SITUATING **OPEN DATA**

GLOBAL TRENDS IN LOCAL CONTEXTS

Edited by Danny Lämmerhirt, Ana Brandusescu, Natalia Domagala & Patrick Enaholo

Situating Open Data

Global Trends in Local Contexts

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Building a framework for the analysis of factors to creation and growth of an open data ecosystem

Edson Carlos Germano, Nicolau Reinhard & Violeta Sun

Public access to large and complex government databases is expected to contribute to the improvement of citizens' lives. However, there are several obstacles to obtaining these expected benefits from open data. On the side of the data producers, these barriers may include problems such as the effort and cost required to convert from closed to open data, and also providing them in a context required by users to ensure their acceptance and usefulness. Other barriers may be poor data quality, lack of legal and political support for the initiative, lack of technical capacity to implement and maintain open data practices and resistance to openness by the databases' administrators (Janssen 2011; Janssen et al. 2012; Magalhães et al. 2013). On the users' side, barriers include problems such as lack of access, low levels of data understanding, lack of human, social and financial resources to effectively use the data, such as combining and integrating different databases to create value for citizens. (Cañares 2014; Gurstein 2011; Magalhães et al. 2013).

Open data intermediaries have been playing a crucial role in removing some of these barriers and thus unlock the potential of open data, by interpreting and integrating open, simple, or complex databases to produce results compatible with users' needs. According to Van Schalkwyk et al. (2014), the presence of intermediaries in the open data ecosystem stimulates the flow of open data among the various ecosystem actors. The publication of databases in open format as well as the intermediaries' effectiveness in generating products and services for end-users have also been improved by more recently developed technologies, such as tools for big data and machine learning. According to the World Bank Report (2016), the internet and digital technologies have spread much more rapidly in developing countries than previous technological innovations. For the

generation of digital natives, the natural appropriation of these technological advances reduces the barriers to using open data.

These digital technologies, such as ICT, are incorporated in global, national and local socio-economic contexts that are defined by Diga and May (2016) as ICT ecosystems, encompassing policies, strategies, processes, information, technologies, applications and stakeholders, that together constitute the technological environment for countries, governments or companies. An important aspect of an ICT ecosystem is that it includes people: the various individuals who create, buy, sell, regulate, manage and use the technology.

An ecosystem where open government data (OGD) are the main resources for the establishment of relations between the actors acting from the production of the data in open format to its final consumption as products or services to users will be denominated an OGD ecosystem. This characterisation of the OGD context as an ecosystem allows the representation of it as a broad conceptual framework that considers actors, resource flows, socio-economic, political and spatial dynamics, among other system variables. Its structure and functioning could then be analysed through the study of the existence and intensity of the interactions among the ecosystem's multiple actors. Interactions influenced by systems of governance, citizenship, communication, knowledge, and innovation affecting the OGD ecosystem, whose actors are the producers, intermediaries, and users, and interactions are represented by the flow of information, services, products, and financial resources.

Research problem and objectives

Roberts (2014) points out that citizens are increasingly dependent on third parties, called 'trusted intermediaries', who ensure that transparency policies are maintained and who assist users in accessing the information available in transparency policies, making them accessible and easy to interpret. Roberts further adds the following concern:

[...] our dependence on intermediaries will increase, and this will raise the difficult question of whether such groups can acquire the resources needed to do the job of intermediation properly. (2014: 10)

In order to understand the different roles played by intermediaries in an OGD ecosystem and their characteristics, the present work proposes a framework considering not only the actors and their relationships. Also under consideration will be variables such as ecosystem governance, existing policies and actors' benefits perception in order to describe the actors, their roles and the structure of the OGD ecosystem, while also identifying variables that can influence this ecosystem and its economic and social sustainability.

Theoretical foundation

The OGD ecosystem analysis framework proposal will be based on the concept of intermediaries and their performance, the use of the ecosystem concept for ICT environments, studies on the OGD value chain, their actors and how value is generated along the chain, and principles for the ecosystem's governance.

Data intermediates

The concept of intermediaries in the field of ICT emerged in the 1980s as a process of intermediation and not as a description of a group of actors, people or organisations that play an intermediary role (Mittilä 2006). The performance of intermediaries was considered by researchers as critical in the production, launching, scalability, and popularisation of innovations through the transmission of information between suppliers. Therefore, intermediaries were seen as liaison organisations, information agents or support organisations positioned between two or more actors (Van Schalkwyk et al. 2016).

According to Davies (2014):

Intermediaries are vital to both the supply and the use of open data [...] translating data into information, knowledge, and action [...], many citizens' trust in local institutions plays a significant role in their choice to use these [...].

In order to understand the roles played by intermediaries and to justify their existence, Sein and Furuholt (2012) present a set of generalised interpretations of intermediaries: intermediaries 'help users access information that is publicly available by locating these sources', 'integrating various sources on a specific topic, structuring these findings into a form understandable by interested users and disseminating it to them'.

Janssen and Zuiderwijk (2014) in their study of what they described as 'infomediary business models' also considered middlemen as value adding actors positioned between data providers and data users. The authors also highlighted the fact that intermediaries are vital in systems that become increasingly complex, resulting in higher levels of interdependence among multiple agents, with the intensification of individuals' specialisation.

Sein and Furuholt (2012) point out that in the context of e-government and governance, intermediaries perform functions such as: 'diffusion of services (Al-Sobhi et al. 2010, in Sein & Furuholt 2012), reducing corruption (Bhatnagar 2003, in Sein & Furuholt 2012), moderating discussion on democracy (Edwards 2002, in Sein & Furuholt 2012) and providing e-government services of various types (Bailey 2009; Gorla 2009, in Sein & Furuholt 2012)'. These studies mention the 'offline' service offered by intermediaries. (Sein & Furuholt 2012).

Researchers, media, civil society organisations, among others, have a tradition of using government data as a source for their activities which can be seen as pioneering initiatives for open data actions. A study of the practices of organisations using government data has identified the potential of such intermediary organisations to enrich the publication and availability of open data in a precarious ecosystem of suppliers or producers of government open data (Chattapadhyay 2014).

Fransman (2007), based on the work of evolutionary economist Joseph Schumpeter, described the ICT business environment as a sector ecosystem within a larger ecosystem with socio-economic characteristics, with a focus on identifying what drives complex ecosystems with varying degrees of interdependence. In his work, Fransman identified the actors that interact dynamically in the ICT ecosystem, including companies, non-profits, public organisations, consumers and intermediaries connected by exchange relationships, as well as by the set of rules, values, and norms in which the actors are inserted.

According to Fransman (2007), the main characteristic of an ICT ecosystem is its being driven by innovation which is defined as the insertion of new knowledge into the ecosystem. Firms compete and cooperate symbiotically, and the interaction between firms and consumers (that is, between knowledge producers and knowledge consumers) generates new knowledge leading to innovation in the ecosystem. This quest for innovation is that it would keep the ICT ecosystem dynamic and evolving. In developing countries, middlemen play an important role in the innovation environment by filling gaps in the national innovation system (Intarakumnerd et al. 2010, in Intarakumnerd & Chaoroenporn 2013).

Although the aforementioned studies analysed the role of the intermediaries in their sectors of activity, only a few analysed the role of the intermediaries in the context of open data. Van Schalkwyk et al. (2014), in a study on the use of open data in the governance of South African public universities, suggest that an intermediary in this data ecosystem depends on personal connections (or social capital) to enable the flow of data to potential users from government databases. According to the authors, open data intermediaries play several important roles in the ecosystem, such as: (i) increasing the accessibility and utility of data; (ii) assuming the role of a 'keystone species' in a data ecosystem; and (iii) democratising the effects and use of open data (Van Schalkwyk et al. 2014). The authors conclude that, despite the low availability of government data, the open data ecosystem in the governance of public universities has evolved because open data intermediaries have facilitated the data flow from government to potential users.

Johnson (2014) draws attention to the concept of 'disciplinary power' and the potential to locate existing injustices in an open data ecosystem. For Johnson, open data enhance the capacity of disciplinary systems that observe and evaluate the compliance of institutions and individuals with norms that become

fundamental values and assumptions of the institutional system, regardless of whether the data reflect the peculiar circumstances of these institutions and individuals. Institutions and individuals who deviate from these norms are marginalised in political debates, since observers evaluate all institutions according to the norm (since there is only data on the actions that reflect the norm) as institutions internalise the norms and guide their actions toward them. Since standards reflect society's power structure where they were created, open data would be reiterating the standards of fairness and injustice.

Studies have sought to create a typology of open data intermediaries that act on specific open data ecosystems. Magalhães et al. (2013) propose a typology of open data intermediaries consisting of three basic types: (i) civic startups, (ii) open data services and, (iii) infomediaries. And they identified three types of business models in companies that use open data as resources for products and services marketed to potential users: enablers, integrators, and facilitators.

Janssen and Zuiderwijk (2014) define infomediaries as the intermediaries that position themselves between data producers and potential users and classified them into six types according to the adopted business model: defined information services, interactive services, aggregators of information, information combiners, open data repositories, and service platforms.

Deloitte Analytics (2012), in collaboration with the United Kingdom Open Data Institute, listed the following types of information intermediaries: suppliers, aggregators, developers, enrichers, and enablers, distributed between two categories of organisations: application developers and businesses.

Using Bourdieu's concepts of social interactions (including the concepts of situations, habitus, and capital), Van Schalkwyk et al. (2016) analysed how open data intermediaries promote the flow of information between data producers and potential users. The study found that the open data value chain may require multiple intermediaries and multiple forms of capital (economic, cultural, social, technical, or symbolic) enabling the connections between data producers and potential users.

The effectiveness of intermediaries in this ecosystem could be attributed to their proximity to data producers or users, and this closeness could be expressed by the type of capital possessed by the intermediary. However, Van Schalkwyk et al. (2016) point out that individually, no intermediary would have all the available capital needed to effectively connect to all agents that exert power in the ecosystem, therefore multiple intermediaries with complementary capital configurations would more adequately represent the various connections between agents that exert the power in the open data ecosystem.

ICT ecosystems

Fransman (2010), describes the components of a socio-economic ecosystem for the ICT context. The author identifies the dynamic interaction between the

organisms (companies, non-businesses, intermediaries, and consumers) that compose the ecosystem by grouping them into four layers within an ecosystem that is driven by innovation (e.g. the insertion of new knowledge into the ecosystem):

- network element providers (producing items such as computers, operating systems, mobile phones, telecommunications equipment);
- network operators (creating and operating telecommunications networks, cable TV, and transmission networks);
- content and applications providers, applications, services, innovation, search, navigation and middleware platforms; and
- final consumers.

The layers composed of key groups of the ICT ecosystem are sequentially structured and interdependent. Each layer depends on its adjacent layer (or layers). For the system to function as a whole, each layer must play its functional role, influencing or being influenced by other layers. The division between the layers, however, is not unique as there may exist organisations that act on more than one layer. This ecosystem does not only include the organisations that make up the layers, but also financial institutions, regulatory agencies, standardisation forums, universities, research institutes and other entities (Fransman 2007).

According to the evolutionary theory proposed by Schumpeter, the emergence of new products, new processes, new forms of organisation and new markets is the result of innovation in the system and, in his words, are the main drivers of the evolution of the system itself (Schumpeter 1943, in Fransman 2007).

According to Fransman (2010), these innovations arise essentially from six symbiotic relationships that occur within the ICT ecosystem. The author uses the biology concept of symbiosis to demonstrate that the individuals who make up the ecosystem coexist in constant interaction and the result of these interactions may or may not be beneficial to the parties involved.

These interactions described by Fransman refer to the relationships between the four key stakeholder groups present in the ICT ecosystem: network element providers, network operators, content and application providers, and consumers. According to the author, each of the six relationships can be analysed in four parallel dimensions: (i) financial, through the purchase and sale of products or services, resulting in a financial flow; (ii) material, through the entry and exit of products, resulting in a flow of materials, physical or virtual; (iii) informational, through the exchange of information resulting in a flow of information, and; (iv) innovative, through the creation and diffusion of the ecosystem innovation process (Fransman 2010) (see Table 1).

Table 1. Six symbiotic relationships in the ICT ecosystem

Relationship	
1	Relationship between network element providers and network operators.
2	Relationship between network operators and content and applications providers.
3	Relationship between content and applications providers and final consumers.
4	Relationship between network element providers and final consumers.
5	Relationship between network element providers and content and applications providers.
6	Relationship between network operators and final consumers.

Source: Fransman (2010)

Fransman (2010) also addresses the ecosystem and the implications of public policies to foster innovation. For him, the following systemic factors have a marked influence on innovation in the ICT sector:

- sectoral regulation (mainly for network operators) and antitrust legislation. For Fransman (2010), the intensity of competition and cooperation among firms is closely associated with innovation;
- availability of financial resources (ease and flexibility to obtain financial resources), costs of loans and equity. Essentially, capital and inherent risk play a key role in the approach;
- other R&D agents, such as universities, research centres, standardisation forums, and intellectual property protection entities; and
- government support.

Diga and May (2016) propose a conceptual framework for the ICT ecosystem, based on contributions from previous works, studying the interactions between these groups of key actors, the presence of infomediaries facilitating the interpretation and use of information, and considering factors of gender, generation, ethnolinguistics, historical context, accessibility, access and use shaping the diverse relationships of people within the ICT system.

These authors also consider the institutional arrangements, national policies and governance structures guiding the use of ICT by the various society members. As a result of this structure, human well-being must also be analysed as a result of the ICT system and human interaction, with the possibility of being improved, stagnant or degraded, leading to changes in physical, social, economic and political aspects. The objective of this conceptual framework is to simultaneously capture technical, economic, and institutional relationships in an emerging domain that is not yet sufficiently mature for adequate modelling with more specialised methods, hence its application in the context of the open government data ecosystem.

Open government data value chain

The generation and use of open government data (OGD) comprises a chain with a set of different combinations of activities such as production, collection, publication, enrichment and organisation of data, access, use, distribution, update, visualisation, services, among others activities, in which each activity can add value to the data for potential users through the production of information and services (Davies 2014; Pellegrini 2012; Robinson et al. 2009; Ubaldi 2013).

One step of the OGD value chain is the identification and classification of each actor, to understand their role in the chain. According to Ubaldi (2013), in order to analyse the OGD value chain, it is essential to understand the role of the main actors and the speed with which the context evolves, causing significant changes in the roles and limits of their responsibilities, thus affecting the actors' involvement in the chain activities.

The sequence in which these activities can occur in the value chain will be defined by the needs of the potential users and the aggregation of value provided by each actor. For example, the agency that produces and publishes the data can be responsible for several of these activities such as production, organisation, publication, and data updating. Previous research has classified the actors according to their roles in the execution of these activities (Davies 2014; Deloitte Analytics 2012; Magalhães et al. 2014; Scott 2014; Ubaldi 2013) which are summarised as follows:

- **Suppliers** collect and produce data as a result of the institution's mission.
- **Publishers** organise and prepare data in open standards and formats for publication.
- **Enrichers** increase the value of data by checking, cleaning and elaborating data, adding links or new data.
- **Aggregators** collect, integrate and analyse open government data and data from other sources that allow them to meet specific information needs.
- **Enablers** add value, by treatment, selection, analysis, and integration of open government data, to their products and services; to meet the specific needs of their users.
- **Distributors** collect, organise and redistribute information, such as repositories and portals.
- **Facilitators** provide platforms or tools that facilitate access to or use of government open data.
- **Developers** build and distribute applications for specific purposes.
- **End-users** (organisations, individuals or government) use government open data for their own economic, social or environmental activities.

Ubaldi (2013) proposes the organisation of the value chain of OGD in four phases, grouping a delimited set of activities, based on a study of the value chain

for Public Sector Information in the European Community (Dekkers et al. 2006):

- **Data generation:** at this stage the data are generated. In general, this activity is carried out by public sector entities or by entities financed with public resources;
- **Data collection, aggregation, and processing:** at this stage data are collected and organised in order to allow access, sharing and reuse, being elaborated, connected or combined to add value to potential users;
- **Data distribution and delivery:** at this stage, data are distributed to potential users for access; and
- **Final data use:** at this stage, data are reused by different users. The larger and more varied these groups of users, the greater the potential for sustainability of the ecosystem and the indication that the value adding to the data has been successful.

Creating value in OGD along the value-chain implies an adequate understanding of the needs of potential users, in terms of content and format, and also an adequate understanding of how data are created, protected, shared and used (Ubaldi 2013). The final use of OGD can occur in several ways. Davies (2010) identified at least five processes of OGD use, which may occur in a distinct or combined manner, according to the purpose of the use.

- **Facts understanding (*Data to fact*):** When a newly opened dataset is used to look for specific facts. These facts may be related to civic engagement, business planning, or understanding bureaucratic processes. In this use, the data would be submitted to research activities, careful analysis, and extraction of information;
- **Information production (*Data to information*):** when one or more datasets are used to construct a representation and interpretation of a given subject, leading to the production of infographics or reports. In this use, the data are submitted to activities such as manipulation, statistical analysis, visualisation, contextualisation and elaboration of reports;
- **Interface availability (*Data to interface*):** when one or more datasets are interactively accessed or exploited through interfaces that allow the analysis and formulation of interpretations without the need for advanced technical knowledge for the data manipulation. In this use, the data are submitted to activities such as cleaning, combining, sub-division and display in preconfigured interfaces;
- **Data production (*Data to data*):** when a dataset is treated for the production of secondary data, in order to allow access in a new format, to complement it with other data or other use. This includes activities such as base format conversion, filtering, complementation and combination, and providing access to the resulting database; and

- **Production of services (*Data to service*):** when data are used for the production of services. In this use, the data can be submitted to a great number of activities in order to incorporate them into already existing or the creation of new products and services.

Ubaldi (2013) describes how OGD affect value creation for different ecosystem actors, such as government, citizens, civil society, and the private sector, where a market for services is developed from the open data. According to this author, value creation from OGD should address issues such as increasing the amount of public data available in open digital format, exploring and understanding the barriers to the process of data entry at various levels of government, data ownership, the role of the various actors involved, and the assessment of the return on investment to identify the facilitators of value creation. The researcher also emphasises that understanding and fostering the use of OGD is critical to the value creation process as well as to the creation of a sustainable and collaborative ecosystem in data creation.

Jetzek et al. (2014) propose a structure composed of four prototypes of mechanisms of value creation, showing how OGD reuse can stimulate value creation in a sustainable manner, that consider not only economic aspects with a focus on increasing revenue and profit but also new aspects of economic impact such as resource sharing and the collaborative production of goods and services.

In this model mechanisms are organised in two dimensions: the first, analysing the value generated by the use of data to improve existing products and services or the provision of new products and services, and the exploration of new opportunities; the second, identifying whether reuse is the result of a market exploration in the traditional economic format, with the economic value generated by reducing costs and increasing revenues, or in a shared economic format, based on a network economy of organisations interacting with each other.

Another model proposed to understand how data-driven innovation emerges from OGD and how this innovation creates social and economic value for society is presented by Abella et al. (2017) in a context of intelligent cities. This model addresses the different stages of the process, from the acquisition of data to its processing for the creation of services and the analysis of their impact.

The first stage focuses on the characterisation of the data according to their degree of reuse. This characterisation is an input to the second stage and allows correlating the available data with the innovative products and services developed in this stage. The second stage focuses on how these data sources, through reuse, become innovative services and products that are used even by the organisation that generates the data. The third stage assesses the economic and social impact generated by these products and services. The economic impact may be to increase incomes or decrease costs for existing activities. The social indicators would be related to the involvement, experience, security, and confidence of the users (Abella et al. 2017).

Governance in relationships between organisations

Governance is the process by which organisations (social actors) influence their environment in order to create order and continuity in the social system (Gomes & Merchán 2017). According to Rasche and Gilbert (2012: 101)

the overall aim of governance is to create the conditions for social order by emphasising the need for the regulation of social affairs. Regulation [...] can take many different forms, including self-regulation of private actors, co-regulation of public and private actors [...].

Examples of regulation mechanisms are rules and/or standards developed by public and private actors and state legislation (e.g. laws of command and control drawn up by states) (Gomes & Merchán 2017).

There is also the special case of transnational governance focusing on the forms of regulation that emerge and are not operated exclusively by the state (Cashore 2002). The concept of transnational governance arises from contemporary capitalism and the transnational relations that emerge from it, such as global production and value chains, the flow of information and capital between countries, and the financialisation of everyday relations (i.e. greater dependence on the financial sector for the realisation of present and future consumption, such as the private pension fund and other forms of investments, credit card and mortgages) (Djelic & Sahlin-Andersson 2006, in Gomes et al. 2017; Morgan 2016, in Gomes et al. 2017; Morgan & Kristensen 2012, in Gomes et al. 2017).

According to Gomes et al. (2017), the regulation process takes place mainly through interested organisations and system participants, whose interactions and negotiations are constantly creating regulatory arenas. The basic activity is not only to elaborate rules and certifications, but also to monitor and audit their implementation. Even without the elaboration of new rules or certifications, negotiation can already have a regulatory effect. Transnational governance can take two forms: (a) soft law or soft regulation: self-regulated certifications and standards (e.g. involving only pro-market actors) or co-regulation (e.g. when there are public and private actors); (b) hard law: the law and its forms of command and control, defining what is permitted or not in a given jurisdiction (Djelic & Sahlin-Andersson 2006; Rasche & Gilbert 2012).

Regardless of the form taken by the transnational governance, three characteristics or dimensions can be highlighted: (a) it involves multiple actors, both the state and its agencies, as well as civil society organisations and companies; (b) it is immersed in multilevel relationships, that is, the local, national and global dimensions intertwine and it is often difficult to separate analytically what happens in each of them; and (c) negotiation, since forms of governance are not the result of the imposition of a single actor (such as the state), but are the result of negotiation and consensus building on the rules and

norms that will influence the behaviour of the actors. Regarding this last item, it can be said that governance involves steering, since regulation is constructed and negotiated through the exercise of influence (Djelic & Sahlin-Andersson 2006; Rasche & Gilbert 2012).

In business environments, the concept of meta-organisations (MO) defines the type of organisational structure where the members themselves are organisations, which, based on shared decisions and interests, such as social interest or standardisation, may constitute a model of partial organisation, in which some of the criteria that define a complete organisation (definition of members, hierarchy, rules, monitoring, and accountability) are not met in their entirety (Ahrne & Brunsson 2010).

Gulati et al. (2012) studied variations in MO architectures according to the model adopted for membership participation and for internal decision-making, leading to a definition of dimensions and taxonomies that includes the networks of organisations or individuals not linked by authority or labour relations, but by common goals. König et al. (2012) have shown that MO, similar to other organisations, may respond with inaction when faced with disruptive innovations, due to MO characteristics such as decision-making format, political organisation, and organisational complexity, and observed that these characteristics may increase or decrease inertia to the response.

Berkowitz and Dumez (2015) studied MOs in the oil and gas sector and found that the companies organised their own environment through the creation of different types of MOs, with limited dimensions and performance, when faced with characteristic situations. One such situation is the need to manage relationships with multiple actors, such as civil society and governments (see Figure 1).

Figure 1. Three situation decisions that originate MO

Source: Berkowitz & Dumez (2015)

With many redundant MOs subsisting and coexisting, Berkowitz and Dumez (2015) argue that the business environment is affected by increasing organisational complexity due to this proliferation of MO. Finally, the study also emphasises the importance of membership of MOs, their implications for legitimacy issues and the emergence of strategy.

Methodology

This study started with a literature review for the definition of the theoretical reference model for the OGD ecosystem analysis, selecting the concepts of value chain for OGDs, ICT ecosystems, meta-organisations and governance of ICT ecosystems.

Jabareen (2009) suggests that the construction of a framework from existing multidisciplinary literature occurs through a process of theorising, which is based on the methodology of grounded theory rather than a simple description of the data and the phenomenon studied. Thus, the author defines a framework as a network, or a 'plan', between concepts that together offer a comprehensive understanding of the phenomenon or of phenomena within a context.

These concepts, within the framework, support each other, playing ontological, epistemological and methodological roles. The ontological role of concepts within the framework is linked to the knowledge of the 'path of things', 'the nature of reality', 'real' existence, and 'real' action. The epistemological role is linked to 'how things really are' and 'how things really work' in a known reality. Finally, the methodological role is linked to the process of constructing the framework and how it can tell us 'something' about the 'real' world (Guba & Lincoln 1994).

Preliminary results

Considering the objectives of the study, the concepts presented in the theoretical framework, and the methodology, reached the main elements of the proposed framework for OGD ecosystems analysis. These elements were organised and resulted in the following table:

Table 2. Synthesis of the concepts for the construction of the framework

Concepts	Concept description	Categorisation
Open government data and OGD projects	<ul style="list-style-type: none"> • The culture of government openness adopted and disseminated; • OGD public policies made official; • the diffusion of standards and capacities; and • standards and technologies adopted. 	epistemological
ICT ecosystem applied to OGD	<ul style="list-style-type: none"> • Identify and characterise the role of intermediaries; • the organisation and management of the network of actors involved; • agencies and government entities that fill gaps in the value chain; • business models adopted by intermediaries and users; and • value creation made possible by the chain. 	ontological

SITUATING OPEN DATA:
GLOBAL TRENDS IN LOCAL CONTEXTS

Concepts	Concept description	Categorisation
OGD value-chain	<ul style="list-style-type: none"> • Identify and characterise the role of information intermediaries; • the organisation and management of the network of actors involved; • agencies and government entities that fill gaps in the value chain; • business models adopted by intermediaries and users; and • value creation made possible by the chain. 	methodological
Meta-organisation theory	Define the type of organisational structure where the members themselves are organisations; understand the possible variations in meta-organisation architecture; and how the structure responds to internal or external stimuli.	ontological
Transnational governance	Ways to exercise regulation in meta-organisations; how new members can be incorporated by the meta-organisation and how they can leave the meta-organisation; and how transactions resulting from relationships between actors and ecosystem levels are managed.	ontological

Source: Elaborated by the authors

An OGD ecosystem, in a conceptual analogy with the biological ecosystems observed in nature, is a system that includes all living organisms (e.g. OGD producers, intermediaries and final users) in an area, as well as its physical environments (e.g. public policies, legal environment, platforms, data value chain, system governance) functioning together as a unit. It can be characterised by one or more equilibrium states, where a relatively stable set of conditions exists to maintain actors and value creation and exchange at desirable levels. The ecosystem should have certain functional characteristics that specifically regulate change or maintain the stability of a desired equilibrium state.

An OGD ecosystem models the economic dynamics of the complex relationships that are formed between actors or entities whose functional goal is to enable use and reuse of OGD. In this context, the actors would include the material resources (data, systems, platforms, etc.) and the human capital (data producers and publishers, intermediaries, users, etc.) that make up the institutional entities participating in the ecosystem (e.g. the government, non-profit organisations, business firms, university research institutes, and economic development and business assistance organisations, funding agencies, policymakers, etc.).

The OGD ecosystem comprises three distinct economies, the data collection economy, which is driven by governmental function, the production economy, which is driven by actors and entities engaged in making data published, and the commercial economy, which is driven by the marketplace and by economic value generation of OGD through services and products offered to final users. Figure 2 illustrates the actors, the data and exchange value flows and the rules and legal arrangements involved in the OGD ecosystem.

Figure 2. OGD ecosystem

Source: Elaborated by the authors, adapted from Enhanced ICT ecosystem framework (Diga & May 2016)

With the concepts selected for the construction of the OGD ecosystem analysis framework (see Table 2), it will be possible to contribute to an analysis and understanding of the governance necessary for the construction and sustainability of OGD ecosystems so that society can obtain greater benefit in the use of this information as well as how government resources (allocated in these projects) are used more efficiently, with a view to maximising results.

It is expected that the proposed framework will work as a reference for future studies that seek to understand, for example, what the conditions for the creation and maintenance of an economically and socially sustainable OGD ecosystem are or what factors affect the creation and maintenance of an ecosystem formed by producers, intermediaries, and users, where value is added to the OGD throughout the activities of the chain generating information flow, products, services and financial resources.

The identification of studies of open data projects, without any of them having sufficient scope of actors and organisations, in order to guide the factors that give legitimacy to the OGD ecosystem, was considered as one of the limitations of this work. The validation of the framework, to be carried out in future studies, will be an important stage in the support and credibility of the proposed framework and will also subsidise the *rethinking* of the framework due to the inherent dynamics of the ecosystem.

Discussion and conclusion

The proposed model is being used in the analysis of the Brazilian federal government OGD ecosystem, comprised of legislation and public policies, strategy, governance and operational structure, federal government and other agencies contributing data, infomediaries and end-users, citizen participation mechanisms. The OGD ecosystem comprises a large number of internet portals, the principal ones being the Brazilian OGD portal, the main access to the system and the Brazilian transparency portal and the OGD monitoring portal, with the special function of assuring government transparency and compliance with regulations.

The OGD ecosystem began being implemented in 2004, being formally established in its present form by law in 2012 and considered now to be an already consolidated structure with a large intra-government and citizen user base. Preliminary analysis results indicate the importance of a central actor monitoring the compliance of laws and supporting the agencies in creating and executing their open data plans. The main challenges in the implementation process were related to government staff technical knowledge about open data standards and resources to funding the opening data actions.

The analysis demonstrates the importance of understanding OGD as a complex ecosystem, with regulations and governance recognising the multiple public and private actors and their continually evolving relationships. This becomes especially important in assuring the system's sustainability in administrative transitions.

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