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Thorhildur Jetzek is an industrial PhD student at KMD and CBS. Her research focuses mainly on Open Data and the impact of Open Data initiatives on society, individual public institutions and private companies. As a part of her research she is studying the Basic Data Program in Denmark in co-operation with the Danish Agency for Digitization. Previously, Thorhildur was a director of Business Development in the Icelandic IT firm Advania. Other previous ventures include program management of a M.Sc. program in the University of Reykjavik, giving university lectures and doing consulting work in the IT arena.

The value of Open Government Data

Recent trends towards openness and technical connectivity have offered the ability to drive massive social and economic change; however they demand a redefinition of relationships. We have observed a move from a polarized world where companies operate in economic markets while governments drive social progress, to an interconnected, networked world of shared resources and co-creation. One of the trends driving this change is open government data. This paper presents a framework of four value generating mechanisms from use of OGD. The framework makes it easier to compare and communicate different pathways to value generation, while highlighting the current tensions between the private/public and economic/social domains. Our proposition is that these tensions bring about possibilites for synergies and value enhancement.

Keywords: Open Government Data, Value, Generative Mechanisms

The unique features of OGD

The amount of digital information accumulating in the world is breathtaking. In the past two years alone, increased internet access within emerging markets and data generation from surveillance cameras and smart meters have doubled the amount of information available in the digital universe to its current rate of 2.8 ZB, a number that will continue to double every year and hit 40 ZB by 2020 (IDC, 2012). The massive increase in the amount of data, combined with openness and technologies that allow global distribution, has changed the structure of digital data as a resource, from a closed proprietary resource to a common shared resource. Additionally, the technical and semantic ability to combine different types of data and the availability of sophisticated data analytics technologies can dramatically increase the value of all this data to the economy. It is estimated that the annual value of data to US health care could be USD 300 billion and that the value of better use of data to Europe´s public sector administration could be EUR 250 billion (McKinsey, 2011).

Open data can be defined as data that are freely accessible online, available without technical restrictions to re-use, and provided under open access license that allows the data to be re-used without limitation, including across different "fields of endeavor" (e.g. commercial and non-commercial alike) (OKF, 2012). Government data is defined as "data and information produced or commissioned by government or government controlled entities" (OKF, 2012) . Government data has already been collected for specific use, been paid for by the taxpayers and offers value beyond what is captured from the originally intended use. Open government data (OGD) can be viewed as a common resource that is owned by the public but provided by the government, and has as such some unique features:

- It is nonrivalrous: One person's use of the data does not reduce availability to others.
- It is not excludable: One person cannot exclude another person from using the data.
- It has high fixed costs: Costs of collecting, processing and storing the data are generally high.
- It has (almost) zero marginal cost: It is cheap to reproduce the data after it has been collected.
- It offers valuable information and has high potential for re-use.

(Nilsen, 2010; Pollock, 2008; Shapiro and Varian, 1999)

Geographic information and the value ecosystem

Geographic information is a particular set of government data that has been shown to offer high economic value. Results from case studies in key application areas show that Gross Domestic product (GDP) was £323 million (0,02%) higher in 2009 in England and Wales than would have been without adoption of geospatial information by local public services providers (Coote and Smart, 2010). The total value of the Dutch geographic information sector is estimated to be around 0,25% of the national GDP (Castelein et al., 2010). Applying the same assumptions to Denmark, the total value of the geo-information sector can be estimated as DKK 4,7 billion in 2011.

Due to the above features of OGD described in the previous section, economists generally support the marginal cost pricing of government data (deVries et al, 2011; Pollock, 2008). Marginal cost pricing has been shown to lead to increased value generation when applied to geographic information. The results of an empirical study on 4.000 firms in the architectural and engineering business in 15 different countries during the period of 2000-2007 show that firms operating in countries where public sector agencies provided fundamental geographical information either freely or at maximum marginal costs had grown about 15 percent more per annum than firms in countries where public sector geographic information was priced according to the cost-recovery principle (Koski, 2011).

The impact and use of geographic information continues to increase with new levels of openness and availability of data and technological advancements. Satellite-based images, geo-coded administrative data, growing number of sensors in everyday devices and location-based information systems present some of the major trends. This development, coupled with the increased use of geographic data in web- and mobile based applications, has led to a much broader user base. A study by PewInternet (2012) reveals that 74% of smartphone owners use their phone to get real-time location-based information, and 18% use a geo-social service to “check in” to certain locations or share their location with friends. According to the same study, 65% of smartphone owners have used their phone to

Government data is generally considered to be a subset of public sector information (PSI) which according to OECD´s definition (OECD, 2008) includes information products and services as well as data. In the currently used terminology, OGD does not include data that are subject to valid privacy, security or privilege limitations, as governed by other statutes.

get turn-by-turn navigation or directions while driving. Accordingly, measuring the value generated and captured from use of geographic information is becoming increasingly complex. Public providers of geographic information are now operating within a complex value ecosystem where co-creation and sharing of data are rapidly changing the landscape.

Enablers of value generation from OGD

Value is objectively established or perceived worth for somebody. Here we distinguish between value generation (creation) and value appropriation (capture). Value generation is when the utility of society´s members increases after accounting for the resources used in that activity. Value appropriation happens when an actor is able to capture a portion of the value created by an activity (Bowman and Ambrosini, 2000). We furthermore distinct between two kinds of value: *Economic value*, defined as the worth of a good or service as determined by the market, and *Social value*, which is created when resources, inputs, processes or policies are combined to generate improvements in the lives of individuals or society as a whole (Emerson et al.,2001). Due to the unique features of OGD, the value that is generated is not necessarily exclusively available for appropriation by the owner of the resource or even the value creator. OGD offers the ability to generate *Shared value* (Porter and Kramer, 2011). Shared value means that the generated value benefits multiple stakeholders, involving businesses, government, and civil society. In addition, openness coupled with technical connectivity allows for the shared use of resources and co-creation of value. Accordingly, we define the value of open data as *shared value generated from the use of open data by an agent or by collaboration of agents*.

In order to understand the mechanisms that transform OGD to value, we must recognize the main contextual, enabling elements (actions, skills or tools) that influence value generation. A survey of the OGD related literature shows that commonly discussed barriers to value generation are: 1) closed or inaccessible datasets, 2) lack of comprehensive data policies, 3) lack of validity, completeness and exhaustiveness of datasets, 4) insufficient metadata, 5) lack of consistency in cross-border access regimes, 6) lack of motivation within public sector, 7) lack of technical skills within the public sector, 8) lack of technical and semantic interoperability between governmental systems and datasets and 9) too fragmented and disparate open data community (Davies, 2010; Dawes, 2012; Halonen, 2012; Jansen, 2011; Janssen et al. 2012; Lee and Kwak, 2011; Mayer-Schönberger and Zappia, 2011;). Barriers to value appropriation are following: 1) lack of data literacy and technical ability and 2) the digital divide; power differences between data users and unequal access opportunities (Bertot et al. 2010; Halonen, 2012).

In order to overcome these barriers, we propose that governments should focus on three enabling factors: *open access, data governance* and *technical connectivity*. Openness in particular is considered as a key enabler for unleashing the value of government data as openness is necessary to make the data available to a bigger group of users. However, as OGD is collected by, and hence controlled by, the public sector, certain risks for private users regarding the sustainability and quality of the resource exist. In order to ensure the equitable, efficient and sustainable use of OGD as a resource, it needs to be managed, monitored and protected (Hess and Ostrom, 2006). Data governance is conceptualized as actions or decisions that act to improve and maintain the quality of data and ensure equitable and sustainable dissemination. Finally, the value from government data can be greatly increased by linking and aggregating different data-sources (Alani et al, 2007). In order to enable such linking of data we need the supporting infrastructure, networks and open data standards. Technical connectivity is conceptualized as the technical infrastructure that

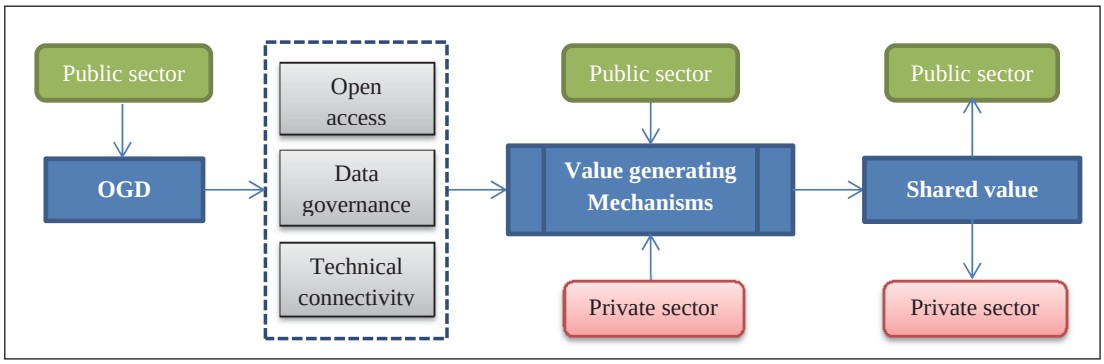


Figure 1: OGD value generating ecosystem

enables the public sector to openly disseminate data, enables the users to access the data and the technology that allows users to transform the data into something of value (knowledge, services or products).

Four value generating mechanisms

Two distinct ideologies seem drive most of the OGD initiatives today; The 'Re-use of data' perspective and the 'Open Government' perspective. We thus reviewed the respective tensions and contributions of these two unique streams. The literature on re-use of OGD is mostly focused on the economic value of government data, often in connection to the European PSI-directive (Jansen, 2011). The literature on Open Government is in a higher grade directed towards how use of OGD can contribute to the generation of social value in collaborative settings (Linders and Wilson, 2011). The promise of openness is to provide a source of pressure that counteracts the tendency of technology enactment to reproduce existing rules, routines, norms and power relations, despite the new and innovative capabilities introduced by these technologies. However, this promise can only be fulfilled if open government changes the nature of relationships between stakeholders and governments, thereby producing innovative forms of organizing that enable groups to link across organizational boundaries and functions (Harrison et al. 2011). Accordingly, an increasing tendency to cite both social and economic reasons for opening data can be observed in the OGD discourse (Jansen, 2011).

We use a two-by-two matrix in order to show the main strategic options for governments as providers of data. One dimension illustrates whether the focus is on better use and more re-use of the data itself (like in the EU directive) or if the strategy is based on the ideology of Open Government (like in the US). The other dimension illustrates whether the focus is on better government (more efficient, effective and transparent government) or on enabling value generation in the private sector, either by using government data to innovate off or by offering the private sector the ability to participate in government tasks. These four distinct types of value generating mechanisms, illustrated in Figure 2, are Efficiency mechanisms; Innovation mechanisms; Transparency mechanisms and Participation mechanisms. Each of these mechanisms represents different ways of generating value from OGD and each of them is requires a different strategy and different implementation tasks; however, our proposition is that all of them are dependent on the same three key enablers. These mechanisms are not mutually exclusive and ambidextrous strategies, where more than one mechanism is implemented, could generate the most value, due to the synergies that can be created.

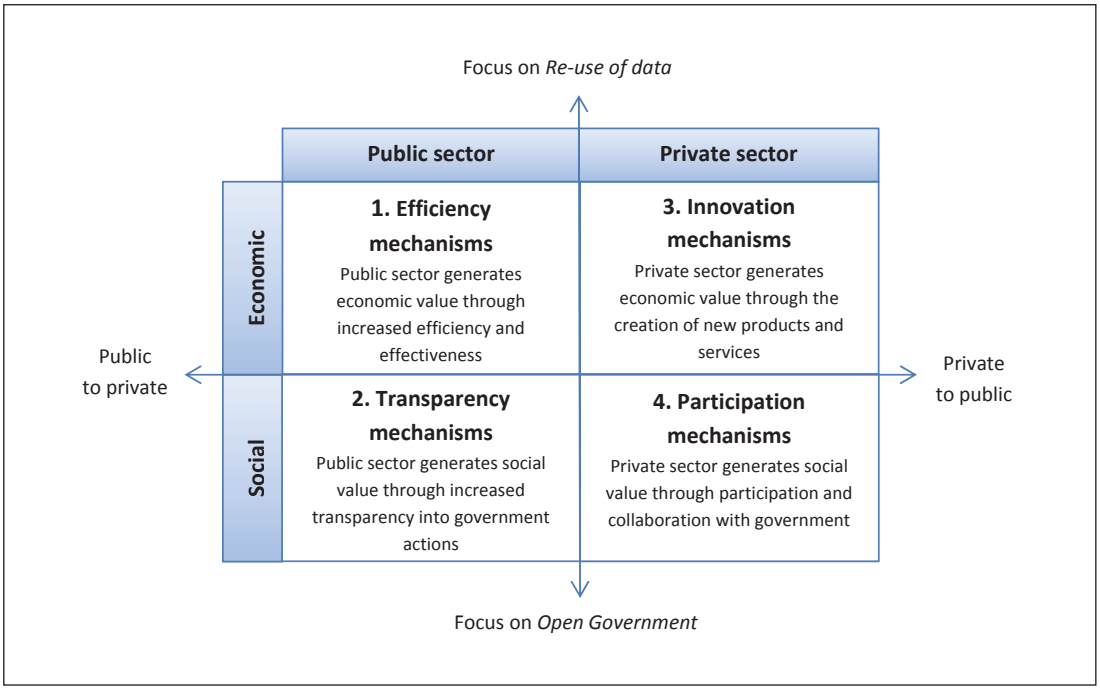


Figure 2: Four archetypes of OGD value generating mechanisms

Efficiency mechanisms

This type of mechanisms enables value generation by *better utilizing current resources*. The general economic theory that describes the workings of this mechanism is Transaction Cost Economics where value is generated by reducing transaction costs in operations. In the case of OGD, such transaction costs might be incurred by keying in the same data many times, saving the same data in multiple repositories or by charging for the data. The creation of more effective methods of collection, management, distribution and use of data can create direct and indirect cost-savings. In this case the strategy behind the value generation mechanism is motivated by the vision of more efficient government, but it still offers the capability to generate shared value by promoting to the health of the bigger community – for instance via better and more effective public services. In Australia, transaction costs incurred by selling and delivering data to users were estimated to be between 17% - 33% of revenues which suggests possible agency transaction cost savings of around $375,000 per annum after data was made freely available online in 2002. If user transaction and access costs and associated savings mirrored those of the agencies, then users' transaction-related net cost savings may have been of the order of $1.7 million per year (Houghton, 2011).

Innovation mechanisms

This type of mechanisms generates value through *transformational effects*, where data is supplied as a service or leveraged in applications in new and innovative ways. Innovation is the source of value creation in *Schumpeter's economic theory*, bringing about novel combinations of resources, new production methods and new products and services, which in turn lead to the transformation of markets and industries and in this way

increasing value. An example of the positive effect of providing government data to the private sector can be found in the Netherlands where openness and technical availability of meteorological data with an emphasis on data governance, has led to the creation of a competitive and innovative private weather market. Impacts include 400% increase in turnover for private sector re-users, 250% increase in high-end users, a rise in the use activity of re-users of 300% and an increase of over €35 million on corporate tax returns (de Vries, 2012).

Transparency mechanism

This type of mechanisms enables value generation by information effects. The general economic theory behind this mechanism is based on the concept of *Information Asymmetry*. Information Asymmetry describes situations where one party has more or better information than the other while participating in transactions, negotiations or general communications. Information asymmetry can cause all sorts of sub-optimal results and behaviors, like *Moral Hazard* where the party more informed makes decisions in his own benefit while the cost falls on others. In the case of government, the consequences of misuse of public power for private benefits can be particularly dire for society in general. Transparency helps resolve the principal-agent problem and encourages due process and fairness by enabling citizens to hold accountable the people and organizations they interact with (Nilsen, 2010). While many empirical studies have given conflicting evidence to the relationship between transparency and corruption, the results of one recent study show that corruption conviction rates almost doubled when Freedom of Information Act (FOI) laws were strengthened in various states in the US (Cordis and Warren, 2012).

Participation mechanisms

This type of mechanisms generates value through the positive effects of scale, where openness and sharing enables value generation drawing from a larger pool of resources. Public participation can take two discrete forms: 1) participation (citizen engagement) and 2) collaboration, collecting ideas and solutions or crowdsourcing (Linders and Wilson, 2011). In the case of participation, a similar theoretical argument has been used in the literature on Open Innovation (Chesbrough et al., 2006) where the principal idea is that an open approach to sharing knowledge across boundaries expands the firm's innovative potential as the firm is able to tap into a much larger pool of ideas and find such ideas faster. In the case of collaboration, we can refer to the academic work that has theorized about, and empirically examined, the motivations of those contributing to the development of Open Source Software. It is argued that individual motivation should not be looked at in isolation, but in interplay with institutions, goods and the social practice: "…people´s pursuit of visible carrots is at times interrupted by the larger quest for the invisible gold at the end of the rainbow." (von Krogh et al., 2012a, p. 671).

Discussion

Thus far, there has not been much scientific evidence to support the hypothesis of a link between opening access to government data and value generation. However, the relationship between use of the OGD resource, the enabling factors, the different mechanisms and value generation and appropriation can be illustrated with anecdotal evidence from different initiatives.

The Danish Basic Data program

The case of the Basic Data Program in Denmark shows how the synergies between internal efficiency gains and cost savings in the private sector can drive value generation from OGD. While Denmark scores high in World Economic Forum´s Global Competitiveness Index (12 out of 142 countries for the period 2012/13), and is said to benefit from one of the best functioning and most

transparent institutional frameworks in the world, the Danish public sector is relatively large and expensive. Denmark ranks 89 out of 142 countries in the aforementioned index when it comes to public sector debt as a percentage of GDP. In order to maintain the current world-class public service level, the Danish authorities prioritize the development of more efficient digital public services (Digitaliseringsstyrelsen, 2011).

As a part of such a digitization initiative, the Danish authorities have started a big OGD project where the aim is to reduce the number of shadow registers, copies of datasets and data entry requirements for geographical data, property data (including ownership and valuation), address data and basic data on people and businesses. The Danish authorities are implementing a common platform where every user, both public and private, can get access to the same, high-quality data which relieves the users from re-entering the same data manually in different programs or copying data between databases. As the data-sources will be based on a common data model, the possibility for automated business processes across authorities is greatly increased. And as data will be freely available online, transaction costs related to user support and billing are also diminished. All in all, the total yearly savings are projected to increase from DKK 52 million in 2015 to 260 million in 2020 (Digitaliseringsstyrelsen, 2012).

In the Danish case, the focus is on collective savings; for each individual institution or even ministry, the business case would not have been positive due to high start-up costs incurred by such big changes to the data model, data quality and data distribution channels. Moreover, the positive external effect from this project is that integrated government data of better quality will also benefit the private industries like real estate dealers, insurance companies, the financial sector, the telecom industry and map-providers, which previously had to spend resources on creating usable information from heterogeneous data-sources. The cost-savings for the private industry are estimated to be around DKK 500 million pr. annum when the program is fully implemented. The strategy behind the Danish Basic Data Program is to generate *shared, economic value* through more efficient collection, dissemination and use of government data, by relying on the three enablers, namely openness, data governance and technical infrastructure.

Although possible effects of new innovations are not a part of the core business case in the Danish Basic Data Program, geographic data were made freely available online from January 1st 2013 in the hope that increased private sector use of data will result in the transformation of data into new knowledge, products or services. Some ideas have already been developed and are illustrated here: http://brugstedet.dk/

Prescribing Analytics

An example of the innovative combination of map data with data on drug prescriptions can be found at http://www.prescribinganalytics.com. The results of this start-up company´s analytics show how prescriptions of statins, drugs used to lower cholesterol, differ between different municipalities in England. The company produced a visualization map that shows the different proportions between expensive (branded) and inexpensive (generic) statin prescriptions in different counties. Wherever the proportion of branded items is high, it represents potential to make big savings by switching to a generic form of the same drug. According to their analysis, if two thirds of the proprietary drugs had switched to the generic forms of the same drugs in the year to June 2012, public healthcare in the UK could have saved £200 million pounds, savings that could have been used to help other patients. These analytics support and make explicit the results from a study in the British Medical Journal in 2010 which reckoned that the British National Health Service could save more than £1 billion by switching from branded drugs to generic equivalents. In this particular case, innovative use of OGD and data

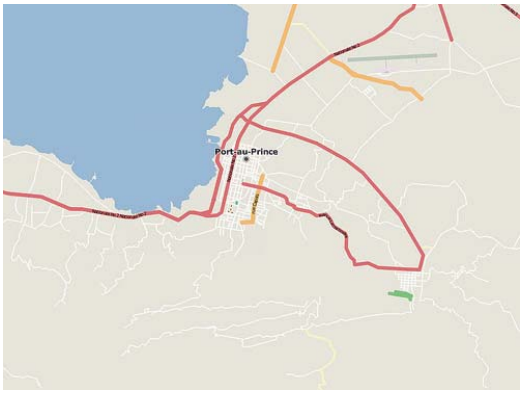
analytics has enabled the creation of *shared economic value* that can be appropriated by the entrepreneurs as well as the UK government.

Corruption in large-scale land acquisitions

The global surge in large-scale land investments is increasingly linked to significant risks of negative impacts on access to and control over natural resources, food security, human rights, and the environment. These investments have been plagued by secrecy, with associated land deals often made without the knowledge or consent of affected communities, who are thus unable to hold governments or investors to account (MacInnes, 2012). One way to counter the possible detrimental effects of land grabs (trans-national commercial land transactions) is to increase transparency surrounding land ownership and associated deals. These are longstanding issues; however, they have been given new urgency by the 39th G8 discussions in June 2013, where David Cameron has put openness center stage, encouraging transparency of trans-national land deals, transparency in tax payments and general transparency in government. Greater cross-border transparency, enabled by open access to government data, could uncover corrupt practices, and given that actions follow, subsequently generate *shared social value* that can be appropriated by governments and citizens of affected countries.

Open Street Map in Haiti

Collaboration with the private sector can help governments address difficult public problems (Harrison et al., 2011). A good example of citizen collaboration is the crowdsourcing activities that have been immensely helpful in natural disaster incidents, such as hurricane Katrina and the earthquake in Haiti (Lee and Kwak, 2011). Just a few hours after earthquake hit Haiti in January 2010 the Open Street Map (OSM) Community began tracing roads from imagery that was previously



Haiti OSM before earthquake from http://www.flickr.com/photos/mikel_maron/4274264771

Haiti OSM 2 days after earthquake from http://www.flickr.com/photos/mikel_maron/4274264771/

Haiti OSM today from http://haiti.openstreetmap.nl/

Figure 3: The development of the Open Street Map after the January 12th 2010 earthquake in Haiti

imagery taken post-earthquake became available and in the first month over 600 people added information to the OSM. OSM communities have continued to work with NGO's and the Government of Haiti to further development of the OSM data. This program includes baseline (transportation, education, health, water and sanitation facilities), humanitarian (hurricane disaster shelters and cholera-response structures) and community mapping as well as capacity building programs. This collaboration is generating *shared social value*, appropriated by the government and citizens of Haiti.

Conclusion

Many examples and anecdotes illustrate the value potential of OGD, especially when it comes to geographic data. The relationship between OGD and value generation and appropriation is complex due to the nature of openness, the features of digital data and the possibilities enabled by recent technological advances. We have proposed that there are in essence four diverse and complex mechanisms that act to extract value from OGD and that these can be illustrated with four different archetypes. The value of OGD can be derived from more efficient use of government data; by making data available to the private sector in order to enable the transformation of government data into new products and services; by increasing transparency in government operations which encourages due process and fairness; and finally by increasing public participation and collaboration which has shown a clear ability to increase social justice and solve various difficult social problems.

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