmental and nongovernmental value-added services for citizens, industry, research, and others (Blakemore & Craglia, 2006; Neuroni, Riedl, & Brugger, 2013; Zhang, Dawes, & Sarkis, 2005). Open data is also a powerful resource for business innovation, as together with social media engagement it can drive the development of new business models (M. Janssen & Zuiderwijk, 2014) grounded on the collaboration between private and public actors.

Although these benefits make open data adoption attractive around the world, there are many challenges and impediments that government organizations and open data users typically experience in their efforts. For example, open data may be difficult to understand (Borzacchiello & Craglia, 2012), it may be difficult to determine data quality (Conradie & Choenni, 2012), and using open data may be time consuming and require hard work (Braunschweig, Eberius, Thiele, & Lehner, 2012). Publishing open data is complex, in addition, since there has to be consistent political commitment, appropriate organizational structures and resources, and technical competence inside public organizations to enable civil servants to release the data (M. Janssen, Charalabidis, & Zuiderwijk, 2012). Several countries, such as the United States and the United Kingdom, have advanced considerably in the open data domain; many countries, however, still lag behind—largely because of the many barriers encountered on the way (Nugroho, 2013).

Measuring progress is important when it comes to open data since assessments typically give credible insight into the strengths and weaknesses of a particular country and thus serve as powerful incentives for further improvements. Measurements may be seen as a reflection of a country's image and its position in the digital universe. Measuring and assessing the progress of open data adoption in various countries can be a way to investigate which actions are necessary to initiate open data programs throughout the world and where interventions can be applied most effectively (The World Bank, 2014). In addition, measurement of open data adoption could help in developing more focused assessments or processes related to the needs for local open data initiatives (The World Bank, 2014).

Many benchmarks for evaluating the progress of open data adoption in different countries have been recently developed by both academics and practitioners. As many open data benchmarks exist, open data users as well as policy makers and civil servants might be puzzled about which benchmark is most appropriate for a certain evaluation purpose. In order to help bring about a better understanding of the common and differentiating elements in open data benchmarks and to identify the methodologies and metrics affecting their variation, this article compares selected open data benchmarks and describes lessons learned from the analysis.

Research Background

In this section, we review relevant literature on the concept of maturity and benchmarking. For a review of the state of the art of open data research and the background of the open data movement, we refer to Zuiderwijk, Helbig, Gil-García, and Janssen (2014) and Hansen, Hvingel, and Schrøder (2013). Although our article is particularly focused on open data maturity, we take a broader perspective on maturity in the field of e-government. Open data is a relatively new discourse, while the term e-government has been around for about two decades now. E-government evaluation is a versatile and lively topic of academic discussions; there are conflicting views on what constitutes e-government maturity and how it could be operationalized in different contexts. Hence, there are a number of important lessons we can draw from that debate for the open data domain.

First, the overall approach to maturity in e-government has so far been evolutionary (Krishnan, Teo, & Lim, 2013)—governments are believed to progress through certain stages. Stages of growth models in general receive criticism for their limited applicability and misleading normative values: in practice, several stages may occur simultaneously. Further, the models are constructed in such a way that preceding stages appear to be "worse" than subsequent ones (K. V. Andersen & Henriksen, 2006). The contemporary debate about e-government maturity has shifted from supply-side models to user-centric maturity indicators. The view of e-government maturity as a function of integration and organizational and technological complexity in the early model by Layne and Lee (2001) can be considered a manifestation of technology bias. An alternative vision is proposed in the model by K. N. Andersen, Henriksen, and Medaglia (2012), which uses citizen orientation and activity centricity as the primary criteria for deriving the four e-government maturity stages, namely, cultivation, extension, maturity, and revolution.

Dwivedi, Weerakkody, and Janssen (2012) confirm that in recent years, the attention has gradually shifted from automating citizens' transaction with government to more comprehensive citizen-centric services. Hence, evaluations must be guided not only by the perspective of what is technically feasible but, more importantly, by the perspective of what is beneficial for the users. A meta-synthesis of six e-government models by Siau and Long (2005) followed such a path: lower e-government stages (web presence, interaction, and transaction) are seen as a process automation driven by a "technology leap," while higher stages (transformation and e-democracy) should be seen as service transformation driven by a "culture leap" and a "political leap." The lesson from this meta-synthesis research is that it is also important to understand the motivation and processes driving the transition of an organization from one stage to another.

Second, e-government evaluation often takes the form of benchmarking, which can be defined as "the measurement of some elements and the comparison of the outcomes to a certain norm, the benchmark" (Maheshwari & Janssen, 2013, p. S83). Benchmarking refers to the use of performance metrics to assess and compare different organizations or countries (e.g., UN e-government index and Accenture reports). Benchmarking can provide a better understanding of an organization's position and can help in identifying growth opportunities (Maheshwari & Janssen, 2013). Moreover, benchmarks can be used for the assessment of e-government results and to evaluate to which extent e-government goals have been satisfied (Veljković et al., 2014). Yet, various barriers for the use of benchmarks have been identified in the literature. For instance, Bannister (2007) mentions the poor design of benchmarks, their lack of reliability for measuring e-government progress, and their "risk of distorting government policies as countries may chase the benchmark rather than looking at real local and national needs" (p. 185). Benchmarking for electronic governance has been characterized by limited success (Ojo, Janowski, & Estevez, 2011) and benchmarks often lack elements that are relevant to stimulate further development (Maheshwari & Janssen, 2013).

As many e-government benchmarks differ, Kunstelj and Vintar (2004) propose to group them as follows: e-readiness, back office, front office supply, front office demand, effects, and impacts.

More specifically, Bannister (2007) suggests a taxonomy for e-government benchmarks that includes the following categories: frequency, source, scope (focus), and scale. In analyzing any benchmark, it is important to realize the focus and drivers for these studies (de Róiste, 2013). Many researchers caution about the intrinsic biases of e-government benchmarks; for instance, they most easily measure ''fast'' results, rather than significant structural changes (D. Janssen, Rotthier, & Snijkers, 2004). This means that in order to score higher, countries tend to pursue more measurable objectives rather than more intangible initiatives (Andersen, 2010). The conclusion is that by including or excluding certain variables (and countries) rankings can vary significantly.

Research Design

This study aims to answer the following research question: *How do existing open data benchmarks differ in measuring open data maturity and what can be learned from this?* Thus, the purpose of this research is to compare and interpret the discrepancies between them and draw lessons from this. The benchmarks were selected based on the following criteria: (1) the benchmark should rank countries, organizations, or other entities based on one or more aspects of open government data publication and/or use; (2) the benchmark should rank multiple countries, organizations, or entities worldwide; and (3) the information about the benchmark is available and accessible. Applying these inclusion criteria resulted in the selection of the following five open data benchmarks:

- Open Data Readiness Assessment (ODRA)[1] produced by the Open Government Data Working Group of the World Bank;
- Open Data Barometer (ODB)[2] produced by the Open Data Institute and the World Wide Web Foundation;
- Open Data Index (ODI)[3] produced by the Open Knowledge Foundation (OKNF);
- PSI Scoreboard[4] produced by the European PSI (ePSI) Platform;
- Open Data Economy benchmarking research[5] produced by Capgemini Consulting.

In this study, we use the interpretive meta-analysis approach, which means we aim to develop new interpretations from the analysis of multiple studies without having an a priori concept to test (Given, 2008). Meta-analysis of qualitative research involves synthesis of evidence from the primary studies (in our case benchmarks) that can be carried out using various techniques. In our case, we chose the meta-study method (Paterson, Thorne, Canam, & Jillings, 2001), which seeks to reveal similarities and discrepancies among accounts of a particular phenomenon (Barnett-Page & Thomas, 2009). Meta-study comprises the analysis of (1) metadata (identification of key concepts, themes, and metaphors in primary research); (2) meta-method (evaluation of methodologies underlying individual studies, including sampling, data collection, and research design); and (3) metatheory (reflecting on the theoretical assumptions at the foundation of the individual studies; Paterson et al., 2001). The synthesis is thus a process in which an interpretation is created, which accounts for all three elements of the analysis.

As Figure 1 shows, the research process has been divided into three steps. First, regarding the metadata, qualitative analysis of open data benchmarks was performed in order to compile a list of concepts, themes, or metaphors (maturity elements) underlying each benchmark. The analysis was first conducted by two authors separately and then compared and refined in agreement. The thematic overlaps and gaps to contrast the different focus and scope of the open data benchmarks were discussed. Second, regarding the metatheory, the academic literature that conceptualizes the maturity of open data initiatives was reviewed. Four conceptual open data maturity models were found. Then we discussed the relationship between the selected open data models and the five benchmarks in terms of conceptualizations of maturity. This also gave us the ground for conclusions about

Figure 1. Research design for benchmark comparison adapted from meta-study method (Paterson et al., 2001).

whether, where, and exactly how the research concepts are reflected in the applied benchmarks. Third, regarding the meta-method, we evaluated the methodologies underlying each of the benchmarks, including the sampling, data collection, data validation, and the researcher's role. These three steps provided us with insights about how the different methodologies influenced the findings of each particular benchmark.

Metadata: Comparing Scope and Focus of Benchmarks

In the first step of this research, we surveyed the selected five open data benchmarks and ascertained which indicators of progress were used in each of them and what the implications of using these indicators are. More specifically, a comparison is provided of the purpose each benchmarks serves, the scope and the main themes covered, the concepts in focus, and the underlying metaphors of what constitutes progress in open data. The details of our comparison can be found in Table 1.

As Table 1 shows, each benchmark was developed to serve a different purpose with varying degree of specificity. Although the main purpose of benchmarking is to provide an assessment of a situation of open data in different countries (as strictly followed in PSI Scoreboard), notably two benchmarks—the ODI and the ODRA —aim at more than that, namely, at fostering interaction between open data stakeholders. The first one seeks to encourage advocacy and push governments to improve and the second one—to establish dialogue between all open data stakeholders at an early stage in the process. The issue of identifying the challenges to open data resounds in the ODB. The Capgemini Open Data Economy benchmark, being authored by a private profit-oriented actor, has the most specific purpose of offering expert advice on how to achieve the economic value of open data.

All benchmarks have a different scope and focus, as found from our qualitative analysis of the main themes and concepts of the benchmarks. For example, the World Bank's ODRA covers the initial stage in the open data process and is solely dedicated to evaluating the different aspects of readiness. In a similar vein, the PSI Scoreboard has a pronounced focus on the legal regime surrounding open data publication and use in a country, although it also includes selected implementation aspects and local PSI. The ODI exclusively measures data sets availability and openness, thus being the most supply-oriented benchmark of all. Selectiveness of variables to measure can be also observed in Capgemini's Open Data Economy that includes one readiness aspect (political

Table 1. Qualitative Thematic Analysis of Selected Open Data Benchmarks.

	World Bank—Open Data Readiness Assessment	Open Data Institute and World Wide Web Foundation—Open Data Barometer	Open Knowledge Foundation—Open Data Index	ePSI Platform—PSI Scoreboard	Capgemini Consulting—Open Data Economy
Purpose	To be a diagnostic tool and a basis for consultative dialogue between open data stakeholders	To serve as snapshot picture of diffusion and illustrate common progress but also different pathways and challenges	To be a tool for advocacy, to question performance of governments, to be reliable but also easy to use	To assess the overall PSI reuse situation including open data community activities	To be a guideline for realization of economic benefits of open data
Themes scope	Readiness	Readiness, implementation, and impact	Data set availability, data set openness, key high-value areas, and national-level services	Transposition of EU directive, national reuse policy, formats, pricing, exclusive arrangements, local PSI, events and activities	Data availability, usability of data portal, and political leadership
Concepts focus	Favorable conditions, leadership, policy framework, institutional structure and capacities, data management, demand for open data, citizen engagement, open data ecosystem, financing, national technology infrastructure, national skills infrastructure	Government readiness, civil society and citizens readiness, business and entrepreneurs readiness; availability of data sets; data sets for innovation, data sets for social policy, data sets for accountability; political impacts, economic impacts, social impacts	Publicly available data, freely available data, data available online, data in machine-readable formats, data available in bulk, up-to-date data, open license, available terms of use, metadata, data quality	PSI directive, right of reuse, commercial/ noncommercial reuse, redress mechanisms, proactive publishing of PSI, availability of standard licenses, endorsement of open standards, endorsement of raw data, data catalogues, endorsement of linked data, PSI pricing mechanisms, exclusive arrangements, local PSI availability, local community activity, annual national/interregional events	User interface, search functionalities, user participation, and communication; government initiative, government support; breadth of data, granularity of data, timeliness of data, and ease of reuse

Table 1. (continued)

	World Bank—Open Data Readiness Assessment	Open Data Institute and World Wide Web Foundation—Open Data Barometer	Open Knowledge Foundation—Open Data Index	ePSI Platform—PSI Scoreboard	Capgemini Consulting—Open Data Economy
Metaphors *rationale*	Progress of open data as evolution of a dynamic ecosystem that is rich in supply and reuse and fuels innovation by many different stakeholders	Effective OGD initiatives require involvement of government, private sector, and civil society	Progress in open data connected to data publishing, namely, making more data available in digital form for free, using open license and clear terms of use, having good metadata, ensuring quality of content and data presentation and the overall usability	PSI progress is largely driven by creating obligation by law and having a detailed compliant policy framework, but also by endorsement of recommended formats and pricing mechanisms, by publication of local PSI data sets, and by local community activity and annual events	Maturity of open data program determined by political support, "comprehensiveness" of data (high value and breadth, granularity), data uptake driven by ease of use, and user participation in the community

Note. OGD = open government data; PSI = public sector information.

leadership), assesses implementation in the form of data publishing practices and data quality, and refers to the ease of reuse and user participation as preconditions for emerging impacts. The most comprehensive perspective is adopted in the ODB which includes measures at all major stages—readiness, implementation, and impact.

In addition, it is important to discuss the underlying metaphors explaining the rationales behind the benchmarks and what view of maturity is adopted therein. The ODI views open data progress as a supply measure, that is, data availability, data openness, and data quality in selected 10 "high-value" areas. The fact that the benchmark is built on the "high-value" data sets in this case can be misleading, as the benchmark is not intended to measure arising impacts. This index is rooted in the assumption that data publication automatically leads to benefits. The missing link, the actual use of data, is somewhat recognized in Capgemini's Open Data Economy that measures the ease of use of data portals, namely, discoverability of data and the functionalities for user interaction online. This benchmark thus stems from the assumption that open data maturity is achieved through continuous supply of comprehensive data (often fuelled by political support) and ensuring easy sourcing of data and effective user participation. It thus promotes a healthy supply–demand view of the open data process. The World Bank's ODRA tool emphasizes this view in the most comprehensive way, as it advances the idea of a dynamic and evolving open data ecosystem. The ODB takes a similar position by stressing the importance of involvement of major stakeholders throughout the open data process (government, business, and civil society). The rationale of the PSI Scoreboard is very instrumental, as it links open data progress foremost to creating legal obligations for government organizations regulating data publishing and reuse. It is a useful tool for an initial stage of an open data program, but it neglects the complexities of actual data use, existing demand for data, and all further sustainability issues. For example, the benchmark in one of its measurements combines data availability with community activity (identified by mailing lists or websites), presuming that activity grows automatically and independently as more data are being released.

In short, although there is an overlap, especially regarding data set assessment, each individual benchmark has a designated focus and views open data maturity in a different way.

Metatheory: Matching Benchmarks to Academic Theories

In this section, we identify and reflect on the theoretical assumptions underlying the benchmarks and couple them to existing academic open data maturity models from the literature. We found four such models that are relevant for further investigation in this article:

- Stage model for open government data by Kalampokis, Tambouris, and Tarabanis (2011). This model is based on an overview of literature on e-government maturity models and consists of the dimensions organizational/technological complexity and added value for data consumers;
- Open data maturity model (OD-MM) by Solar, Concha, and Meijueiro (2012). This model is based on the literature and is validated using expert interviews. It has a three-level hierarchical structure called domains (3), subdomains (9), and critical variables (33) and infers an organization's open data maturity from the capacity levels across the critical variables;
- Open government maturity model for social media–based public engagement by Lee and Kwak (2012). This model is based on literature, case studies, interviews, archival data, and a focus group. It aims to "guide open government initiatives which focus on transparent, interactive, participatory, collaborative public engagement that is largely driven by the Open Government Directive and enabled by emerging information and communication technologies such as social media and Web 2.0." (p. 493). We decided to include the open government maturity model by Lee and Kwak (2012) in the sample, as it has open data as one of its core components;

Table 2. Descriptive Characteristics of Selected Open Data Maturity Models.

Models	Unit of Analysis	Main Stages	Function of Maturity
Kalampokis, Tambouris, and Tarabanis (2011)	Technological and organizational aspects of data integration	Aggregation, integration, integration with nongovernment formal data, and integration with social data	Increasing capabilities to develop value-added services based on more complex integration of data
Solar, Concha, and Meijueiro (2012)	Organizational capacities to comply with requirements in legal/managerial, technological, and user-oriented dimensions	Scale: inexistent, emerging, existent, and advanced	Institutionalizing procedures and best practices for user-oriented open data process
Lee and Kwak (2012)	Processes and objectives of data transparency	Initial conditions, data transparency, open participation, open collaboration, and ubiquitous engagement	Realizing the public value of data transparency and citizen participation
Sayogo, Pardo, and Cook (2014)	Data publishing, open data portal features	Scale: no features, limited, and advanced Compliance with standards	Following standards in data publishing and providing online features for data manipulation and user engagement

- Framework for benchmarking open government data efforts by Sayogo, Pardo, and Cook (2014). This model is based on the assessment of 35 open government data portals by using the principles of the Sunlight Foundation (2010) and the Open Government Working Group (2007) and by applying the criteria of data manipulation and engagement capability to 8 of these 35 portals.

The main descriptive characteristics of these four models are summarized in Table 2. Each of these models has its limitations. For example, the model of Kalampokis et al. (2011) is focused on data integration and thus combines technical and organizational complexity into one dimension. This means that in this model, a poorly implemented linked data initiative is "more mature" than a well-organized and sustainable release of data files in repositories. This model emphasizes technical progress and has limited applicability, as yet, to real-life situations since most open data initiatives are still at the aggregation stage. The model of Solar et al. (2012) has a far broader vision on open data maturity, as it also covers citizen and entrepreneurial perspective. The model includes practices aimed at supporting developers and facilitating citizen participation on the basis of open data. However, the model infers maturity from organizational capacity, which means that if in a certain case the capacities are present but not realized, it would still count toward greater maturity level. The model by Lee and Kwak (2012) on open government maturity is heavily value laden in that it includes a large number of normative terms, such as "ubiquitous" and "'open," without detailing the organizational transformation enough. It simplifies reality by viewing open government development as a strictly linear process driven by technology advancements. For example, the use of collaborative software automatically indicates Stage 3. Finally, the model by Sayogo et al. (2014) takes a similar approach to that of Solar et al. (2012), as it examines data manipulation and engagement capabilities but focuses strictly on the online features enabling

participation and collaboration rather than the business processes and organizational activities to put them in place.

All in all, the major differences between these models originate in the underlying definitions of open data. Open data has a narrow definition as an open data artifact and a broad definition as an open data process. Sayogo et al. (2014) and partially Kalampokis et al. (2011) adopt the narrow definition, while Lee and Kwak (2012) and Solar et al. (2012) adhere to the broad one. Further, for practical convenience, it appears necessary to distinguish between open data maturity (how well established a process is) and open data sophistication (how advanced a process is). In this sense, Kalampokis et al. and Sayogo et al. measure the sophistication of an open data initiative, while Solar et al. and Lee and Kwak offer better insights about the maturity of it.

It is important to compare the views on maturity adopted in the five selected benchmarks with the conceptualizations from the aforesaid academic open data models. We argue that it is possible to pair some of them, allowing a margin of interpretation, as there is thematic overlap. For example, since the ODRA benchmark of the World Bank is concentrated on readiness, it shares the logic of the Solar et al. (2012) model that centers on various organizational capacities related to open data. Similarly, the models of Sayogo et al. (2014) and Lee and Kwak (2012) echo the Open Data Economy benchmark of Capgemini Consulting, as they all emphasize quality data publishing and user participation opportunities. It is also noticeable that certain models and benchmarks share the data-driven focus as is the case with the ODI benchmark and the model of Kalampokis et al. (2011). The legal dimension of open data initiatives, dominating in PSI Scoreboard benchmark, is only present in the model of Solar et al.

The foregoing leads us to the conclusion that there is a certain tension between research and practice. The models put forth normative objectives and detail organizational practices, included in the user-oriented dimension, but they do not explain individual adoption of open data and they give ambiguous insights about how the impacts are achieved. This missing link—actual use of data—is very difficult to measure, and hence it is only indirectly accounted for in the open data benchmarks (e.g., as community activity or emerging impacts). As the provision of open data matures, so does the consumption of it—and there is an obvious gap both in the literature and benchmarks regarding this evolution of end-user practices.

Meta-Method: Analyzing Benchmark Methodologies

In this section, we compare the five benchmarks based on the methodology they employ to achieve results. The criteria for comparison, as illustrated in Table 3, include country sampling, frequency, researcher role, type of data, collection method, validity check, weight of components, and scale. The use of different methodologies can explain variation in the ranks of countries, which is often important to decision makers.

First, the selection of countries to be included in benchmarking projects is always strategic. In our comparison, we can observe some extremes in this regard: the Open Data Economy benchmark of Capgemini Consulting only surveyed the countries where open data efforts had already been initiated, while the ODRA of the World Bank works mainly with countries only about to initiate their open data programs. The country sample in the ODI is based on pragmatic reasons, featuring those where such crowdsourced research can be carried out. The PSI Scoreboard is a specific snapshot of the European open data landscape, while the ODB aims to take a global view including not only "already successful" countries of certain regions but also accounting for the developing context of open data.

Given the young age of all benchmarks, little comparison can be done for a particular country over time; of the five benchmarks, only the ODI had two editions (2012 and 2013). The benchmarks

Table 3. Comparison of Methodologies of Selected Open Data Benchmarks.

	World Bank ODRA	ODI Barometer	OKNF OD Index	ePSI Scoreboard	Capgemini OD Economy
Country sampling	Three countries On demand Can be applied at subnational level	77 countries Countries from the Web Index	70 countries Countries with free and active civil society to carry out research	28 countries EU member states	23 countries Countries that have already initialized some open data initiatives
Frequency	On demand	Pilot study in 2013	Continuously updated, but yearly editions since 2012	Beta version Continuously updated	On-off report
Researcher role	In cooperation with country officials	Selected expert researchers	Crowdsourced by global community of experts and advocates of open data	By ePSI platform staff	By consultants
Type of data	Factual evidence, interview responses	Expert survey responses, secondary data	Factual evidence, individual assessment, 10 key data sets considered high value in G8 OD Charter	Policy documents, online research, unclear how local experts are surveyed	Individual evaluation of functionalities
Collection method	Information requests to client, interviews with stakeholders, desk research, and evidence marked as "+", and "−"	Expert survey and data sets assessment	Survey and data sets assessment	Desk research and network of local experts	Unclear
Validity check	Professional contracted team, agreement with client about assessment details, and methodology available as living document	Double-blind peer review, verification by technical expert, researchers indicate confidence levels of their responses, and all data archived and openly available	Peer review by country editors, special discussion list, and possibility to make edits and corrections	Data openly available in spreadsheet and feedback via contact form	Problematic
Weight of components	Importance ranges from medium to very high	Three components have equal weight, their subindices are calculated as average of the constituting variables	Availability questions have different weight (most points for open license), country score calculated from 10 data sets scores	Seven indicator groups have equal weight (700 points), within them individual indicators have varying weights	Three dimensions have equal weight

Table 3. (continued)

	World Bank ODRA	ODI Barometer	OKNF OD Index	ePSI Scoreboard	Capgemini OD Economy
Scale	Red = significant obstacles exist Amber = no significant obstacles and no favorable conditions Green = favorable conditions exist	Assessment on 0–10 point scale (scoring guidance for extreme points), 100 points illustrates the highest scoring country and not the ultimate possible score	Yes/No/Unsure for availability questions, 0–10 for data quality questions (minimum scoring guidance, justification possible in comments)	Yes/No questions	0–3 scale (no scoring guidance available)

Note. ODRA = open data readiness assessment; OD = open data; EU = European Union; ePSI = European Public Sector Information.

were carried out by professionals affiliated with a certain organization (ODRA and Open Data Economy benchmarks), by a pool of volunteer researchers (ODI and ODB), or a combination of both (PSI Scoreboard). In the latter two options—crowdsourced benchmarks—mechanisms of verification and checks are said to have been implemented. A major strength of the crowdsourcing approach is the possibility for any user to propose edits thus enhancing the reliability of research findings. This functionality exists in the ODI and the PSI Scoreboard, which process requests for edits or input on a continuous basis. The ODB, though encouraging the exploration and reuse of gathered data, does not actively promote further collaborative editing of their research.

Most benchmarks build on the analysis of primary and secondary data gathered during online research, data set assessment, and interviews with experts. It is important to note that where data set assessment takes place (ODI and ODB), there is limited scoring guidance, providing indicators for 2–3 points on a 10-point scale. However, the ODB encourages its expert researchers to indicate the level of confidence they place in each of their scores. We find that the most "engaged" approach, in terms of obtaining primary data from all concerned stakeholders of a particular case, was adopted by the ODRA. The remaining benchmarks have an arbitrary selection of interviewees dependent on the judgment of an individual expert. The most "closed" piece of research is the Open Data Economy of Capgemini Consulting, where there is very limited information available regarding the methodology used.

This comparison of methodologies shows that the ranks of countries around the world (as offered by the ODI, the ODB, and the PSI Scoreboard) should not be expected to convey a strictly numeric position of a country but rather an approximation of reality. The ODB, for example, also provides a "heat map," which is a more argumentative means to illustrate open data diffusion.

Discussion

Each benchmark has its strengths and is applicable in specific situations. The strength of the ODRA is that it gives a comprehensive early stage assessment of the initial conditions that will ensure a strong open data initiative. The ODB offers an insightful analysis of the entire chain (readiness, implementation, and impacts) and is a goal-oriented measure that can be used to understand how to tailor implementation so as to achieve a particular impact (economic, social, or political). The strength of the ODI is that it is a continuous measurement of data set supply that promotes better openness and quality of data; it thus can be used as a technical guide in the publication of data. The PSI Scoreboard, like the ODRA, is more applicable at an early stage. The PSI Scoreboard has a general focus on PSI; it is useful as a checklist instructing the legal regime, technical issues, and the initial institutional arrangements required to get data publishing off the ground. Finally, the Open Data Economy has limited applicability due to the lack of transparency, but it is a useful tool to help public managers understand the interplay between supply and demand and how to set up basic interaction at an open data portal. Which method is most useful to assess open data maturity depends on the context and goals of the open data initiative. For instance, if one aims to determine only readiness for open data initiatives, it may be sufficient to use a benchmark that includes only readiness metrics, while the assessment of the entire open data chain (readiness, implementation, and impacts) requires another benchmark.

An important element that characterizes comprehensive benchmarks is improvement support. The data-oriented measurements like the ODI and Capgemini's Open Data Economy overlook the organizational transformation that should accompany the technical infrastructure for open data and thus send false signals to countries attempting to improve their rank. The issues of sustainability of governance structures and processes and the building of an ecosystem around open data should be at the core of any open data benchmark. While the recommended data formats, standards, pricing, and policies are precisely formulated in the open data benchmarks, the issue of

community building, for example, does not have tangible and measurable indicators and thus gives few hints about how to improve liaison with different stakeholders and which tools to use for any particular group. Overall, most examined benchmarks cover the supply side more extensively and include only one or two measures for data use and demand.

Many different open data benchmarks have been found in this research developed by both academics and practitioners. A reason for the diversity of benchmarks may be that open data is an emerging field, and open data initiatives have been developed all over the world. These initiatives are set up by different types of organizations, with heterogeneous goals, scope, and definitions, resulting in benchmarks that have a different focus. When one benchmark may not be appropriate for assessing a specific maturity aspect, alternatively a new benchmark may be developed. Furthermore, to date, limited research exists on the usefulness and the effects of existing benchmarks, which may lead organizations to retain from reusing an existing benchmark and instead developing their own new benchmark that they feel more confident about.

The question remains whether open data benchmarks result in open government. Open data publication is only one aspect of opening governments. Moreover, governments may take measures to adhere to open data benchmarks, while actually they do not become significantly more open. It is therefore important to realize that open data benchmarks are only an approximation of reality. Additionally, since the open data benchmarks have a different scope and focus and use different methodologies, they produce inconsistent results in terms of country ranks. Decision makers may use the results of the benchmark that gives the best rank and most positive impression of their country to their advantage. Selectively using a benchmark to a country's advantage without being aware of its strengths and weaknesses may result in merely chasing open data benchmarks instead of looking at real needs for open data progress.

Conclusions

The objective of this article was to investigate how existing open data benchmarks differ in measuring open data maturity and what can be learned from this. The investigated benchmarks included the ODRA (World Bank), the ODB (Open Data Institute and World Wide Web Foundation), the ODI (OKNF), the PSI Scoreboard (ePSI Platform), and the Open Data Economy (Capgemini Consulting). The meta-analysis methodology used to evaluate and compare these five benchmarks consists of three steps, namely, metadata, metatheory, and meta-method. This method allowed for comparing the scope and focus of the benchmarks, their theoretical underpinnings, and the methodology used in rankings.

With regard to metadata, it was found that although there is overlap, especially regarding data set assessment, the benchmarks were developed to serve different purposes with varying degree of specificity, scope, and focus. Most open data benchmarks (except for ODRA of the World Bank) produce results that are generic and ambiguous for any particular organization. As far as metatheories were concerned, differences between models from the literature mainly originate from the underlying definition of open data. Further, there is a tension between reality on one hand and academic open data models and benchmarks on the other. There is an obvious gap in both the literature and benchmarks regarding the evolution of end-user practices and individual adoption of open data. Models and benchmarks should to an important part be guided from the perspective of what is beneficial for open data end users, as this is the primary goal of opening data. Therefore, we recommend developing benchmarks from this perspective. With regard to meta-method, the benchmarks that provide ranks of countries should not be expected to convey a strictly numeric position of a country but rather an approximation of reality.

We found that each benchmark has its strengths and is applicable in specific situations. In this research, open data benchmarks have been assessed individually, while they can complement each

other. It is worth investigating to what extent the selected benchmarks can be integrated in ways that may result in a more comprehensive and more inclusive open data benchmark. From the analysis in this article, the following lessons are learned for the development of more comprehensive open data benchmarks. First, the lesson is drawn that measurements of open data benchmarks should cover various levels, including open data policies, readiness, implementation, adoption, and impact. Second, measurements should focus on different aspects of open data ecosystems, including open data publication, organizational transformation, community building, user support, feedback loops, to name a few. Third, open data benchmarks need to be developed at various administrative levels and should cover local levels (e.g., individual organizations), high levels (e.g., countries or continents), and levels in between (e.g., regions). Fourth, the lesson is drawn that the open data benchmarks should provide support for improving the existing situation, and fifth, that they should be validated. There should be continuous measurement of the open data benchmarks over time, and continuous research on open data benchmarks is necessary to keep up with the rapid developments in the field of open data.

Open data is only one aspect of open government, which is already difficult to measure. Only a few efforts have so far been undertaken to benchmark open government in its full scope; more attention was paid to the development of theoretical frameworks and models illustrating the complexity of open government (Lee & Kwak, 2012; Sandoval-Almazan & Gil-Garcia, 2014). The open data component of the open government strategy is thus a gateway for measuring open government. This can be explained by the fact that the remaining components of open government, that is, participation and collaboration, which form the ''front door'' or the citizen side of open government (Sandoval-Almazán, 2011) lack coherent and pragmatic conceptualizations. Thus, the research community is faced with a challenge to develop tangible indicators for measuring user engagement in the open government context. We believe our findings have important implications in this regard and some of our recommendations can be carried along in developing benchmarks for open government. For example, when evaluating the progress of collaboration enabled by open government, it is similarly important to focus on the user side and adoption rather than confine oneself to the availability and provision of opportunities for collaboration. Collaboration should as well be measured via its different aspects, most notably the output and processes; using technology-driven indicators (e.g., use of collaborative software) should be avoided. The ecosystem approach to open government (Harrison, Pardo, & Cook, 2012) can be very fruitful for developing evaluation metrics, as we argue also in the open data case. Thus, future research can take a more in-depth and focused look at what else can be learnt from open data benchmarks (as well as e-government and e-participation indices) for the development of a sound open government benchmark.

Declaration of Conflicting Interests

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Notes

1. http://data.worldbank.org/sites/default/files/1/od_readiness_-_revised_v2.pdf.
2. http://www.opendataresearch.org/barometer.
3. https://index.okfn.org/country.
4. http://www.epsiplatform.eu/content/european-psi-scoreboard.
5. http://www.capgemini-consulting.com/the-open-data-economy-0.

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