A Survey on the Problems Affecting the Development of Open Government Data Initiatives

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Abstract— **Open Government Data is an initiative that promotes transparency, accountability and value creation by making government data available to all. Open government data initiatives have become very popular worldwide because of the benefits that they can entail, especially in developed countries. However, many of these initiatives do not always achieve the expected benefits. Although related research has reported that most of these initiatives face various problems affecting their success, little emphasis has been put on understanding such problems. Accordingly, in this study, we report our efforts to explore the main problems affecting open government data initiatives. Specifically, we performed a literature review to identify six problem categories, its subcategories, and its incidence. Additionally, using an Information Systems adoption process, we established the impact and occurrence of each of these problems before, during, and after an open government data initiative.**

Keywords—open government data, open data problems, open data, IS adoption

I. INTRODUCTION

"Open data is data made freely available by governments, organizations, researchers, among others, for use by anyone without copyright restrictions." (Sadiq & Indulska, 2017, p. 1). When data is released by governments, we refer it as government open data. Government open data is an initiative, a philosophy that promotes transparency, accountability and value creation by making government data available to all. The open data popularity is based on that this data can serve as a basis for government innovation, and as a tool to foment governance and democracy (Ruijer, Grimmelikhuijsen, & Meijer, 2017; Sadiq & Indulska, 2017). For example, in developed countries such as Australia, the United Kingdom, and France, these initiatives of open access to data are a reality, allowing citizens to take advantage of such data through their data portals, e.g. see https://data.gov.au/ or https://data.gov.uk/.

Although open government data initiatives have been developed worldwide, recent research reports that most of these initiatives are affected for many factors such as data quality (Sadiq & Indulska, 2017), access policies (Chatfield & Reddick, 2017), infrastructure capacity, security issues, privacy issues (Bertot, Gorham, Jaeger, Sarin, & Choi, 2014), among others. These factors prevent that open government data benefits can be achieved with success (Ruijer et al., 2017). Considering these problems, some researchers have tried to establish some solutions. For example, some researchers propose theoretical models to foment democracy through open data (Ruijer et al., 2017). Other researchers propose ways to measure and to control open data quality (Vetrò et al., 2016). Also, others have tried to understand the main barriers to release data (Conradie & Choenni, 2014). In short, many studies have been conducted to understand and to improve the open government data benefits. However, the factors affecting open government data initiatives are numerous and very little understood (Attard, Orlandi, Scerri, & Auer, 2015; Conradie & Choenni, 2014; Djoko Sigit Sayogo & Pardo, 2012; D. S. Sayogo & Pardo, 2013).

While many problems affecting open government data initiatives has been reported, a clear understanding of such problems, its commonness, and its impact during the adoption process of such initiative is not evident in literature (Attard et al., 2015; Conradie & Choenni, 2014; Djoko Sigit Sayogo & Pardo, 2012; D. S. Sayogo & Pardo, 2013).

In this research, first, we aim to explore the different types of problems affecting open data initiatives. And second, to understand the impact of those problems on each stage of the adoption process of open government data initiatives. Accordingly, we conducted a systematic literature review of a substantive body of knowledge pertaining to the study of open data in the Computer Science field. This paper presents a brief background of open government data and its adoption process. Then, we present the results of our review, which provides an overview of the issues affecting open government data initiatives, as well as the impact of this problems on its adoption process. We conclude the paper with a summation of the results, research opportunities and limitations.

II. BACKGROUND CONCEPTS

A. Open Government Data

Open data, in a governmental context, is a concept that means governmental data must be available, with free access, and with a possibility of redistribution in any form and without any author right restriction (Murray-Rust, 2008). Although this term became popular in the scientific community, it has received considerable attention in public sectors in the last years (Jaeger & Bertot, 2010; Kassen, 2013; McDermott, 2010).

Currently, open government data is conceived as a political philosophy which promulgates several values. First, to contribute to citizens' rights through the access to government information as a pillar for democracy (Allen, 1992). This principle contribute to public trust and

confidence on governments (Tolbert & Mossberger, 2006). Second, to promote the engagement of citizens to participate in projects that involve open government data. Citizens' participation foment discussions about how to address their needs in a better way (Kassen, 2013). Third, to increase transparency, accessibility to information, and improve decision making (Bertot et al., 2014; Dawes, 2010). Transparency means that stakeholders not only can access data, but these stakeholders also should be able to use, reuse and distribute this data (Attard et al., 2015). Finally, to stimulate the development of applications or initiatives that can be used on both public and private sectors (Dijk, Kalidien, & Choenni, 2013; Graves, 2011), which directly contribute to economic growth (Borzacchiello & Craglia, 2012; Kassen, 2013).

Despite the many advantages of using open government data, there are some problems that hinder its benefits. For example, lack of clear guidelines for the development of open data policies (Zuiderwijk & Janssen, 2014), problems with data access such as data fragmentation (different portals keeping a same data set) (Boulton, Rawlins, Vallance, & Walport, 2011), data access restrictions (only specific user groups have access to some data sets, poor data catalogues (people do not know the existence of some data sets) (Conradie & Choenni, 2014), among others.

B. The Adoption Process of Open Government Data

The adoption of open government data can be studied drawing on the Information Systems (IS) adoption body of knowledge. The advantage of this approach is that it allows us to understand the process by which an IS is introduced in a social system from the awareness of a new technology till its routinization in the organization (Cooper & Zmud, 1990). The adoption process has been divided in three stages, namely *pre-adoption*, *adoption* and *post-adoption*.

The *pre-adoption* stage covers the awareness of a new technology, the efforts from individuals to learn about it, and the development of a favorable or unfavorable attitude toward the new technology. The pre-adoption of open government data has been studied using the Institutional Theory (Altayar, 2018), the Symbolic Adoption Model (Mossberger, Wu, & Jimenez, 2017) and the Diffusion of Innovations Theory (Susha, Grönlund, & Janssen, 2015; Weerakkody, Irani, Kapoor, Sivarajah, & Dwivedi, 2017).

The *adoption* stage itself is related to the testing of new technology, the decision to adopt an IS, and its implementation. Several theories has been used to study this phase, such as the Theory of Reasoned Action (Wang & Lo, 2016), the Theory of Planned Behavior (Djoko Sigit Sayogo & Pardo, 2012), the Technology Acceptance Model (Charalabidis, Loukis, & Alexopoulos, 2014), and the Unified Theory of Acceptance and Use of Technology (Zuiderwijk, Janssen, & Dwivedi, 2015).

The *post-adoption* stage covers the routinization and infusion of a new IS. Routinization happens when an IS is widely used as an integral part in a firm's value chain activities. Infusion refers to the increase of organizational effectiveness using IS. This stage has been studied on the basis of the Expectation-Confirmation Theory (Ahmed, Mahmuddin, & Mahat, 2017) and the Coordination Theory (Zuiderwijk & Janssen, 2013).

Over time, the IS adoption process has been used to understand what happens in organization before, during and after an innovative technology is introduced (Thong, 1999). Also, it allows to study how it changes the interactions among human concerns, data, hardware, software and processes (Baskerville & Pries‐Heje, 2001). In this research, we use the IS adoption process to understand the impact and occurrence of different problems before, during and after an open government data initiative.

III. RESEARCH APPROACH

To understand the problems affecting open government data initiatives, its occurrence, and the impact of these problems on the adoption process, we conducted a systematic search of literature to identify relevant publications for our analysis (Webster & Watson, 2002). To identify these publications, we used the terms "open data", "government" and "public" to search publications in the Scopus database. Specifically, we performed the following query: "open data" AND ("government" OR "public") in the titles and abstracts of the publications. The query was performed on February 2018 and returned more than 600 hits. To obtain a more valuable set, as well as for analytical feasibility, we limited our search only to Q1 and Q2 journal articles according to the Computer Science SJR index, resulting on 166 publications. Unfortunately, we could not have access to two publications, therefore only 164 publications were selected for the final analysis.

The analysis process had three phases with a different coding approach each one. Additionally, to make our coding process more objective, we used the NVivo 11 (QSR International, 2018) software and two independent senior researchers as coders of the data, both on each phase. This analysis process is described in detail to follow.

On the first phase, we used an open coding approach in order to locate and to assign initial codes to the data (Neuman, 2011). During this phase, one of the coders made a full text analysis of the selected publications and established an initial list of codes using NVivo. Each code of the list represents a problem affecting open government data initiatives. All the problems on the list were discussed, one by one, by the two coders to solve any inconsistency. Accordingly, we established a 28-problem list to be used on the next coding phase.

On the second phase, we used an axial coding approach. This approach consist of using the previous phase codes to organize ideas or themes and to identify the axis of the main problems in analysis (Neuman, 2011). During this phase, one of the coders grouped the 28 initial codes into different categories using NVivo. Each category was discussed and agreed by the two coders, resulting on a six-problem category affecting open government data initiatives. On this phase, we also added to each coded problem, three additional sub- codes. Each sub-code represents one of the three stages of the adoption process of open government data initiatives, i.e. pre-adoption, adoption, and post adoption.

Finally, on the third phase, we used a selective coding approach. This approach consists of using previous codes, looking selectively for cases that illustrates the problems we coded (Neuman, 2011). Accordingly, using NVivo, we searched for stemmed words of 12 key words that could

inform about problems with open government data initiatives, namely "risk", "lack", "barrier", "affect", "cause", "problem", "issue", "avoid", "critics", "negative", "restrict", and "stop". All these words are synonyms of the word "problem". The result of this search returned 4980 references over the 164-publication dataset. Each one of these references was analyzed and coded – when relevant – to one of the problem codes we established before. Furthermore, we coded each reference to one of the sub codes representing the adoption process stage, which we also established on the previous coding phase. Accordingly, we gathered data to evidence a problem, but also to establish what adoption process stage was affected by a specific problem. It is important to notice that, on this phase, each researcher coded a sub-set of publications, but them constantly interchanged opinions during the coding process to solve any inconsistence. The results of our analysis are presented in the next section.

IV. RESEARCH FINDINGS

Open government data can bring many benefits for both government and society. However, these initiatives must frequently face and solve problems or challenges, during each stage of the adoption process, to achieve such benefits (Ruijer et al., 2017). To identify these issues, first, we looked for reports of this kind of problems and then, we identify the adoption stage in which these problems occur, on the set of publications that we selected. During this process we got several findings, which we describe to follow.

First, the results show that there is an important number of publications reporting problems that affect open government data initiatives since 2012 (See Fig.1). Precisely, 69 publications, from our initial 164-publication data set, report this kind of problems. Moreover, according to Fig. 1, these figures tend to growth in the last years. It is important to notice that the figures corresponding to 2018, may be lower than the previous years because of our data set was collected at the beginning of 2018.
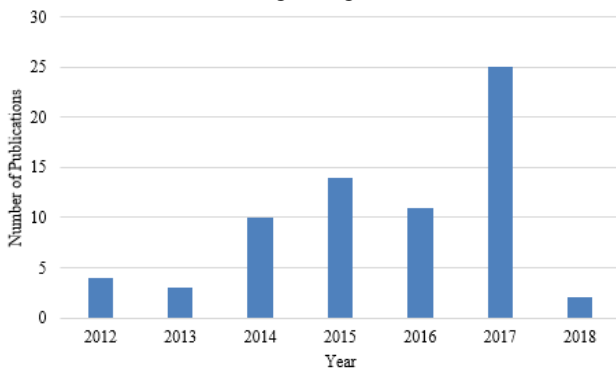

Fig. 1. Number of Publications per Year Reporting Open Government Data Initiative Problems

Second, our results show that there is a great diversity on the problems affecting open government data initiatives (Table I). However, all these problems can be grouped into six main categories as shown on Table I. On this table, problem categories are sorted alphabetical to facilitate reading. We describe to follow each one of these categories.

Citizen problems are related to factors that involve citizens, which in some way affect the adoption of open government data initiatives. In this category, we identified two main problems. One of the problems is related to public participation. Public participation means that citizens are no interested or motivated on using open government data (Lee, Almirall, & Wareham, 2015; Susha, Zuiderwijk, Janssen, & Grönlund, 2015), and more importantly that citizens do not know what they need regarding open government data (Hivon & Titah, 2017). Public participation problems also refer to that public stakeholders may not participate actively in the open government data initiatives by using data portals, suggesting what data to publish, rating data sets and portals, among others (Chen et al., 2017). The other citizen problem is related to user's or citizen's skills. Event thought citizens would like to be part of open government data initiatives, most citizens lack of technical skills that allow them to use the data (Slingsby, Dykes, Wood, & Radburn, 2014; To & Lai, 2015).

Data quality problems are the most reported problems during our review. Some of them are reported, on a general way, as data quality problems, while others are described more specifically. This kind of problems are related to the data lifecycle stages, namely data creation and receipt, data distribution, data consumption, data disposition, and data destruction (Chaki, 2015) .Although there is a vast variety of factors related to data quality problems (Sadiq, 2013), we have identified in our review just a few. For example, first, data accuracy problems refer to that metadata records may not correctly describe the data in a dataset, which directly affects the discoverability of datasets (Becker, 2008). Second, data ambiguity problems refer to that data is not useful because it is no easily understandable even it is in a machine-readable format (Janssen, Charalabidis, & Zuiderwijk, 2012). Third, data completeness problems refer to that the number of completed fields that a meta records have is incomplete. If the metadata records are not complete, it will affect the discoverability of datasets (Janssen et al., 2012). Fourth, data format problems refer to that data is not made open to the public in a machine-readable format which is also non-proprietary (Marjanovic & Cecez-Kecmanovic, 2017; To & Lai, 2015). Fifth, data misuse refers to that data is not enough on quality, which leads to misuse or misunderstanding of the data (To & Lai, 2015). Sixth, data representation problems refer to that data is published in portals in a non-standardized manner in terms of semantics, standards, and schema (Shadbolt et al., 2012). It makes difficult to aggregate existing metadata in a way that would be useful for data consumers. Finally, data scarcity refers to that data is difficult to collect or to produce, and on most occasions is not enough to be useful (Clark, Williams, & Ekins, 2015).

TABLE I. MAIN PROBLEMS AFFECTING OPEN GOVERNMENT DATA INITIATIVES

Main Problems
Citizens
Public participation
User skills
Data quality
Data accuracy
Data ambiguity
Data completeness

Data formats
Data misuse
Data quality
Data representation
Data scarcity
Economic and financial problems
Budget provision
Cost metrics
Organizational
Authority involvement
Awareness
Benefit metrics
Competition
Institutionalization
Inter-organization collaboration
Motivation
Policy and legal
Copyright & licensing
Liability
Regulations
Privacy & data protection
Technical
Data access
Data interoperability
Storage capacity
Technical knowledge
Technical support

Economic and Financial problems are related specifically to budget provision and cost metrics. On the one hand, it is difficult to provide enough budget by public organizations to make open data initiatives real and operational during time. For example, there may not be any local budget allocation for open government data initiatives during the adoption and post adoption process, which could affect the success culmination of such adoption (Barry & Bannister, 2014; Janssen et al., 2012; Lee et al., 2015). On the other hand, it is very difficult to establish metrics that allow to measure the costs of implementing and keep operational this kind of initiatives (Krishnamurthy & Awazu, 2016; Styrin, Luna-Reyes, & Harrison, 2017).

Organizational problems are related to the way in which public organizations manage the open government data initiatives. Specifically, we detected several problems involving public organizations. First, there is a lack of involvement of authorities in this kind of initiatives. Normally, authorities delegate decision taking or do not put much resources and efforts on releasing open government data (Nam, 2015; Yang, Lo, & Shiang, 2015). Second, the awareness problems refer to be conscious of what open government data means and what it implies. For example, some public entities may consider that the provision of raw data is a daunting task, or the requirement might not be understood clearly (Lakomaa & Kallberg, 2013). Third, public organizations do not see clearly or cannot measure properly the benefits of open government data, which leads to a lack of interest on adopting these open data initiatives. Fourth, competition refers to that public organizations may think that releasing government data or public data is unfair because of private organizations can get commercial appropriation of it (Barry & Bannister, 2014; Zuiderwijk, Janssen, van de Kaa, & Poulis, 2016). Fifth, the institutionalization problems refer to that open data tasks are usually assigned to employees whose jobs were already predefined for other activities, with no institutional structure or entity specifically dedicated to this task

(Janssen et al., 2012). This issue directly affects the performance of open data initiatives (Krishnamurthy & Awazu, 2016). Sixth, inter-organizational collaboration problems refer to that many organizations do not interact or collaborate properly in order to release data to citizens (Krishnamurthy & Awazu, 2016). For example, some government data hosted in a specific public organization needs a review and an approval from others in order to avoid legal or privacy issues (Yang et al., 2015). Finally, motivation problems are in some way related to some of the previous problems. By motivation, we mean that public organizations, authorities, and public employees do not see benefits by doing all the tasks related to open data (Lee et al., 2015; Zuiderwijk et al., 2016). In fact, they see these tasks as extra work without any purpose (Khayyat & Bannister, 2015).

Policy and legal problems are related with all the regulatory and legal issues resulting of the release of government data to public. We established four problems on this category as we describe to follow. First, copyright and licensing problems refer to that open licensing with different grades may contain restrictions that prevent data – with different licenses – from being merged for a specific use (Khayyat & Bannister, 2015). Second, liability problems refer to the fear that public entities generated because of these entities may be held liable for damaged caused using the provided data (Russnák, Ondrejka, Herman, Kubíček, & Mertel, 2016). This normally occur when data is stale, incorrect or wrongly interpreted (Barry & Bannister, 2014). Thus, public organizations do not collect and/or publish its data to avoid these problems (Barry & Bannister, 2014). Third, privacy and data protection problems refer to the conflict between open data and the aims of transparency and accountability, and data protection and the right to privacy. For example, merging different data sets can lead to discover personal data on anonymized data (Zuiderwijk & Janssen, 2015). Finally, regulation problems refer to the lack of open government data policies even though there are legal frameworks concerning freedom of information, reuse of public sector information and the exchange of data between public entities (Attard et al., 2015; Khayyat & Bannister, 2015).

Technical problems are related with several issues of keeping open government data initiatives operational. First, data access problems are the main concern on this kind of initiatives. Most of the time, even though organizations wants to release public data, there is a lack of infrastructure and support to achieve it (Aguilera, Peña, Belmonte, & López-de-Ipiña, 2017; Barry & Bannister, 2014). Second, data interoperability problems refer to that it is necessary that data sets from different organizations are linked with each other in order to provide richer data and to facilitate information discovery (Alvarez-Rodríguez, Labra-Gayo, Rodríguez-González, & De Pablos, 2014; Callahan, Cruz-Toledo, & Dumontier, 2013). Third, storage capacity problems refer to that organizations do not have the enough infrastructure to keep large data sets stored and available for long periods of time (Aguilera et al., 2017). Finally, technical knowledge and technical support problems are related with the lack of technical skills on public employees, who are involved in open data initiatives. These skills are needed in order to work with open data and to

provide support to any stakeholder or citizen who requires it (Barry & Bannister, 2014; Russnák et al., 2016).

Our results also show that, from the six problem categories we established, there are two categories that are more incident in the open government data initiatives, namely data quality, and policy and legal (see Fig. 2). Contrarily, other problems such as organizational, technical, citizens, and economical and financial are less common.
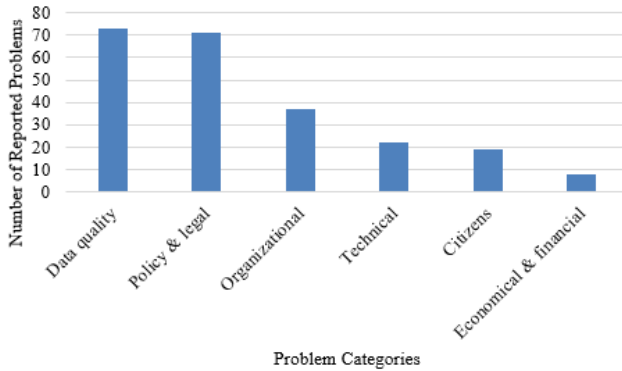

Fig. 2. Total Number of Reported Problems

There are several types of problems affecting open government data initiatives, and most of them impact on each stage of the adoption process (see Fig. 3). However, Figure 3 also show that most of the reported problems are during the post-adoption stage. Surprisingly, during the adoption stage, the report of problems affecting open government data initiatives are relatively low comparing to the other figures. Moreover, Figure 3 also show that data quality problems have more incidence during the post-adoption stage, while policy and legal problems have more incidence during the pre-adoption stage. In fact, we can see the same pattern of behavior if we analyze data on each year (see Fig. 4).
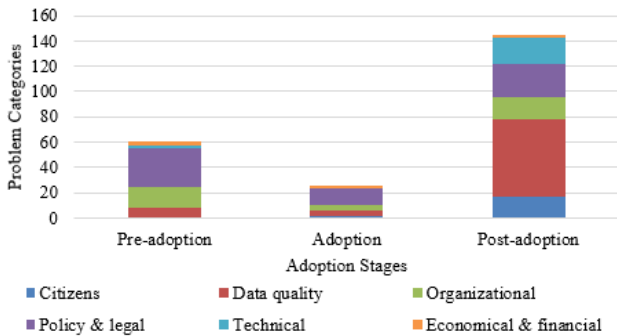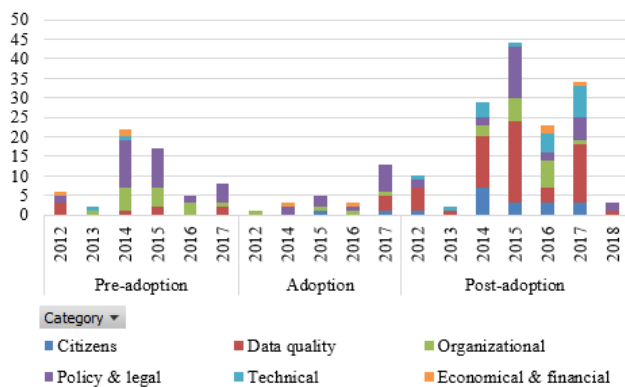

Fig. 3. Main Problems Affecting Adoption Stages

Fig. 5 shows the different problems that are present on each category, on each adoption stage of open government data initiatives. According to Fig. 5, we can see more clearly that during the post-adoption stage, data representation problems are more frequently reported than the other problems. Contrarily, during the pre-adoption stage, all the policy and legal problems are more frequently reported than the other problems.
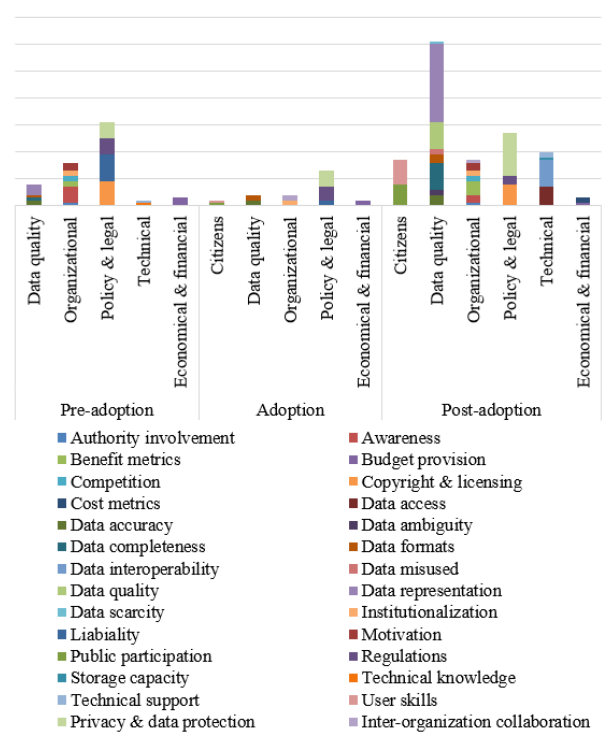

Fig. 5. Main Problems Affecting Adoption Stages per Year

V. DISCUSSION AND FUTURE RESEARCH

Promoting the effective use of open government data requires the establishment of an adequate framework of recommendations, guidelines and policies that, on the one hand, minimize the appearance of problems affecting open government data initiatives and, on the other hand, allow to maximize the benefits of open government data. This can only be achieved by understanding the current problems that open government data initiatives have during its adoption process. For this reason, in this research, we explored the different kind of problems that open government data initiatives may face during its adoptions process through a systematic review of literature.

The results of this review show that there is an important number of reports that evidence several problems affecting open government data initiatives since 2012. In fact, these reports tend to growth since they were reported. Consequently, despite the benefits that this kind of initiatives can provide to government and society, to achieve such benefits are not that easy. Accordingly, we consider that it is necessary to explore deeply such problems in order to provide solutions that allow to minimize them. Such exploring study could be performed by collecting empirical data. Specifically, this study could

be performed in a particular organization or several organizations into a same government.

The results also show that there are six main problem categories, namely citizen, data quality, economic and financial, organizational, policy and legal, and technical problems. These problem categories represent a very complex environment that open government data initiatives have to face. To follow, we discuss each one of these categories.

First of all, problems related to citizens show that it is necessary to establish mechanism, first, to develop citizen' interest on participating on these initiatives, and second, to develop citizens' skills to explode and to get benefits from open government data. Accordingly, the level of citizen participations, the needs of open government data, and the skills that citizens need to maximize the benefits of open government data should be studied.

Second, data quality problems have the highest incidence, especially during the post-adoption stage. In this case, we do not recommend to study new solutions for data quality problems because data quality by itself is a very big research area. In fact, both academy and industry have been undertaken many efforts to establish solutions for these problems. Instead, the types of data quality problems that affect specifically to a particular organization should be study.

Third, economic and financial problems are those ones with the lowest incidence. Our results show two main problems, namely budget provision and cost metrics. Although studies on provision of budget for open government data initiatives are not very attractive, it is not the case for cost metrics. This last issue is a very interesting topic to study because organizations need to know how to measure the real costs of adopting open government data.

Fourth, organizational problems have an important incidence on both the pre-adoption stage and the post-adoption stage. Problems in this category such as authority involvement, awareness, benefit metrics, competition, institutionalization, inter-organization collaboration, and motivation show that open government data initiatives face similar challenges as any technology adoption initiative. Accordingly, it would be interesting to study how such organizational problems can be addressed and minimized in order to decrease the impact on the open data initiatives.

Fifth, policy and legal problems have an important incidence during the three adoption stages of open government data initiatives. Consequently, these kind of factors can be a serious issue that can impact and even terminate the adoption of open government data initiatives. Accordingly, before public organizations embark on this type of initiatives, it is necessary to anticipate the organizations to any future legal problem. Specifically, especial attention should be paid to copyright and licensing problems, and privacy and data protection problems.

Finally, technical problems such as data access, data interoperability, storage capacity, technical knowledge, and technical support are present on the pre-adoption stage and the post-adoption stage. Although these kind of problems are very common during the adoption of any technology in organizations, it should be study what technical knowledge public employees involved in open data government data initiatives should have in order to provide support to internal and external stakeholders.

This study is not without limitation. Due the large volume of related publications (in the tens of hundreds, making full analysis not feasible), we limited our data set to only Q1 and Q2 journal articles according to the Computer Science SJR index. This strategy eliminates many publications from the analysis. However, we consider that the 164 publications in our data set is enough to provide a clear understanding of what the main problems affecting open government data initiatives are, and how these problems affect to each stage of the adoption process of such initiatives. Additionally, it is important to notice that our research approach use publications instead of empirical data; thus, we cannot generalize our results for every government or organization. Our results just present an initial exploration of real and diverse problems that open government data initiatives face, reported by the academy.

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