

Methodologies and Best Practices for Open Data Publication

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Abstract. Publication and reuse of machine-readable data on the Web is one of the current trends in data management that is mainly manifested by the Open Data movement. This movement is especially strong in the government and public sector domain where many Open Government Data initiatives have been launched in a large number of countries across the globe. In the European Union the recent update of the PSI Directive aims at fostering the reuse of data and information held by the public sector bodies by promoting publication of data in open machine-readable formats together with the relevant metadata. Even though the support of governments and the EU to Open Data and PSI reuse seems to be strong, public sector bodies are facing many challenges when publishing Open Government Data and the desired reuse is not always evident. In order to overcome these challenges Open (Government) Data publication methodologies are being proposed and the best practices in this domain are being formulated. In this paper we discuss the current challenges related to the OGD publication and reuse, we provide an overview of the existing methodologies and the best practices for publication of Open Government Data, we present an OGP publication methodology developed in the COMSODE project.

1 Introduction

With many Open Government Data initiatives being executed in a large number of countries across the globe (see for example [36]) and the recent update of the PSI Directive [8] we can see a significant shift towards provision of data held by the public sector bodies in machine readable formats together with the relevant metadata.

According to [23] Open Data is “*data that can be freely used, reused and redistributed by anyone – subject only, at most, to the requirement to attribute and share-alike.*” In this paper we refer to Open Data published by public sector bodies (PSBs) on the web in machine-readable formats as Open Government Data (OGD).

Open Government Data promise significant benefits that can range from increased efficiency and effectiveness of the public sector bodies to greater trust and improved transparency [25]. Significant economic impacts are expected from the reuse of OGD as well. However current studies often provide only estimates and there is still lack of empirical evidence [30]. Even though the support of the top management is a neces-

sary prerequisite of a successful OGD initiative it does not guarantee the reuse of the released data [25]. One of the reasons might be that the public sector bodies sometimes view the OGD from different perspective than the potential users [32].

It is evident that there are many issues related to publication and reuse of OGD. In order to help the involved stakeholders to deal with these issues methodologies and best practice guidelines for OGD publication have been developed or are currently under development. In this paper we discuss the current challenges related to the OGD publication and reuse and we provide an overview of some of the current methodologies proposing the best practices of the OGD publication. We also present the *Methodology for publishing datasets as open data* [18] developed in the COMSODE project which tries to address some of the known problems in this domain and we introduce two projects in that this methodology is utilized.

This paper is structured as follows. This introduction is followed by a section discussing the current problems and issues related to the OGD publication. Next examples of the existing OGD publication methodologies are presented. *Methodology for publishing datasets as open data* is introduced in the next section. Conclusions are presented at the end of this paper.

2 Challenges of the OGD publication

Public sector bodies are facing a number of challenges when publishing Open Government Data. Some of the challenges might further hinder reuse of the data. For example unclear licensing of datasets might prevent the re-users from developing sustainable business models on top of the published data. Both Ubaldi [30] and Janssen, Charalabidis and Zuiderwijk [12] provide a comprehensive discussion of the challenges in the OGD domain. Kučera and Chlapek [14] point out that there are not only benefits that could be reaped out of the OGD reuse but there are also risks that need to be mitigated.

Table 1 summarizes the current challenges related to the OGD publication discussed in the literature. We classify the challenges into the following groups:

- *Political and social challenges (SOC)* – challenges related to the political support, decision making and social problems;
- *Economic challenges (ECO)* – challenges and problems related to benefits and costs of OGD and to its measurement; potential problems related to the financing of the OGD initiatives belong to this group too;
- *Organizational challenges and challenges related to the internal processes (ORG)* – problems related to the organizational structures and the internal processes through which the OGD are delivered by the PSBs;
- *Legal challenges (LEG)* – problems related to the legal openness of OGD as well as the legislative issues;
- *Technical challenges (TCH)* – issues and challenges related to the technology, data formats or infrastructure needed to publish OGD.

Table 1. Challenges related to the OGD publication.

ID	Problem/issue	Group	Refs.
CL1	Too many OGD initiatives – users in Netherland sometimes feel frustrated by too many OGD initiatives.	SOC	[12]
CL2	Misinterpretation or contradictory conclusions – different users might draw different conclusions out of the data or the data might be misinterpreted.	SOC	[14], [12]
CL3	Provided feedback might not always have the necessary level of quality to be used for improvements.	SOC	[12]
CL4	Some of the published datasets have little value for the users or the possible use is not always obvious.	ECO	[12]
CL5	Some PSBs seek benefits for themselves rather than the benefits to the society.	ECO	[12]
CL6	Fees might represent a barrier to the re-use. However some PSBs are required to sell data to cover their costs.	ECO	[30], [12]
CL7	Not enough resources, especially in case of the small public sector bodies	ECO	[12]
CL8	No systematic OGD cost measurement	ECO	[30], [17]
CL9	No systematic OGD benefits assessment	ECO	[17]
CL10	No standard process or policy for the OGD publication. Responsible persons might not always know how to proceed with the OGD publication.	ORG	[30], [13], [12]
CL11	Lack of interaction between OGD users and publishers – PSBs not always respond to the provided feedback or questions of the users. There might be lack of the appropriate processes and tools [12].	ORG	[30], [12], [29]
CL12	There is not always a centralized OGD portal available to the PSBs.	ORG	[12]
CL13	Publication of OGD requires an appropriate structure of processes, roles and responsibilities. However these are not always in place and setting up the right organizational structure requires significant effort.	ORG	[30]
CL14	Published datasets are in many cases not regularly updated and thus the provided data might be obsolete or non-valid.	ORG	[29], [12]
CL15	There is a risk of violation of protection of the personal information or other protected information when publishing OGD. Concerns about the possible violation of legislation acts as a barrier to the OGD publication.	LEG	[12], [17]
CL16	Published datasets have missing, unclear or restrictive terms of use. This results in legal uncertainty of the potential users.	LEG	[30], [12]

ID	Problem/issue	Group	Refs.
CL17	Same or similar datasets do not always share the same format or schema.	TCH	[30], [12]
CL18	Sometimes users need to register to access data. Such practice is seen as discriminatory by [28].	TCH	[12]
CL19	Published data does not represent the primary data but only processed data.	TCH	[12]
CL20	Quality of the published data is often not good enough. Common data quality issues are related to the accuracy, completeness and timeliness of the data.	TCH	[12], [29]
CL21	It is difficult to find the required data.	TCH	[30], [12], [29]
CL22	Missing description of the data formats and schemas. Missing explanation of the data. Missing standards.	TCH	[12]
CL23	In some cases it might be difficult to publish OGD due to the underlying ICT infrastructure (e.g. in case of the "legacy" applications).	TCH	[30], [12]
CL24	Lack of suitable software tools for OGD publication.	TCH	[12]

List of the challenges related to the OGD publication presented in the table 1 is by no means comprehensive. Although some of the problems discussed above might be addressed by the PSBs themselves, e.g. by putting more emphasis on quality of the published data and metadata (CL14, CL20, CL21) and the user engagement (CL11), some of the challenges will probably require more systematic changes. Charging for data is one of such issues. In its recent notice [7] the European Commission recommends regular assessment of the potential costs and benefits of a zero-cost policy and a marginal cost policy. However according to [32] if the civil servants are responsible for the income of the relevant PSBs it might lead to maximization of the fees. In some cases PSBs even see the commercial re-users as competitors and believe in selling their data [32].

Some of the challenges presented above might not be unique to the OGD domain, e.g. insufficient data quality. However OGD utilize the web as a medium for the data provision and consumption and due to this it contributes to the data on the web phenomenon [16]. Current draft of the W3C Data on the Web Best Practices points to the fact that the openness and flexibility of the web can lead to new challenges [16]. The fact that the publishers and the users might be unknown to each other is one of them [16]. According to [24] the concept of quality is cross-disciplinary, however there is no single agreed up-on definition of quality. Data quality might be understood within the contexts of the fitness of the data for its intended use [5]. However if the OGD publishers are not aware of the potential users it might be difficult to specify the intended use of the published data which in turn might affect the assessment of the data quality. This illustrates that in case of the OGD some of the already known problems related to data management are put into the new context which might require specific solutions.

However the approach of the PSBs to OGD is not the only barrier to the OGD reuse. According to [26] there is a lack of knowledge of how the data can be utilized among the potential users and thus more success stories are required. More attention should be also paid to the OGD based business plans as a business plan is a precondition of any long-term OGD reuse [26].

3 Open Government Data publication methodologies

Challenges discussed in the previous section show that publishing data on the web for reuse is not just a matter of providing the data in machine-readable formats. There are various other problems that are not-technical in nature, like the challenges related to the licensing, user engagement or appropriate internal processes and organizational structures. In order to help the stakeholders to deal with the known challenges and problems methodologies and best practice guidelines for OGD publication have been developed or are currently under development. In this paper OGD publication methodology is defined as a set of methods, procedures or practices for publication of Open Government Data.

Existing OGD publication methodologies that are discussed in this paper are listed in table 2. For each of the methodologies its name is provided as well as its authors or publisher and the country of origin. Relevant references are also provided.

Table 2. OGD publication methodologies.

Name	Author/publisher	Country	Refs.
Best Practices for Publishing Linked Data	W3C	International	[11]
Czech Open Government Data Publication Methodology	D. Chlapek, J. Kučera, M. Nečaský	Czech Republic	[4]
Government Data Openness and Re-Use	M. Álvarez Espinar	Spain	[2]
Guide for disclosure of public data	Difi	Norway	[6]
Guidelines on Open Government Data for Citizen Engagement (2nd edition)	United Nations	International	[31]
Open Data Certificate	The Open Data Institute	International	[21]
Open Data Field Guide	Socrata	USA	[27]
Open Data Handbook	Open Knowledge Foundation	International	[23]
Open Data Handbook (Flanders)	Flemish government	Belgium/ Flanders	[9]
Open Data Institute Guides	The Open Data Institute	International	[22]

Name	Author/publisher	Country	Refs.
Open Data Ireland: Best Practice Handbook	D. Lee, R. Cyganiak, S. Decker	Ireland	[15]
Open Government Data Toolkit	World Bank	International	[35]
Methodology for publishing datasets as open data	COMSOE	International	[18]
Methodological Guidelines for Publishing Linked Data	B. Villazón-Terrazas, O. Corcho	Spain	[33]
National Guidelines for valorizing Public Sector Information	Agenzia per l'Italia Digitale	Italy	[1]
Project Open Data	The White House	USA	[34]

It is obvious that OGD publication methodologies are being developed both at the international level as well as at the national or local level. Space limitations do not allow us to discuss each of the methodologies in detail but they differ in scope, focus and structure. For example *Open Data Handbook* developed by the Open Knowledge Foundation [23] provides an introduction to the concept of Open Data and it provides basic recommendations for its publication. Compared to the *Open Data Handbook* the *Open Data Ireland: Best Practice Handbook* [15] provides more detailed recommendation and it also compares current international and Irish practices.

It is interesting that the United Nations and the World Bank, both well-known international organizations, developed their OGD methodologies. United Nations provides quite a comprehensive set of recommendations aimed at establishing and executing an OGD initiative [31]. The World Bank often refers to other methodologies or papers instead of developing its own recommendations. However it developed the *Open Data Readiness Assessment* tool which helps to assess the OGD readiness of a government [35].

In the USA the *Project Open Data* is supervised by the White House but it is open to anyone who wishes to participate (see [34]). On the other hand Open Data Field Guide [27] was developed by a private company Socrata which also provides solutions for OGD portals.

Alongside the USA there are local/national OGD publication methodologies in the Czech Republic, Flanders (Belgium), Italy, Ireland, Norway and Spain. However it is necessary to say that the list of the methodologies in table 2 might not be comprehensive as a more detailed study aimed at the OGD initiatives across the globe would be necessary.

Some of the methodologies are aimed primarily at Linked Data or Linked Open Data (see [3]). Namely *Best Practices for Publishing Linked Data* [11] and *Methodological Guidelines for Publishing Linked Data* [33]. However Linked Open Data is mentioned or addressed by other methodologies as well, for example [9], [15], or [18].

Open Data Certificate is a tool for assessment of the quality of the open datasets [21]. There are four levels of the certificate [20]: Raw, Pilot, Standard and Expert. The certificate is awarded to a dataset according to what practices are being followed by its publisher. Because the required practices for the respective certificate levels are

described, the Open Data Certificate can be considered as an OGD publication methodology. However there are currently no step-by-step guidelines to implementation of the required practices.

4 Methodology for publishing datasets as open data

4.1 Overview of the methodology

Methodology for publishing datasets as open data (COMSODE methodology) represents one of the outcomes of the project Components Supporting the Open Data Exploitation (COMSODE) [18]. It is a generic methodology that covers both technical and non-technical issues related to the publication of OGD. It is mainly aimed at PSBs that have already decided to publish some of their data as Open Data (although the question “*Why should I publish Open Data?*” is being discussed in the methodology there are no specific guidelines for gaining the top management support).

The COMSODE methodology consists of the five building blocks:

- Phases – a phase represents a stage of the Open Data publication process. Phases reflect the lifecycle of an open dataset and they are further divided into task.
- Cross-cutting activities – activities that should be performed in every phase of the open data publication process are called the cross-cutting activities. Cross-cutting activities are also divided into tasks.
- Artefacts – artefacts represent the inputs and outputs of the tasks.
- Roles – a role represents a responsibility assigned to one or more persons in an organization. In the context of the methodology roles are being assigned with responsibilities for the tasks of the phases of the cross-cutting activities.
- Practices – practices provide more detailed guidelines to execution of the tasks specified by the methodology.

The following phases of the open data publication process are proposed in the COMSODE methodology [18]:

1. (P01) Development of open data publication plan,
2. (P02) Preparation of publication,
3. (P03) Realization of publication,
4. (P04) Archiving.

Objectives of the first phase (*P01*) are to identify potential datasets for opening up, to analyze and prioritize the datasets taking into account risks, benefits and cost and to develop an open data publication plan for the selected datasets. In the second phase (*P02*) the selected datasets are prepared for publication, tasks in this phase involve for example transformation of the data into machine-readable formats, creation of metadata or selecting the appropriate license. Once the datasets are prepared for publication, tasks of the third phase (*P03*) can be executed. Maintenance of the datasets is also performed during this phase. The goal of the last phase (*P04*) is to manage end-

of-life stage of the dataset lifecycle. Activities of this phase are triggered when it is no longer possible to maintain or even make available some of the previously published open datasets, e.g. due to the changes in legislation.

Four cross-cutting activities were identified that should be performed throughout the whole publication process [18]:

1. (CA01) Data quality management,
2. (CA02) Communication management,
3. (CA03) Risk management,
4. (CA04) Benefits management.

The cross-cutting activities are aimed at management of the data quality (*CA01*), the communication and collaboration between the publisher and the (potential) users of its data (*CA02*) and at management of the benefits (*CA03*) and potential risks (*CA04*) related to publication of OGD.

Feedback from the re-users is an important part of the OGD ecosystem [13], [26]. Therefore, it is not viewed just as a single step in the publication process but rather as a cross-cutting activity that should be performed throughout the whole publication process. This approach is depicted in figure 1. More details about how the feedback should be processed and how the users should be engaged is described in [18].

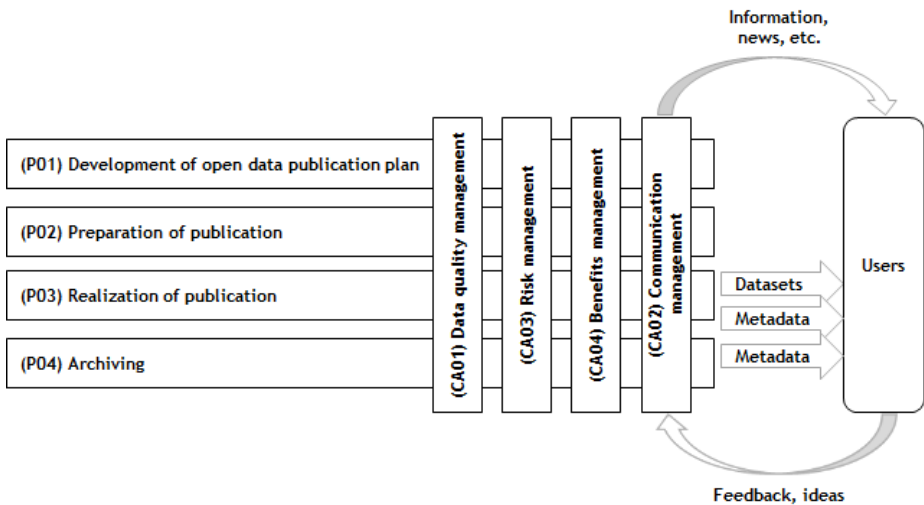


Figure 1. Feedback loop in the COMSODE methodology, source: [18]

4.2 Challenges addressed by the methodology

COMSODE methodology addresses some of the challenges of the OGD publication discussed in the section no. 2:

- Identification of datasets for opening up – the methodology provides recommendation for identification of datasets for opening up and it also promotes publication of datasets that are perceived as “*high-value datasets*” (addresses the challenge *CL4*).
- It discusses the potential OGD benefits including the benefits for the whole economy which might help to avoid situations when PSBs too much focus on their internal benefits (*CL5*). However, benefits for the PSBs are discussed as well.
- The methodology provides recommendations for the effort estimation which might help to manage costs of the OGD initiative (*CL8*). There is a separate cross-cutting activity aimed at the management of benefits (*CL9*).
- The methodology proposes an OGD publication process and it sets responsibilities for the proposed tasks. This might help to establish standard process and organization structure supporting the OGD publication (*CL10, CL13*).
- In order to prevent the lack of interaction between OGD users and publishers (*CL11*) the cross-cutting activity (*CA03 Communication management*) should be performed.
- The methodology is independent on the availability of the central data portal (*CL12*). However if the central data portal is available, PSBs are free to utilize it.
- A separate cross-cutting activity is introduced in order to ensure that the published data has the desired level of quality (*CL20*). Maintenance of the data and metadata is addressed by specific tasks and the related practices (*CL14*).
- A separate cross-cutting activity is introduced in order to manage the OGD related risks including the risk of the personal data protection violation (*CL15*).
- The methodology proposes recommended practices for dataset licensing (*CL16*).
- There are several practices in the methodology aimed at ensuring high level of technical openness of the datasets. These practices include but are not limited to the reuse of the existing schemas and ontologies (*CL17*) and documenting the schemas in a machine-readable way (*CL22*).
- The methodology promotes data cataloging which should help to improve discoverability of the datasets (*CL21*).

However, there are some remaining issues that are not addressed by the current version of the COMSODE methodology, namely:

- Social issues – the methodology is aimed mainly at the individual public sector bodies. Solving the social issues would probably require actions on the government level (consolidation/coordination of the OGD initiatives, *CL1*) or actions aimed at the re-users (building knowledge and skills how the data can be use and how to provide feedback that can be effectively used for improvements, *CL2-3*).
- Fees (*CL6*) – the methodology provides no guidelines reading fees.
- Limited resources, especially in case of the small PSBs (*CL7*) – the methodology does not provide any recommendations specifically tailored for particular types of PSBs. This challenge is therefore not addressed.
- The actual design of the data portals is outside the scope of the methodology and thus it does not provide any recommendation regarding registration of the users on

the portals (*CL18*). Dealing with the legacy applications is also beyond the scope of the methodology (*CL23*).

The COMSODE methodology promotes a risk based approach to the OGD publication. This means that if some data cannot be published in its primary form due to the possible breach of the personal data protection, it proposes to anonymize the data. It does not prevent publication of the primary data (*CL19*), but it respects that the publication of some primary data is not always possible.

The COMOSDE methodology is software tool independent. It only proposes a Reference architecture of software tools for open data publication [19]. However, a platform called the Open Data Node is developed in the COMSODE project [10].

4.3 Methodology in use

The COMSODE methodology has been utilized in a project aimed at opening up data of the Supreme Audit Office of the Czech Republic. As a first step a project plan following the phases P01-03 of the methodology was prepared. Identification of suitable datasets for opening up and development of the open data publication plan was performed in January and February 2015. The publication of the selected datasets is expected to happen in June 2015. A selected subset of the datasets will also be published as Linked Open Data.

In January 2015 the Ministry of Interior of the Czech Republic launched a project aimed at supporting the Czech PSBs in their OGD initiatives. The COMSODE methodology serves as one of the most significant inputs upon which the Czech Open Government Data standards will be developed.

5 Conclusions

The Open Government Data promise significant benefits to citizens, business as well as to the public sector. However, PSBs often face challenges when publishing OGD. Based on the literature review, 24 challenges related to the OGD publication and reuse were identified. These challenges include the political and social challenges, economic, legal and technical challenges as well as the organizational challenges and challenges related to the internal processes. Even though some of the identified challenges might not be completely unique to the OGD domain, e.g. the insufficient data quality, OGD might represent a unique context for these challenges which might require specific solutions.

In order to help the stakeholders to deal with the known challenges and problems, methodologies and best practice guidelines for OGD publication have been developed or they are currently under development. We were able to identify 16 OGD publication methodologies at both international and national or local level. Further analysis of these methodologies might provide a better understanding of the current best practices for publication and reuse of the Open Government Data.

Methodology for publishing datasets as open data is one of the existing OGD publication methodologies. This methodology is one of the generic OGD publication

methodologies. It proposes an OGD publication process organized into four phases: (P01) Development of open data publication plan, (P02) Preparation of publication, (P03) Realization of publication, (P04) Archiving. The phases are accompanied by four cross-cutting activities: (CA01) Data quality management, (CA02) Communication management, (CA03) Risk management, (CA04) Benefits management. This methodology is currently used to in a project aimed at opening up data of the Supreme Audit Office of the Czech Republic and is expected to be used as one of the key resources upon which the Czech Open Government Data standards will be developed by the Ministry of Interior of the Czech Republic.

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