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Open Data as Enabler of Public Service Co-creation: Exploring the Drivers and Barriers*

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Abstract—**Open data is being increasingly looked at as a major driver of public service innovation. Open access to datasets and advanced analytical tools are believed to generate valuable new knowledge that can be turned into data-driven services. At the same time, open data is also believed to spur open governance and enable the engagement of various stakeholders in the co-creation of services. Despite this appealing vision of open data-driven co-creation of public services, we are far from understanding how it can be realized in practice. We turned to 63 experts and practitioners in a survey covering six European countries and found a multitude of barriers that need to be overcome first. Luckily we also found some drivers. This paper provides some first insights into these drivers and barriers and proposes policy recommendations to foster a data-driven transformation of public service creation.**

Keywords - open data, public service, co-creation, co-production, drivers and barriers

I. INTRODUCTION

Open data is no longer new to the topic of e-government research and practice. That being said, one area in which open data's full potential and limitations are being overlooked lies within the idea of service co-creation. There is a vision of open data revolutionizing service creation in the public (and private) sector [1], some studies even speak about a new generation of "open e-government services" [2], but not much is known about what preconditions need to be there for that revolution to actually happen. This paper aims to provide an initial contribution to fill the gap in understanding the relationship between service co-creation and open data, with a focus on public services.

According to a widely used definition, open government data refers to the idea that public sector data should be available in a convenient (ideally machine-readable) form, freely accessible, reusable, and redistributable by everyone [3]. Although the private sector can also make its data open, the existence of large quantities of data in government databases makes the public sector a key provider of open data. The availability of open data is important as it is believed to facilitate the linking and reuse of data for the creation of new data-driven services [4]. However, in practice, various sociotechnical barriers are associated with the supply and use of open data. Such impediments have to do with availability, ease of access, usability, quality, compatibility, interaction between data providers and users, and many other factors [5].

The concept of open data is also strongly intertwined with the idea of open government, i.e. opening up government processes, documents and data for public scrutiny and involvement [6], which in turn is closely linked to the concepts of transparency and accountability [7]. The word 'involvement' deserves a special emphasis here since the core idea of open government is not only that the government should be transparent but that it should also act as an open system that interacts with its environment and actively seeks feedback to improve its work [8]. The development of the open government paradigm has thus led to the idea that open data should not only be used to inform and serve society but also stimulate the active participation of societal actors in public policy making and creation of services for the public value.

This thinking bears many resemblances to the idea of service co-creation and co-production[1]. The concepts have been around for a couple of decades [9], but are seeing a revival in the context of open government and the development of ICT-enabled platforms for government-citizen interaction. Whereas traditionally public services have been initiated, designed, and delivered by public administrators, with citizens at the receiving end [10], the idea of co-creation or co-production suggests that citizens and other stakeholders should participate in the planning and provision of public services. According to this logic, public services are no longer simply something delivered by public agencies but instead a process of co-creation with users and communities [11]. However, much like open data, the success of co-creation depends on various drivers and barriers that arise from its complex

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[1] The terms "co-production" and "co-creation" are often used synonymously to refer to the participation of users and stakeholders in the design and delivery of public services. While there are slight differences in their meaning (see also Section III.B), we treat them interchangeably in this paper.

context. Some are related to the individuals who take part in co-creation initiatives, some to organizational processes in public sector organizations, others to resources, culture and attitudes (see, for example, [11] and [12]).

Although a number of previous studies have explored the drivers and barriers of open data (e.g. [5], [8], [13], [14]) and co-creation (e.g. [11], [12], [15]) separately, there is a gap in our understanding of the specific factors that matter in settings where the two concepts overlap. We argue that if governments want to seize the potential of open data in public service co-creation, a better empirical understanding of this phenomenon is needed. This paper seeks to contribute to improved knowledge of the drivers and barriers, while also discussing possible policy solutions to some of the biggest hurdles. Having had the opportunity to collect empirical data from experts and practitioners in six European countries, we are hereby sharing our first insights into the issue.

The paper is divided into three main parts. In Section II we explain the methodology of the study. Section III looks at existing studies of drivers and barriers and gives an overview of the survey results. In Section IV we discuss the implications of our findings and make some policy recommendations.

II. METHODOLOGY

This paper presents the initial results of an ongoing study of open data-driven co-creation, undertaken in the framework of OpenGovIntelligence, a European research and innovation project[2]. This initiative aims to explore the ways in which open data can be used for the co-creation of public services by building theoretical and empirical knowledge of the topic and testing some promising approaches in real-life pilots. The pilots are being conducted in six European countries – Belgium, Estonia, Greece, Ireland, Lithuania and the UK. In addition to their differences in terms of the overall political system and public administration tradition, these countries also differ in their existing government data exchange systems and level of open data maturity, involving early adopters (the UK most notably) as well as laggards (e.g. Estonia or Lithuania). This provided us an opportunity to study open data-driven co-creation in six different contexts and engage experts and practitioners in these countries in an exploration of the related drivers and barriers.

The first step of the research that was undertaken was a literature review in March-May 2016. We consulted literature on the topics of open data, data-driven services, public service co-production and co-creation, public sector innovation, and the related drivers and barriers. The aim of the literature review was to understand the way in which these concepts have been defined and addressed in literature, and develop the framework for the subsequent survey. The review included academic articles from databases such as Scopus/Elsevier, Springer and Google Scholar, and to a lesser extent relevant working papers and policy reports (mostly published by the European Commission and OECD). Most of the publications found dated from 1995-2016. Among these publications, a further selection was made based on relevance to our research, leaving altogether 91 academic and policy reports which were looked at more thoroughly.

The literature review was followed by a web-based survey in May-June 2016 with the aim to study the particular drivers and barriers that are relevant for open data-driven co-creation – as our literature review showed, the drivers and barriers in this specific context had not been thoroughly discussed in previous studies. An additional aim was to understand the importance of country context for the drivers and barriers. The survey involved civil servants, entrepreneurs, private sector employees, civil society and research actors from the six pilot countries. This mix of public and private actors allowed us to probe both the public sector and user side of data-driven co-creation. The invitees were hand-picked with the assistance of the project partners in the respective countries who had knowledge of experts and practitioners with some degree of expertise and experience related to open data and/or co-creation.

The survey yielded 63 responses, including 34 public administration representatives and 29 non-governmental actors from all six countries, with the highest number of respondents (16) from Greece and lowest (8) in Lithuania. 22 respondents represented the central or federal government level, 7 represented regional government and 4 local government. 15 respondents were from private companies, 7 represented non-governmental and civil society organizations, while 8 represented universities and other research institutions.

The survey included 11 questions, mostly open-ended. Respondents were first asked to describe their previous experience with using open data and taking part in public service co-creation. They were then asked to outline the key drivers and barriers to the use of open data for service co-creation based on their experience, point to missing capacities and needs with regard to opening up data or engaging in open data-driven service co-creation. The next questions asked respondents to give examples of successful and unsuccessful policy initiatives that have been implemented to encourage the reuse or supply of open data, and propose ideas for missing policies in the field. For the purpose of the survey, open data was defined along the lines of the definition proposed by the Open Knowledge Foundation as data that is presented in a machine-readable format that can be freely used, re-used and redistributed by anyone. For co-creation, we adopted a rather broad definition – the direct involvement of

individual users, groups of citizens and other stakeholders in the planning and delivery of public services – to cover the whole array of possible forms of stakeholder participation in public service creation, from initiation to implementation.

Our research approach, understandably, has its limitations. As the literature review was conducted with the purpose of generating background knowledge for the next steps of the study, the overview presented in this paper by no means intends to provide a comprehensive description of what is out there. Instead, it contains selected pieces of information that we have considered important in the context of drivers and barriers for open data and co-creation. Similarly, the aim of our survey was not to provide an exhaustive list of key drivers and barriers. Rather, the paper gives a good overview of the issues raised by selected experts and practitioners, which helps us identify areas that deserve further research.

III. OPEN DATA-ENABLED PUBLIC SERVICE CO-CREATION: DRIVERS AND BARRIERS

A. Drivers and barriers in literature

1) Drivers and barriers to open data

Open data has been part of the policy agenda for more than a decade now but is still relatively young as a research field [16]. According to a review published in 2014 [16], most research in this field involves conceptual papers, empirical case studies, and descriptions of technological solutions, with little systematic and theoretical research on the drivers and barriers to open data. A poor understanding of the barriers is a problem as it can lead to 'myths' about the ways in which the benefits of open data can be realized in practice [8]. Therefore, there has recently been an increase in research discussing barriers to open data. Apparently the impediments are manifold and are related to the availability of data, ease of access, usability, quality, compatibility, interaction between data providers and users, and many other factors [5].

It is interesting to note that when examining the drivers and barriers directly related to open data, drivers tend to come from forces external to the government whereas barriers tend to come from within the government [17]. For example, some of the major drivers which were identified by Huijboom and Broek [17] relate to "citizen pressure, market initiatives, emerging technologies and the ideas of thought leaders". This directly relates to drivers which were discussed by Gonzalez-Zapata and Heeks [18]: "economic value through new products, services, revenue, profits and jobs; better governance through increased transparency, accountability, participation, and empowerment; improved government data infrastructure; improvements in public services". Though many drivers come from external forces, one of the primary internal driving motivators is the Public Sector Information Directive which has played a major role in driving open government data policies in many European Union countries [19].

Within the literature there are many barriers which are consistently cited, and as previously mentioned, these often times lie internally within the government. In this paragraph we will briefly discuss barriers related to open data and open data policies which have been outlined in previous works. The first barrier, which is consistently discussed by government agents in opposition to open data, is the unpredictable nature of their government's support for this sphere, and the lack of political communication between providers and re-users of open data [13, 14]. This lack of political enthusiasm may lead to a low priority being given to open data based public sector innovation policies, which would then lead to legislative barriers. These barriers arise from the ambiguity or lack of regulatory open data policies which convolutes the understanding of open data sets, challenges the flow of data from government agencies to other actors, and leaves agencies feeling no incentive to publish their data [20]. However, even if these legislative barriers were not present, civil servants may expect to find guidance in the form of strategies; so if these strategies do not exist it may act as a major barrier for open government data [21]. A barrier, which is not strictly related to internal government forces, is the role of privacy and security in relation to open data. Many actors may feel that there need to be well-defined barriers between public and private information or that open data automatically will lead to a breach in privacy [17, 22]. So, information security, confidentiality, and right to privacy also act as major barriers for widespread adoption of open data strategies and policies.

Though a majority of work relates to government barriers, some works have been carried out in relation to barriers from the user perspective. For example, Zuiderwijk et al. [5] find that usability of open data, misinformation, and unfriendly user interfaces pose significant barriers to the adoption and usage of open government data by non-government actors. Johnson [23] also discusses barriers which users may face in relation to open government data and identifies that a lack of a user perspective vision, ability to access the data, and ability to understand the data all act as major barriers.

2) Drivers and barriers to co-creation

A collaborative approach to public service production has emerged as an important way to innovate public services that have traditionally been provided by public administrations in a top-down manner. The engagement of users in the service production process is seen to increase the efficiency and effectiveness of services by aligning services to users' needs and expectations. It is also seen as a way of fostering an open and transparent government [24]. There is a whole stream of literature on 'co-production' and 'co-creation' that has emerged from public management and service management research which study the participation of users and stakeholders in public service creation [9]. It might be important to note that the lines between the concepts of co-production and co-creation are unclear and the terms are often used interchangeably. The only slight difference is that co-creation is more often associated with creating value for service users and the public [9, 12].

In principle, co-creation with users can happen in any stage of the public service production, from co-design and co-decision to co-implementation and co-evaluation [25]. The emergence of open data can be seen as an important enabler for co-creation: access to data and some analytical skills easily allow citizens to take the role of explorers who discover problems and needs, idea-generators and co-initiators of solutions, co-designers of services, or co-implementers and diffusers of service innovations (see [26] for a more detailed discussion of data-driven co-creation).

However, a collaborative model of service creation is not particularly easy to implement in real life. A number of barriers prevent co-creation from becoming a widespread practice. Some of them emanate from the organizational context of public sector organizations, including: organizational structures and processes that are incompatible with the process of co-creation, lack of open attitude to citizen participation, risk aversion characteristic to the public sector [12], lack of willingness to change, administrators' fears of losing status and control, lack of necessary skills (e.g. knowledge of effective participation methods, facilitation skills), lack of funding for the whole array of activities that may be needed for effective co-production, and simply low perceived value of co-production [15] to name but some. Other drivers and barriers are related to the user/citizen side. These include, for example: the internal motivation of participants [27], personal characteristics and values, awareness of participation opportunities, participation skills, perceived capacity to participate in co-creation initiatives, perceived responsibility for improving public services, social capital, trust in the co-creation initiative [12], relative importance given to the service that is being co-produced, money, time and other resources [28], ease of participation [11], etc.

As one of the key factors, existing research underlines the importance of collaboration willingness and mutual trust between government and citizens [29, 30]. The importance of attitudes, trust and (clashing) interests as a factor affecting participation and collaboration has not only been discussed in relation to service co-creation but citizen participation in general (see, for example, [31] and [32]). At the same time, studies have also found that if citizens are given the opportunity to participate and reassurance that their input is taken seriously, people will want to get involved [33]. One of the key challenges that this shift to collaborative models poses to the public sector is the need to redefine the traditional roles of public and private actors in the policy process. Collaborative innovation in the public sector requires politicians to cease seeing themselves as all-powerful providers and instead become agenda-setters through dialogue with a number of actors. This makes public managers the ones responsible for collecting innovative ideas and managing collaborative arenas, rather than sole experts. Thus, it requires private companies and civil society organizations to become partners in pursuing public value through creating innovative solutions, viewing citizens as co-creators rather than clients or customers [34]. These perceptions, as noted in [34], are difficult (though not impossible) to change. Moreover, successful co-creation also requires a deep transformation of organizational processes in the public sector and the processes whereby public services are produced. There is ample evidence in literature of the complexity of organizational change – the implementation of new processes in organizations occurs in multiple steps, takes considerable time, and is likely to involve mistakes that further slow the process of change [35].

B. Survey results

Not surprisingly, our empirical study largely confirmed the drivers and barriers mentioned in literature. Whereas the literature looks at open data and co-creation as two distinct phenomena, our study provides insights into the particular challenges that come out of the complexity of data-driven co-creation. Table 1 presents an overview of the drivers and barriers that were mentioned most often by the survey respondents within the study[3]. These drivers and barriers were further broken down into four categorizations: Data and technology, Stakeholders, Organizations, and Legislation and policies. It is also important to stress that often times a given driver is the opposite of the given barrier. For example, B.DT1 and D.DT1 show "availability of open data", in this situation a lack of access to open data acts as a barrier for data driven service co-creation, whereas having access to open data acts as a driver for data driven service co-creation. This interesting pattern was seen repeatedly in the survey results. In the following sections, a more detailed overview of the drivers and barriers will be presented by providing insight into each categorization.

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[3] The drivers and barriers have also been coded so that they are able to be referred to individually in the rest of the paper; this will allow for more substance to be given to arguments and policy recommendations made

TABLE I. OVERVIEW OF DRIVERS AND BARRIERS FROM SURVEY.

Barriers	Drivers
Data and technology	
B.DT1 – Lack of availability of open data	D.DT1 - Availability of open data
B.DT2 - Lack of data quality, fragmentation of datasets	D.DT2 - Provision of high-quality easy-to-use datasets, provision of datasets of key importance
B.DT3 - Messy data formats and lack of metadata	D.DT3 - Harmonization of data and metadata
B.DT4 - Missing infrastructure to support open data	D.DT4 - Open Data Portal
Stakeholders (perceptions, attitudes, culture)	
B.S1 - Political environment	D.S1 - Citizen demand and visionary policy-makers
B.S2 – Lack of awareness of open data and benefits	D.S2 - Awareness of open data and benefits
B.S3 - Technological skillset missing	D.S3 - Training and skills development
B.S4 - Requires trust and participation	D.S4 - Participation
Organizations	
B.O1 - Existing business models	D.O1 - Development of new business models
B.O2 - Missing innovation orientation in public sector	D.O2 - Presence of innovative orientation in public sector
B.O3 - Incompatible organizational processes	D.O3 - New organizational processes required
Legislation and policies	
B.LP1 – Legislation on data sharing and licenses	D.LP1 - Legislation on data sharing and licenses
B.LP2 - Limited legal obligation to publish open government data	D.LP2 - Strengthening legal obligations to publish government data as open data by default
B.LP3 - Privacy and security concerns	D.LP3 - Increases transparency and accountability

Source: Authors

1) *Challenges and barriers*

   a) *Data and Technology Barriers*

   The use and provision of open data is inherently technical, due to this technology-related factors were quite often cited as barriers for data driven service co-creation. The overarching technological barriers are presented in Table 1 as B.DT1–4. These barriers also represent a classification of smaller barriers, for example, underneath B.DT3 barriers such as missing values, lack of metadata, encoding issues, and outdated data could all be included. What these barriers lead to in practice, according to survey respondents, is data sets being published which are unusable, have low value, are not machine-readable, are not understandable by humans, or are highly fragmented. Thus, these technological barriers can lead to a situation where data is being released, but it can simply not be used to assist in driving the co-creation of new services.

   b) *Stakeholder Barriers*

   The second categorization of barriers is related to the beliefs and behavior of different public and private stakeholders, such as policy-makers, data providers and users, service providers and users, as well as other groups involved with the co-creation of new services. One of the most commonly mentioned barriers was B.S2, a lack of awareness of open data and its benefits. In essence, many respondents noted that others did not know what open data was, did not have a clear concept of how it could be used, or were unaware of the benefits which open data provides to data driven service co-creation. This, in turn, leads to B.S1 where due to the perceived lack of benefits a lack of political support for open data service co-creation occurs; it follows that this further leads back to B.DT1 – a lack of availability of open data. As mentioned previously, open data and data driven service co-creation requires a technological skillset and this skillset is not often present. Furthermore, the survey respondents frequently noted that due to a lack of technological knowhow open data could not be used for service co-creation. In regards to the co-creation aspect of data driven service co-creation the most common barrier was B.S4, essentially what survey respondents articulated was that co-creation requires participation, participation means time, and many were hesitant to offer their time. This argument is also heard, though in a slightly different format, as service users believing that the government is

the service provider and therefore if the government is asking for citizen input and participation it means the government is failing in its duties a service provider.

c) Organizational Barriers

The third categorization that emerged from the survey results is related to organizational barriers. One of the biggest barriers within this section is B.O3 – the incompatible organizational processes. Examples of barriers which may fall underneath this are: reluctance to release data due to confidentiality procedures, incompatible routines and processes, lack of feedback loops, resistance from the public sector to change, lack of trust, lack of political priority, and inadequate resources. Another significant barrier is B.02, when there was a missing or lack of orientation towards innovation within the public sector organizations were less likely to become involved or get behind the idea of open data. In many cases, a broader use of open data is hindered by existing proprietary business models that are based on selling key data (B.01) – by making data open, a number of organizations would lose an important source of revenue. Moreover, regardless of the business model, publishing open data is associated with high costs, which are often seen to exceed the foreseeable benefits. However, even more importance is given to the perceived incompatibility of existing administrative procedures and organizational practices with co-creation and collaboration. Co-creation requires the transformation of public sector processes to allow government to receive and react to feedback from citizens, which public sector organizations are so far not used to.

d) Legislation and Policy Barriers

Several respondents mentioned legal issues as a barrier, in particular existing legislation related to sharing and licenses (B.LP1). Interestingly, legislation-related barriers seem to involve two types of factors – those that arise from the actual legislative provisions, and those that have to do with the way the existing legislation is perceived and interpreted. Several respondents referred to "privacy and security concerns" in relation to legal barriers and some explicitly mentioned "misunderstandings" about privacy and identity-related information. This implies that any attempt to overcome these barriers should not only be limited to reviewing the legislation in force but also involve raising public awareness of what the law actually means.

2) Enablers and drivers

a) Data and Technology Drivers

As was mentioned previously, many of the drivers related to data driven co-creation are the reciprocal of a given barrier. What was made known through the study was that, of course, having access to high quality open-data (D.DT1, D.DT2) with the proper metadata and standards in place (D.DT3) was a major driver. What was noted was that when these drivers were in place it also often meant that an open data portal existed, which was actively maintained and contained data which was usable to end users. If usable data was present, it allowed for third parties to take the lead in initiating new services bottom-up, even if the government itself is unwilling or unable to create these services. Respondents also highlighted the importance of building and disseminating concrete applications to demonstrate open data solutions, facilitate data analysis and enable easy visualization and exploitation of the data.

b) Stakeholder Drivers

Many of the enabling factors for data driven service co-creation were associated with stakeholders' attitudes, actions and mutual interaction. A major precondition for any open data innovation seems to be that different kinds of stakeholders perceive open data as valuable in the first place (D.S2). Some of the key benefits that were mentioned as driving open data innovation include the perceived ability of open data to support administrative efficiency and automation of organizational processes, improve access to information and enhance evidence-based policy-making. With regard to policy-making, open data is seen to facilitate the creation of services that answer real needs and generate genuine public value. Important benefits were also associated with open government goals, as open data is seen as a way to increase government transparency and citizen participation (D.S4). Lastly, open data is believed to create economic opportunities by enabling the creation of cheaper and simpler web applications and commercialized solutions driven by the private sector. Here, the role of the demand side should not be underestimated – the survey revealed that a clear demand for open data from the private sector, individual users and the broader community could be an important driver that can pressure the public sector to publish open data (D.S1). In fact, the role of individual people, their beliefs and behavior was among the most frequently mentioned drivers in the survey. Visionary policy-makers and administrators are considered a powerful force driving the exploitation of open data, regardless of the country context (D.S1). However, in addition to vision and good will, knowledge and skills are believed to matter a great deal – any innovative reuse of open data requires digital and analytical skills, which according to the respondents remain scarce so far.

c) Organizational Drivers

Based on the survey, key drivers at the organizational level concern, above all, strong innovation leadership and capable change management (D.02). Administrations and organizations which give open data and open innovation a high political priority, and have sufficient buy-in among senior staff, are also the leaders of data-driven co-creation. This may be reinforced by the existence of relevant capacities in the organization – management skills, digital literacy, skills of data management and collaborative innovation. In addition to that, the survey brought out the importance of resources and funding, including the need

to develop new business models that make creative use of open data (D.01). As existing business models were often cited as an important barrier to open data innovation, any progress in this respect indeed requires organizations to reorganize their resources and rethink their business strategies. It is interesting to note that variables related to organizational processes were only mentioned among barriers and not drivers; thus, it leads to the assumption that existing routines and practices in public sector organizations may be understood as being incompatible with innovation in regards to data driven service co-creation. This suggests that an enabling organizational context is one of the critical preconditions for successful open data-driven co-creation (D.03). However, due to the complexity of organizational change, this is clearly one of the areas where quick changes are unlikely to occur.

d) Legislation and Policy Drivers

Lastly, enabling legislation, policies, government strategies and initiatives were considered important drivers by the majority of respondents. Such drivers include legislation on the provision of government information and data, legal obligations to publish open data, open standards policy, open data action plans, European open data policy and many others. Some also mentioned the importance of a broader openness and transparency agenda and benchmarks with other countries as a measure to foster open data policies. The availability of funding schemes for the release and innovative reuse of open data was seen as an additional driver, whereas many cited the dissemination of best practices and real use cases as a way to inspire and give guidance to other administrations and organizations. In fact, regulations and policies constitute a particularly interesting group of drivers. Not only are they seen to hold a considerable potential to drive open data innovation, they are also something that – unlike beliefs, habits and administrative routines – are easier to change. Therefore, a couple of successful examples highlighted by the survey respondents will be given a closer look in the next paragraphs.

Two good examples that were frequently mentioned have a supranational or cross-border character. One of them is the European open data policy, in particular the Directive on the re-use of public sector information (known as the "PSI Directive") and the Directive establishing an Infrastructure for Spatial Information in the European Community (the "INSPIRE Directive"). European Open Data Portal was also outlined as a valuable initiative for open data publishers and users. The European Union's approach is believed to be successful because of its comprehensive and strategic nature: the PSI Directive imposes an obligation to Member States to publish public sector information as open data by default, while the open data portal creates a supportive technical infrastructure. This general approach has been supported by initiatives in particular policy fields that have helped release and harmonize key datasets, pilot new solutions and share best practices. Such areas are, for example environmental information, marine data and cultural heritage. The EU is also making efforts to enhance data interoperability and data protection through new technical and regulatory measures, which promise to further stimulate the reuse of open data.

The other international example is the global Open Government Partnership (OGP), launched in 2011, which many see as an important trigger for national-level policies on open data and open government. The value of OGP is seen in its global scope as it allows to compare the status of countries and share best practices with a number of other countries that have joined the partnership. In discussing the success factors of OGP and the EU policies, survey participants noted that both have been top-down driven initiatives that have been backed by strong political will. We believe this should give some food for thought also for policy-makers at the national level.

The survey also highlighted several national-level policies as success stories that could set an inspiring example to others. One that repeatedly came up was the UK open data policy, including the Information Principles for the UK Public Sector (2011) and Open Data White Paper (2012), which are seen to have successfully driven the publication of open data by the public sector. The UK has also made efforts to promote open data publication among local governments. Examples of this are the local government transparency code and local government open data incentive scheme. The survey participants from the UK saw the latter as a good way to encourage local authorities to publish open data as it provided standardized schemas for certain datasets and financially rewarded the effort of publishing open data.

In the study, the Greek Transparency Program ("Diavgeia") was mentioned several times, reconfirming it as an important national-level example. The program requires all government institutions to publish their acts and decisions in a public online portal since 2010. Following an update in 2013, no regulation or decision can enter into force unless published online. The Transparency Program is reportedly the largest horizontal action throughout the Greek public sector, and is perceived to be successful because it is at once "practical and visionary", combining regulatory measures with technical solutions and giving birth to a whole surrounding ecosystem of smaller applications. The Greek respondents also praised a user-friendly search interface (although some noted the actual usage level has remained below their expectations). Last but most importantly, the success of the Transparency Program is associated with its importance to citizens – as transparency is seen as a serious problem in the Greek public administration, the program directly addressed a demand from the broader community.

All of these successful policy measures seem to have some common features. First, they have a clear focus and ambition, and a strategic, systematic and comprehensive approach. Policies that have combined regulatory actions (obligation to publish) with technical solutions (portals) and financial incentives seem to be held in particularly high esteem. Secondly, successful initiatives have often been driven top-down at the highest political level. Thirdly, these policies have demonstrated clear value for citizens and governments – they have been executed in a user-centric manner, addressed topics that are important to citizens, enabled the publication of datasets that are relevant for users, demonstrated the added value of open data, reduced transaction costs for data publishers and users, provided good interfaces, and in many cases been backed up by consistent communication.

Lastly, in the case of international initiatives, the element of best practice sharing and promoting competition has also worked well in driving open data innovation in individual countries.

Although the survey yielded a long list of good examples, the full potential of policy drivers still needs to be unlocked. For example, although the survey respondents were generally happy with the European open data policy, they insisted that much more could be done to enforce the directive at the national level. Some even suggested the directive should be updated to pressure states to make all government information public free of charge. It should also be noted that policies might effectively address the barriers related to open data but none of them has a direct effect on problems related to co-creation and the involvement of citizens. As our study suggests, successful co-creation is mostly a matter of attitudes, behavior, and supportive organizational processes. This area is therefore likely to require fundamental organizational and cultural transformations which are more difficult to achieve through policy measures.

IV.   CONCLUSIONS AND POLICY RECOMMENDATIONS

The aim of our study was to explore the phenomenon of open data-enabled co-creation as a new model which is believed to transform the way public services are produced. As existing literature allowed us to assume, high barriers are associated with both open data and co-creation. Our empirical survey indeed reconfirmed the importance of the barriers frequently cited in literature. However, it also gave us a deeper understanding of the complexity of this model – it seems that in situations where both open data and co-creation are at play, the barriers related to both add up. Somewhat surprisingly, our results also suggest that country context matters less than might be expected. The barriers and drivers seem to be very similar in countries with more advanced open data ecosystems and in those that are only beginning to discover open data (except for the supply of open data, which is understandably a bigger problem for latecomers). Nonetheless, the way things currently stand, open data-driven co-creation is not (yet) the revolution we hoped it would be – it is rather a complication of things that are already complicated.

Regarding individual barriers, the availability of relevant, good-quality and easily usable open data is the number one hurdle that should be addressed in order to make data-driven service creation possible. However, data is not a sufficient driver on its own. What seems to be necessary is that the publication of open data goes hand in hand with increased awareness of open data and a full recognition of its many benefits. As long as the value and potential uses of open data are poorly understood, there seems to be a vicious circle of governments not releasing data and citizens not demanding it. At the same time, there is a burning need to enhance data-related skills among data providers and users. Such skills include general digital literacy as well as specific knowledge about data formats and standards, appropriate licenses, data protection requirements, tools for analysis and visualization, etc. A shared understanding of the value of open data together with relevant skills seems to be a winning combination that can trigger further changes and remove other hurdles on the way.

Similar awareness and skills are also needed for co-creation. The existing culture, attitudes and practices in public sector organizations do not exactly support the engagement of citizens, businesses and other stakeholders in the creation of public services. Any change in the service creation process first requires all stakeholders to see clear value in co-creation and to have the skills for engagement, participation and collaborative service design. At the same time, skeptical or even hostile attitudes are not easily replaced by openness and trust. It is likely that data-driven co-creation is only possible in contexts where a certain level of trust already exists between different stakeholders and where public administrators believe that good things can come of unknown sources. As our survey demonstrated, the willingness to give up control can yield benefits for all – even if the government is reluctant to initiate new projects of service co-creation, it might even be helpful to just make the first step and release government information as open data. This allows non-governmental parties to take the lead in initiating new services bottom-up and possibly create new successful business models that public sector organizations themselves could adopt.

As the study implies, many of the drivers and barriers are closely interrelated. The supply of open data depends on its perceived value, whereas the perception of value depends on awareness of the benefits of open data. A key instrument in building such awareness is believed to be the sharing of best practices and successful models. This therefore promises to be one of the most effective measures that can be taken to drive open data innovation. On the other hand, a similar chain of relationships can also be observed for co-creation. The starting point for organizational changes and new processes is the perceived value of co-creation, which in turn depends on prior awareness and knowledge of its benefits. Here, too, best practice sharing is seen as an important means to improve awareness. If this is supported by conscious efforts in building relevant skills and capacities, we have a combination of drivers that is likely to create a favorable environment for open data-enabled co-creation.

Another pleasing finding is that regulations and policy instruments can also act as a powerful driver, in particular at the supply side of open data. As existing successful examples suggest, this potential should be used much more actively, in particular at the national level. This does not only mean the creation of new policy instruments but also the enforcement and reinforcement of existing ones such as the PSI Directive. Furthermore, our study points to the importance of devising a comprehensive and strategic policy agenda that includes strict regulatory measures as well as softer coordination initiatives and instruments for technical and financial support. Such a holistic approach has been proven to create a more favourable environment for the provision of open data by addressing several important barriers at once.

In light of these observations, we suggest public administrations to take an active role in unlocking the potential of data-driven co-creation by addressing the barriers preventing this potential. The recommendations which follow will refer back to Table 1 and attempt to address each barrier which was presented.

1. Make open data a clear political priority. Our study highlighted the power of political leadership and visionary policy-makers in driving positive changes top down. **Barrier addressed:** B.S1
2. Take a comprehensive, systematic and strategic political approach to open data and open government. This includes making open data part of a broader openness and transparency policy, integrating the technological state of the art and emerging trends, combining regulatory measures with technical infrastructures (e.g. open data portals), hands-on guidelines, dissemination of best practices, and funding schemes to support the publication of open data. **Barriers addressed:** B.DT4, B.S1, B.S2, B.02, B.03, B.LP1, B.LP2.
3. Publish key datasets as open data. The study revealed a demand for government datasets that non-governmental actors could use to initiate their own services. Data of particular value to re-users are, for example, datasets with large geographical relevance. These datasets should be provided in ready-to-use formats to make them easy to analyze and link to other datasets. **Barriers addressed:** B.DT1, B.DT2, B.DT3
4. Review data licensing and copyright regulations to ensure their compatibility with open data goals, public interest and new business models. This includes a more widespread adoption of free software licenses with minimal restrictions and maximum compatibility. **Barriers addressed:** B.LP1, B.LP2, B.01
5. Engage in cross-border collaboration for the harmonization of data standards to add value to open datasets. **Barriers addressed:** B.DT2, B.DT3
6. Increase public officials' awareness of personal data protection regulations and ways to publish data without compromising privacy and security. **Barrier addressed:** B.LP3
7. Introduce a legal obligation for government institutions to make public sector data open by default. For EU governments, this may mean strengthening the implementation of the provisions of the PSI Directive. According to the survey, imposing a statutory obligation to publish open data is a good way to exert much-needed pressure on public organizations. **Barriers addressed:** B.LP1, B.LP2
8. Remodel existing processes for public service production to integrate co-creation. As the first step, this could be done by creating innovation teams around internal change-agents, who should be given sufficient freedom to experiment with open data and collaborative service creation models in innovative ways. . **Barriers addressed:** B.01, B.03
9. Provide and disseminate concrete applications to display open data solutions that could be taken up by public and private organizations. **Barrier addressed:** D.DT4
10. Initiate capacity-building and training programs for public sector officials to build data-related knowledge and skills. This could be done by offering specialized training programs on open data and digital skills, publishing handbooks that explain open data, providing guidelines and sharing best practices. **Barriers addressed:** B.S3, B.S4, B.02

In addition to government's efforts, there are also small things that citizens, private and non-governmental actors can do to encourage data-driven co-creation. Among other things, these include the following:

1. Raise awareness of the value of open data as an enabler of improved services, better informed decisions, government transparency, civic participation, and economic opportunities. Among other means, this value can be demonstrated and communicated by prototyping and disseminating applications for data analysis and interactive data visualization, disseminating the success stories of particular initiatives, and sharing best practices.
2. Take initiative in using the existing open data to build small applications and services to show how data can be employed to meet user needs. The key role of individual innovators and leading by example clearly came out in our study.
3. Express a clear demand for open data. Vocal grassroots groups who demand open government data can become an important motivator for public sector organizations to publish government information and datasets.
4. Initiate capacity-building and training programs for employees and volunteers in the private and non-profit sector to develop the necessary skills, knowledge and abilities to work with open data and participate in public service creation.

These policy recommendations are based upon the conducted survey, but more data should be collected in order to gain a better understanding of how to overcome the current barriers for data-driven co-creation. Existing studies do give us a useful perception of the key barriers but do not say much about how these can be overcome. It is therefore vital to collect more empirical data on actual cases of data-driven co-creation, both successful and unsuccessful, to learn what factors affect this process and how barriers can be surpassed. The pilot projects conducted as part of the OpenGovIntelligence project aim to generate exactly these kinds of lessons that can build our knowledge of the problems and solutions. The need to share lessons and best practices turned out to be a recurrent theme in our study – the dissemination of stories, tools and methods is believed to be a key driver that can foster data-driven co-creation. This discovery is a rather optimistic one since such dissemination is something that can be easily implemented with the help of existing networks and collaboration platforms such as the Open Government Partnership.

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