The potential impact of open data in Serbia

An ex-ante assessment contextualising post-hoc evidence from elsewhere

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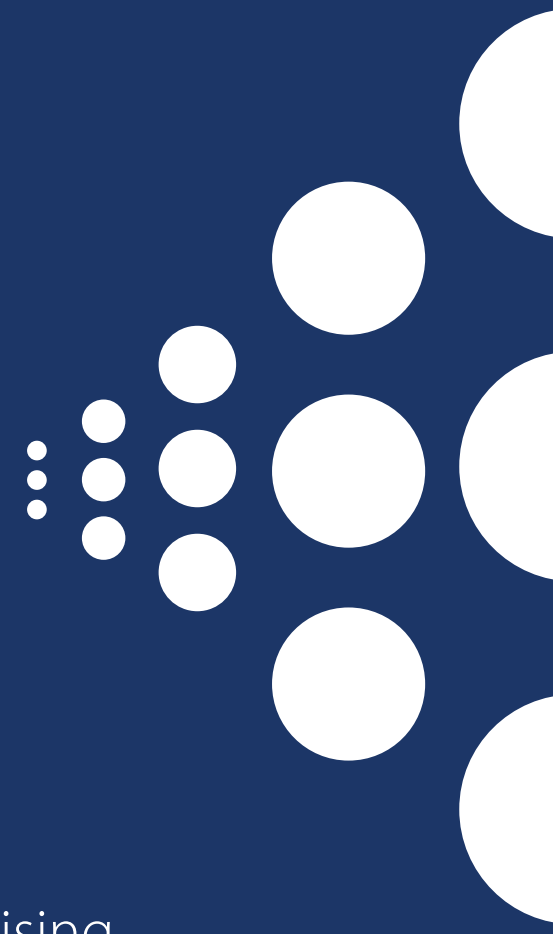

An ex-ante assessment contextualising post-hoc evidence from elsewhere

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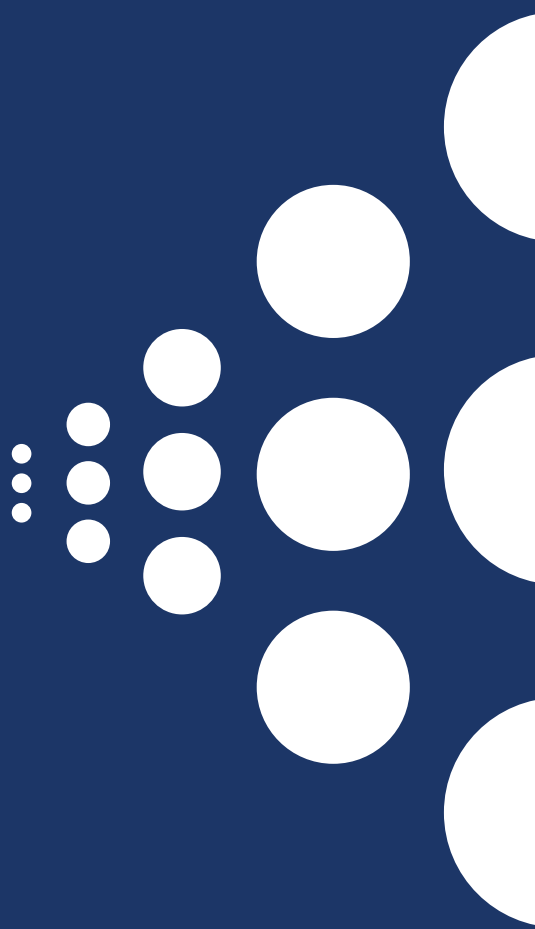

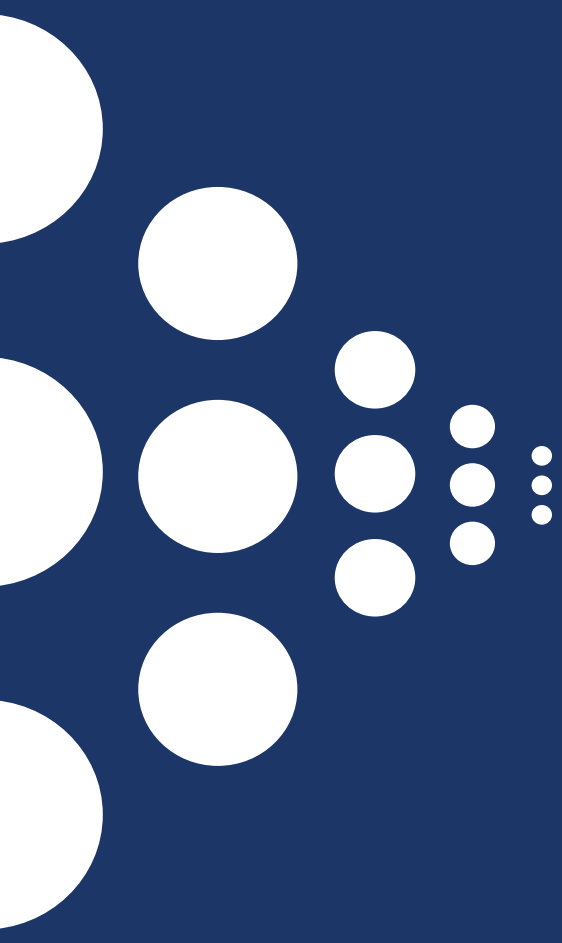

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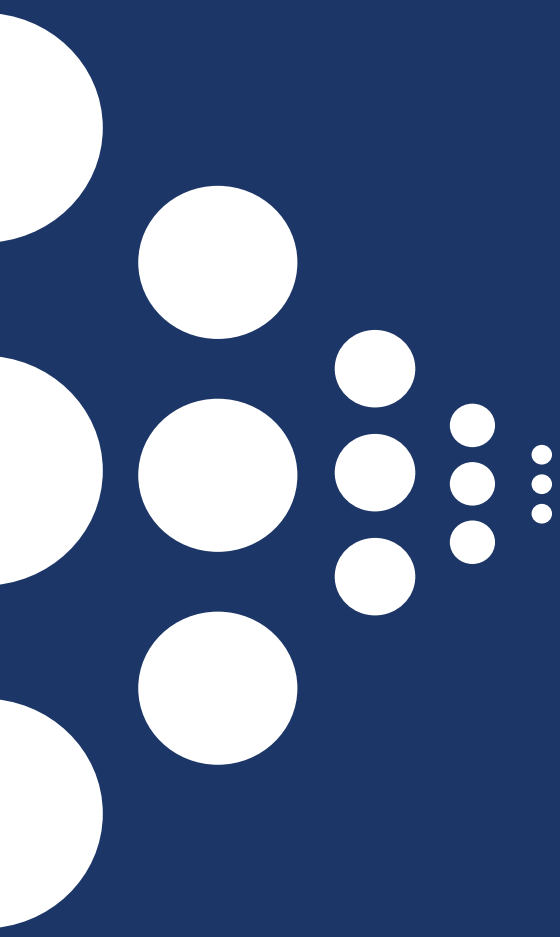


1 Introduction

Research questions

In the discussion about further opening up access to government held public data, quite often questions arise concerning the possible socio-economic impact one can expect. These questions usually emerge when decisions are to be made concerning the amount of effort put into opening up data and the corresponding expected costs.

In the past decade therefore various studies have been undertaken into the impact of open data, in different countries, in different sectors. Often the already acquired insights and knowledge from these studies are not taken into account when individual government data holders are making decisions concerning open data. This usually happens because of two reasons. One reason is that examples of impact already known to a data holder are seen as not particularly relevant to the data holder itself (our situation, our sector/domain is different). Another is that the existing body of knowledge, such as practical examples or study results, that are relevant for a data holder's own domain and public tasks, is not readily available and accessible at the time of decision making.

A better contextualisation of existing study results to the current situation in Serbia, therefore can be of use to overcome institutional reluctance to open up data, and help prioritise domains and data sets to be opened up.
This report is a literature review meant to provide that contextualisation by answering the questions which impact of open data has already been demonstrated elsewhere and how that can be mapped onto the Serbian context and Serbian policy priorities, as well as how such impact might be measured moving forward.

How to use the results, and this document

This document is meant as a summary and reference to the Serbian government, to be able to have a focused discussion on how and why to open up government held data sets for free general re-use. This can be of help in different settings:

- In discussions with data holders,
  - to show that the transition costs of opening up data for re-use are limited, after which they cannot be distinguished from regular operational costs of a public sector body
  - to show that the costs of collecting data are always sunk costs as part of the execution of a mandated public task,
  - to show that the socio-economic value from re-use ultimately always returns to the Serbian government in the shape of:
    - additional tax revenue (income taxes, corporate taxes, and VAT from resulting new economic activity.)
    - stronger participation and self-reliance of citizens
    - more efficient public service delivery, of a higher perceived quality, to citizens.
- Where decisions are to be made to charge at most marginal costs for access to data that is currently provided against fees, because
  - the expected price elasticity is higher than 1, resulting in a non-linear growth of usage when prices are lowered, in turn resulting in additional tax revenue that over time will be higher than an initial loss of revenue
  - any fee transferred between different public sector bodies or levels of government or government owned private entities, ultimately are a net loss to the Serbian government as a whole, due to the involved transaction and overhead costs coming with such de-fact 'internal' transfers.
  - such transaction and overhead costs where they currently exist and where fees are lowered to marginal costs or abolished, will lead to an immediate cost saving for both data holders and data users.
- In discussions with other levels of government, or other public sector bodies, as well a private companies, civil society organisations and citizens, to increase the awareness of the available potential of open data, so that steps can be taken to make such impact visible and measurable in practice.

Methodology

In this report no direct new research is undertaken to establish existing or potential socio-economic impact in Serbia. Existing insight and research results concerning such potential and impact from around the world in the past 10 years is collated and summarised. It is also contextualised for Serbia specifically, by comparing Serbia's economic indicators to those of countries and sectors in research from elsewhere, and by taking into account current government policy priorities as well as the relative size of policy domains in the national budget.
The results of studies taken into account are collated and ordered per domain/sector and type of data holder so specific existing outcomes can inform discussions in specific domains and public

sector bodies in Serbia: it allows public sector bodies to easily filter out those existing studies that are most relevant to their own situation.

Second, interviews were held with eight public sector bodies from six different sectors, in order to specify potential areas of open data impact, as well as find where such impact might be most closely aligned with existing tasks and priorities of the data holder involved. This way intrinsic motivation for open data, where opening up data reinforces the aims of a data holder, may be found.

Based on the body of research taken into account and existing international indexes of comparison for open data, as well as the results from the interviews, suggestions are made where and how to assess emerging open data impact in Serbia. The suggested methods are not aimed at completely and objectively verifying the socio-economic impact of open data, but at allowing data holders and the Serbian government to assess a baseline impact for those areas and topics they deem most relevant, and to determine if such a lowest estimate is enough to sustain further open data efforts.

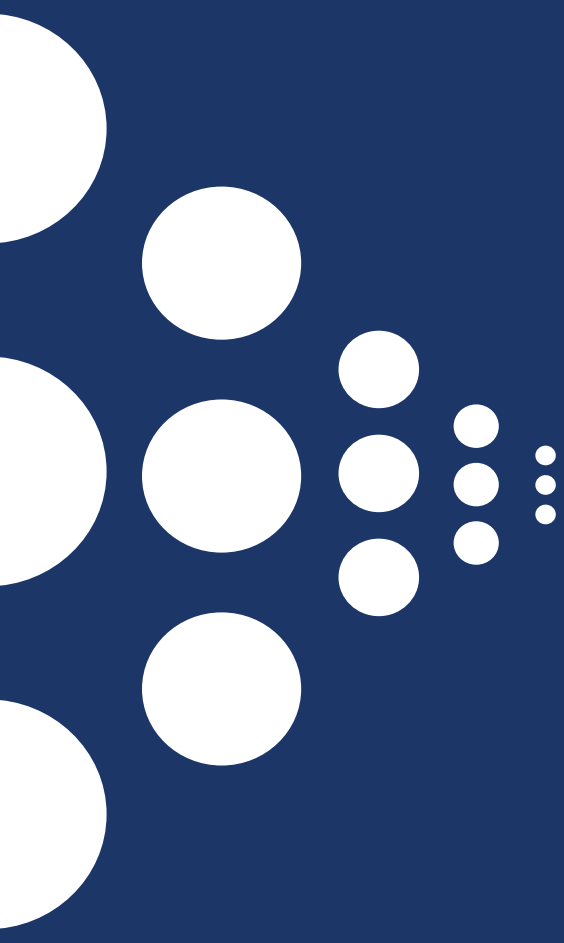
Structure of the report

This report consists of several parts:

- A concise summary of the general economic reasoning behind the potential value of open data in Chapter 2, directly resulting from the studies and cases taken into account
- An overview of the studies and cases concerning the socio-economic impact of open data taken into account, and their key findings concerning different parts of the open data value chain, in Chapter 3
- The most relevant results for and parallels with Serbian government data holders in Chapter 4
- The results from the interviews with six Serbian government data holders in Chapter 5
- A suggested path to measure open data impact in Serbia in Chapter 6
- Recommendations for future steps in Chapter 7
- A list of all studies and cases taken into account in Annex A, as well as individual summaries and sources of all those studies and cases in Annex C. This makes it easier for interested stakeholders to dive deeper into the source material themselves. Throughout the report referenced studies are mentioned with their page number in Annex C (*Name* C*xx*)

On the absence of a summary

This document is provided without a management summary, as the document itself is to be regarded as the management summary of all studies and cases taken into account, which together form an overview of existing insights from all over Europe and worldwide, concerning the potential and impact of open data.



2 The economics of open government data

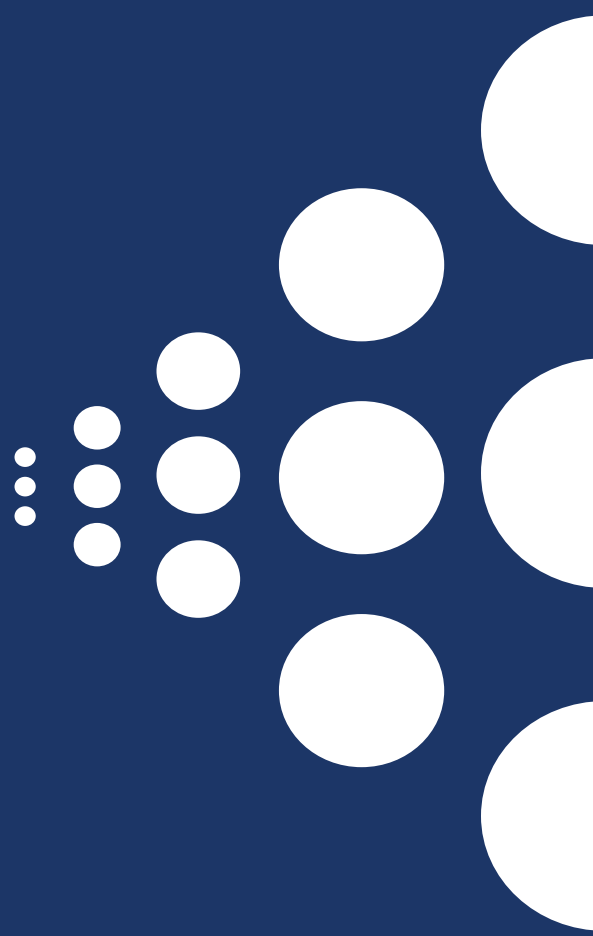
Re-use of government data, open government data, has been on the agenda of Europe for a long time already. As a consequence many studies have already explored and documented the economic potential and impact of open data. Those studies yield a number of stable patterns and repeating results. These put together reveal the underlying economic principles of the value that open data can unlock. In the following points those principles are listed.

1. Public digital government information is *non-rivalrous*, meaning if someone uses it it does not limit the potential use of others. This is in contrast to e.g. natural resources.(Pollock C2, Newbury C1)
2. Public digital government information is *non-exclusionary*, meaning its access is not limited to specific groups of users, but equally available to all. (Pollock C2, Newbury C1) The combination of non-rivalrous and non-exclusionary means public digital government information is to be regarded as a public good.
3. The collection and production costs of government data can be very high, yet are always mandated as part of a public task, and therefore always sunk costs (costs that have already been incurred, regardless of a decision to making data publicly available). (Pollock C2, Newbury C1)
4. The reproduction and distribution costs of all consequent digital copies of existing digital data, i.e. the marginal costs of reproduction, are equal or close to zero. (Pollock C2, Newbury C1)
5. Government bodies usually are monopolistic data holders, meaning there are likely no alternative data sources available. Additionally it is to be expected that price elasticity of demand for re-use will be higher than 1. This means that when the price of providing data that are currently being sold by government is lowered, a non-linear increase in number of users and usage volume per user is to be expected. (Pollock C2, Newbury C1, POPSIS C4, Houghton C21)
6. The sales of data by a government data holder to other public sector entities is by definition an operational loss for the public sector as a whole, because of the connected costs of transactions, administration, and compliance enforcement.
7. The value of potential re-use of government held data is larger than the potential revenue to be gained from selling that data. The re-use value also returns to the government in the shape of additional tax revenues. Over time those new tax revenues will surpass the potential loss of revenue from data sales. After that point is reached, the net gains for government (and society) only increase. The time needed to get to that point is only a few years. As a consequence free provision of data, or at most priced at marginal costs is economically the most effective and efficient. (Houghton C21, POPSIS C4, KNMI case

C31, Pollock C2, Sawyer and De Vries C22, Danish address case C17, Danish Roadmap Base Registers C18)

8. The value of open data re-use is not only in the first order of such re-use, but shows strong network effects, although those may be harder to show. (Danish address case C17, Sawyer and De Vries C22, Vickery C3, Cap C14).
9. The value of open data re-use is also found upstream, in impact for the data holder itself, and for other public sector bodies: lower transaction costs, more efficiency, better government service provision, and increased data quality. (POPSIS C4, Danish Roadmap Base Registers C18, Dutch Cadaster C25)

In summary the business case for re-use of government data resides in freely distributing it, not in limiting access or setting gate keepers: open data.



3 Studies included and their overall results

In Annex A an overview is provided of all the research and cases that has been incorporated in this ex-ante impact assessment. It concerns some 50 pieces of research and cases, often with a European focus, and from the period 2008-2018. In the list of available material what stands out is that a lot of material comes from 2011. This is the year in which the EU Directive for the re-use of public sector information was evaluated. Similarly such an evaluation, albeit much less extensive, was published in 2018, which has also been included.
What all these research results have in common is that they conclude that much untapped potential resides in public sector information that can be published as open data. There is a growing body of evidence (both on macro and micro-economic level), that removing barriers (such as fees) to re-using such data has two types of impact. It has impact 'downstream' on economic growth, innovation or the labor market. It also has impact 'upstream', inside the public sector itself. There efficiency gains, reduction of transaction and other overhead costs, and more effective public service delivery are visible.

In Annex C an overview is given of the key results of all the research and cases incorporated in this ex-ante impact assessment.

Below the key conclusions from the incorporated body of research are listed.

A Direct economic value

- The direct value of re-use of government data is economically very significant (Vickery C3, Cap C14) with a 2010 potential of 40 billion Euro, rising to 75 billion in 2020 in the EU. The cumulative value over the period 2016-2020 amounts to 325 billion Euro in the EU. Much of that potential is currently underused (Pettifer C28, Koski C19, Shakespeare C10).
- In the EU in 2016 75.000 jobs are directly related to open data usage, growing to 100.000 in 2020. (Cap C14)
- Increasingly public sector bodies only charge at most marginal costs of data provision (in the case of digital data these marginal costs are usually zero. (POPSIS C4)
- Where this happens and is a change from charging above marginal costs, large and non-linear growth in the number of users is visible, as in the diversity of users and the volume of usage per user. (POPSIS C4, all cases) This as price elasticity is above 1 (see bullet 2.5. in the previous chapter).
- This is specifically true for data sets with a high infrastructural value, such as core government registers. (Danish address case C17, Danish Roadmap Base Registers C18, Spanish Cadaster C23, Australian cases) These core registers are often the most re-used and the most broadly re-usable. (Spanish infomediary sector C5, Cap C14)

- Small and medium sized enterprises (SME's) are best positioned to make use of the potential value of open data, as for them removing barriers towards re-use have the most impact. (Koski C19)

B Indirect value (downstream)

- A lot of value also originates several steps away from the primary form of re-use (2nd and higher order effects). A network multiplier effect exists. This network effect is much larger than the direct economic value of open data re-use. (Vickery C3, Cap C14, Koski C19, Danish address case C17, Sawyer and De Vries C22)
- The indirect value of open data in the EU has been estimated to be 192 to 209 billion Euro (2015), growing to 265 to 286 billion in 2020. The cumulative value of open data in the EU 2016-2020 can be as high as 1,1 to 2,2 trillion Euro. (Cap C14)
- Indirect value, while bigger, is much harder to measure, especially so on macro-economic level. Micro-economic studies can much better demonstrate indirect value, but are currently mostly only available in the shape of individual case studies and not on a national or sectoral level. (Koski C19). ESA is a unique example of doing some 24 micro-economic studies in the period 2017-2021 into the impact of the re-use of satellite data.

C Value for government itself (upstream)

- Public sector bodies enjoy strong benefits of open data. These benefits included more efficiency in finding and using data, abolishing transaction costs, no more bilateral agreements or contracts needed, reduction of double work, reduction of errors, and lower sensitivity to fraud. (POPSIS C4, Danish Roadmap Base Registers C18)
- The potential savings in the public sector amount to 1,7 billion Euro in the EU in 2020. (Cap C14)
- Public sector bodies are high volume re-users of open data from other public sector bodies and governments. The EU-wide value of this is estimated at 22 billion Euro in 2020 (Cap C14).

D Costs for data holders

- As demand for a digital dataset increases, the costs for data provision hardly increase. As a result the average costs decline and approach the fixed costs of the public sector body involved. (Sawyer and De Vries C22)
- Data holding public sector bodies that currently sell data that face barriers to move towards open data, do not struggle with the costs of data provision, but struggle with finding the political will to refinance loss of revenue. Usually the actual revenue is small compared to the overall budget of the public sector body involved, and usually should be easy to refinance from the general budget. Removing charges for data also immediately result in costs savings, as the transaction costs and administrative burdens of charging are relatively high. (Meteo cases, Australian cases, Koski C19, POPSIS C4)
- Data provision professionals (public sector bodies whose core tasks relate to data) can use their existing infrastructure to provide open data (De Vries C11)
- Other public sector bodies (like municipalities) whose core tasks do no relate to data face a challenge in creating sustainable processes for data publication as an embedded part of their everyday operations. (De Vries C11)
- The transition costs towards open data a relatively low (De Vries C11), and costs-benefits analyses almost always come out in favour of open data.

E Quality

- The interaction between data holding public sector bodies and re-users of their open data shows an increased quality, such as better and more detailed questions being asked. (Dutch Cadaster C25)
- The interaction between public sector bodies and re-users, and feedback received, has positive impact on the quality of the data concerned. (Dutch Cadaster C25)

F Base registers and national data infrastructure

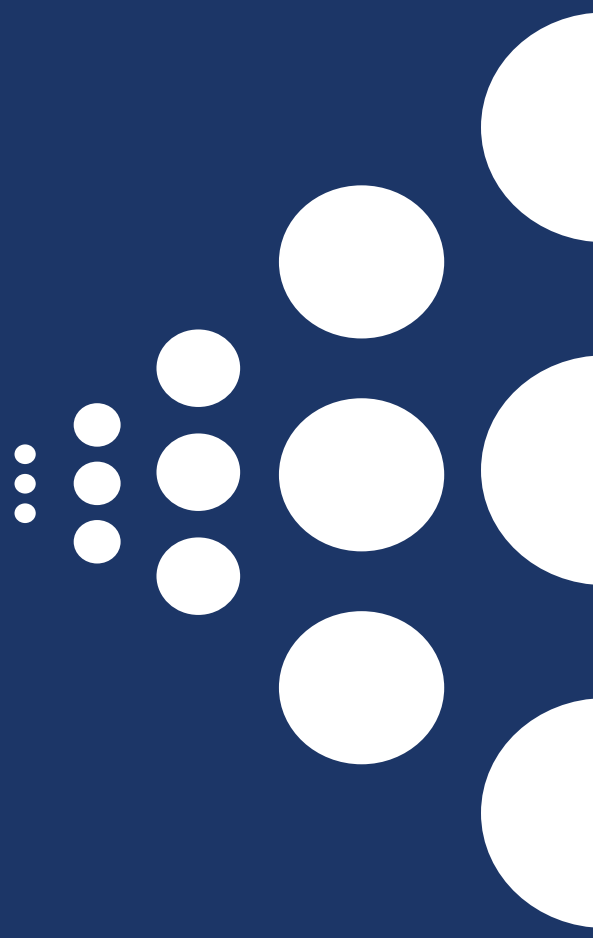
- Fragmentation of available data is an impediment to realising the re-use potential of open data. (Shakespeare C10).
- A coherent system of core government registers, a national data infrastructure, solves such fragmentation and can be the key 'back-bone' for the re-use of other open data (as such core registers allow for combining and contextualisation of data) and as increase the speed with which open data potential is realised. (Shakespeare C10, Danish Roadmap Base Registers C18)
- A system of base registers in itself can be a cost saving strategy for the government, next to a source of value creation in society. The time needed to recoup the costs of creating such a system through government savings is short (at most 4 years) (Danish Roadmap Base Registers C18)

G Open data as a policy instrument

- Value of open data also expresses itself directly in policy domains, by allowing stakeholders to change behaviour. (NHS healtchcare cases 51) or as a source of general trust (IMF C33). This means publishing open data is an intervention in its own right. Next to regulations and subsidies therefore open data is a third policy instrument. This brings with it potential strong impacts on the quality and effectiveness of public service delivery.
- Reasoning from desired impact in prioritised policy domains (such as healthcare) is therefore a good way to prioritise which data should be made available as open data first. (Koski C19, Zuiderwijk C6). This while also taking into account which data is in high demand, or very broadly usable by others. (Cap C14, Spanish infomediary sector C5,)
- This may also point the way to how to easier measure impact of open data. When it is known which impacts are of most interest, it is easier to design measurements connected to those desired impacts. It is easier to find something if you know where to look. (Koski C19)

H Open data policies

- Open data policy needs to be aimed more broadly on desired impacts, not just data provision (Shakespeare C10) and be less internally oriented (Zuiderwijk C6)
- Stimulating demand and re-use needs to be part of open data policy (Zuiderwijk C6)
- Active support of experimental re-use in public private partnerships can deliver a ROI of 10:1 (NESTA/ODI C13)
- Publishing an inventory of data that government has (regardless of whether it is available as open data) has a positive impact on societal demand for data.
- Measuring impact of open data re-use needs to be a continuous effort, and part of open data policy. (Shakespeare C10, Zuiderwijk C6, Koski C19)



4 Studies transposed to the Serbian context

In this chapter the results of research and cases taken into account are translated to the Serbian context. This can take the shape of statements about the value of open data to Serbia directly, or the shape of clustering relevant evidence concerning specific types of data holders that have a Serbian equivalent. It does not contain new estimates or predictions.

Firstly this chapter looks at general aspects, then specific data sources and data holders. Where possible key data holders or data sources pertaining to key government priorities are mentioned first. Relevant evidence of impact from elsewhere is mentioned and referenced. The assumption is made that similar impacts are to be expected if similar open data is released in Serbia, at least in type if not in volume. This, together with the previous chapters informs specific discussions on which data to release and in which order.

Serbia isn't like….

Serbia isn't the same as other countries, whether it's Austria, the Netherlands or Australia. Likewise the Danish Cadaster is different from the British or Spanish equivalent. It is often common to therefore end discussions about open data with a statement that things are simply different elsewhere and have no bearing on decisions here. This is what every stakeholder in every type of change project always expresses at some point. It is therefore to be expected that every Serbian data holder will say so as well during the transition to an *open by design* approach to government data management in Serbia.

It is therefore crucial to acknowledge that the patterns of positive socio-economic impact from open data are consistent, regardless of the specific circumstances in a country or in a sector, from Russia to the USA, from Denmark to Kenya, from Belgium to Malaysia. This will not be different for Serbia. Of course some public sector data holders and different sectors in Serbia will be better positioned than others to capitalise on the potential of open data more quickly. That potential however always ultimately is the result of opening up government data to as many people and entities as possible, and not of any other circumstances that may apply.
The results of all the research and cases mentioned in Annex A are consistent as to making the conclusion inevitable: Opening up data means making value creation possible in Serbia.

Open data as an instrument for policy priorities

Across the world open data is used to build trust between government and the public, to connect stakeholders around specific domains and issues, and to create progress by enabling more stakeholders to act. Publishing open data, knowing this effect, then can and should be a deliberate government act, to create an impact in the policy domains to which the opened data relates. Traditionally governments influence the behavior of other stakeholders either through providing funding to stimulate certain behaviors or sectors, or by setting regulation to curb certain behaviors or to level playing fields. Publishing data is a third such policy instrument to influence stakeholders, and a decision to publish data means an intervention in a policy domain or a stakeholder ecosystem. Moreover, in general the release of data is an intervention much more easily organized and done, and against considerable lower costs than other interventions in a policy domain.
Where open data is seen as a policy instrument, open data efforts are no longer something done at the behest of others, or in addition to the regular public tasks, but become a key ingredient, a national infrastructure even, in executing those public tasks themselves.

Open data helps build trust by providing the same access to the same set of facts reflected in the government held data. It shows Serbian society that the Serbian government is pro-actively committed to such trust building equality of information access.
Open data also allows very diverse stakeholders to connect their own aims and activities with others, while at the same time reducing the costs of administration and interaction between them, and with the public sector. This reduces the 'cost of doing business', and allows costs savings that create room for new activities, economic impact and socio-economic benefits. The Serbian government's own policy priorities can be used as a way to filter and prioritize which data should be available as open data first. This next to providing access to core government data sets that can serve as a fundament for all types of re-users to contextualize and connect other, smaller and more diverse, government and private data sets, and thus create value.

The current situation in Serbia concerning open data

The Serbian government, in collaboration with the UNDP and the World Bank, did an open data readiness assessment (ODRA) in 2015. The ODRA was followed by establishing an open data working group in which a range of public sector bodies collaborates on moving open data forward in Serbia. The membership of this open data working group is still growing, a sign that interest within the Serbian public sector is increasing.

The most recent international Open Data Barometer by the World Wide Web Consortium, ranks Serbia 65th out of 114 countries surveyed, in its most recent edition (2016, published 2017), and 11th out of 16 in the EECA region. Within the EU28+, Serbia ranked ex-equo with Hungary, the EU member with the lowest open data ranking. This 2016 measurement, the year after the ODRA, was the first time Serbia was part of the Barometer research. It shows a mid-range readiness for open data, a lower level of implementation, and low impact of open data. Noticeably it shows that key

data sets surveyed exist in digital form, and are generally accessible online. Yet they are mostly not available as open data: in machine readable format, with an open license and free of charge. This fits with the profile of Serbia just recently moving forward with open data. Readiness comes first, followed by implementation, after which impact would become visible.
The Open Data Index by Open Knowledge International does not rank Serbia in its most recent overview of 2016 (presenting 2015 data), but ranked Serbia 48th out of 122 in their 2014 data. The Open Data Index does not look at impact, implementation or readiness, but looks at the way 13 key datasets are or are not available to the public. On this dimension Serbia scored 42% of possible points.

The 2017 report by the European Data Portal on the maturity of the open data landscape in Europe, also looks at Serbia. It puts the portal maturity at 73% (EU28 average 76%), open data maturity at 40% (EU28 average 73%), and overall open data readiness at 33% (EU28 average 72%). It shows that a lack of diversity of available data is the main element holding the portal maturity back, and that in terms of readiness impact is lagging behind as both open data policy and open data usage are at about half the EU28 average. The report explicitly notes that Serbia as the only one of the EU Accession countries is pursuing specific activities to promote open data, and stimulate re-use, and mentions the open data working group in that context. It also notes that the Serbian open government data portal in terms of functionality and usability is very close to the current EU average. Overall, taking into account the findings of the 2015 ODRA and comparing them to the 2017 European Data Portal report, it seems that extending availability of core data sets, and maintaining efforts to stimulate re-use, both in line with European good practice, would translate rapidly in higher maturity scores, as well as Serbia's position in the other rankings mentioned.

The potential total value of open data for Serbia

Macro-economic estimates of the potential value of open data arrive at 1-2% of GDP in Europe with about 0,5% of that realised by 2020 (Cap C14). In terms of 2017 GDP this would mean for Serbia an open government data potential of 414 to 829 million USD, with some 200 million realised by 2020. A 2013 global macro-economic estimate for open data across seven sectors (McKinsey C8) states 4-6% of GDP, or about three times that. The difference is that the global study also takes opening data by non-government entities in account, whereas the European focuses on open government data alone. In terms of 2017 GDP the global study would correlate to a total open data economy potential of 1.6 to 2.5 billion USD for Serbia, but it assumes a high level of private and public sector readiness and maturity. The European study is more nuanced in taking existing conditions into account.

The measure by which that overall potential is realised depends on the level of open data maturity (Cap C14), which means different outcomes for different European countries in the coming years. For the EU28+ the total open data market value is set to grow from 193-209 billion Euro in 2016 to 265-286 billion Euro in 2020, or some 37%. This total value is split in a direct market value, and indirect market value, where one Euro in direct value corresponds to 3,50-3,75 Euro in indirect value. The direct market value to the EU28+ is put at 55.3 billion Euro in 2016, growing to 75.7 billion in 2020 (Cap C14).

Looking at different sectors, by 2020 the public sector (including education and healthcare) itself is the largest benefactor of open data impact, for about 29% of the total, followed by industry, trades and transport, real estate, professional services, ICT, finance and insurance, construction, entertainment/recreation and agriculture. Potential impacts can take different shapes, such as a reduction of traffic fatalities with 5,5%, or reducing congestion by 629 million hours by 2020 across the EU. (Cap C14) In Serbian context these numbers correspond to 32 fewer traffic fatalities annually, and over 8.5 million congestion hours. Next to such direct impact, the public sector across the EU28+ is expected to also realise 1.7 billion Euro in costs savings from open data, by 2020 (in the order of magnitude of 0,1 per mil of EU GDP, or some 4 million Euro in terms of Serbia's 2017 GDP).
In Serbia the IT sector currently makes up about 10% of GDP and is a key export sector. The Serbian government is seeking to strengthen this sector, e.g. by supporting start-ups and entrepreneurs. Government data, both core data as well as data around priority policy domains, are a key resource in further supporting these efforts. The production of this resource are sunk costs as part of the execution of the administration's public tasks, which as open data can be cheaply made available to the Serbian society and economy. As part and in support of the ongoing efforts by the Serbian government to step up the digital agenda, the IT sector in general, and its start-ups in particular. Additionally, when core government data sets, such as geo-data, are made available as open data, not only new companies benefit, but also existing SME's have been seen to grow 15% faster than those without free access to open data.

The EU not surprisingly is therefore positioning open government data as a key building block of a data economy, and one where governments can easily directly act themselves. The EU in their latest proposals e.g. ties open data to such things as stimulating deep learning and AI (currently of geo-politic importance), improving healthcare outcomes through data sharing, cross-border data exchange between companies, open research data, and strong personal data protection. This in itself will mean new opportunities for the Serbian IT sector as the EU is an important export market. But by getting out in front of the current EU proposals, Serbia is also in a position to improve its overall open data readiness and thus its opportunity to capitalise on the open data potential. Key elements in the latest EU proposals on adapting the PSI Directive, the governing legal framework for open data re-use, are bringing publicly owned enterprises as well as research data collections within scope of open data, and ensuring base registers (named high value data sets in the proposal) are made available free of charge, machine readable and with an open license. That last element helps create a European open data infrastructure, through which other types of (open) data can be more fruitfully re-used.

High value data sets as national data infrastructure

Base registers as open data deliver both direct internal cost savings and direct economic value. Next to that they provide a useful fundament for valuable re-use of all other open data. This as base registers provide context and ways to connect and correlate other datasets. Therefore these base registers are often very much in demand, as well as most used as open data. It is not surprising that some of these data sets are tracked by international open data indexes, such as the W3C Open

Data Barometer and the Open Knowledge Index as an indicator of open data maturity of a country as a whole.

The Serbian government already has these base registers digitally available, and is already working towards more efficient data management and intra-government data exchange.

Opening up base registers for general re-use additionally provides a valuable fundament to open data, as it helps reduce the fragmentation of open data provisioning, and increases the likelihood of valuable re-use of smaller data sets. This is the path to realising the full potential of open data. The British government therefore initiated an effort towards a national data infrastructure (Shakespeare C10). The Danish government both motivated by internal cost savings and efficiency as well as economic value of re-use has created a base register system under the name 'Good basic data for everyone' (C18), and the Dutch government decided on opening up base registers for the public re-use for the same reasons. In Switzerland initial research into a 'national (open) data infrastructure' has been completed, and plans are being drafted. In practice this sometimes means that core data sets currently being sold above marginal costs pricing need to be refinanced, usually from the general budget, to make open data possible. Where such fees have been done away with, non-linear growth of re-use is the common result.

Noticeably:

- There is a certain logic to the order in which base registers can be connected and opened up. The starting point is topographic data, followed by addresses (have a location on the map), buildings (have a location and address(es)), cadastral data (parcels, ownership of parcels and buildings), companies (have an address, own buildings), persons (not open data but core to government functions, own companies, buildings, have an address)
- Base registers such as the topographic map, address, buildings, cadastral data and the company register rank very high on the list of re-used data, as well as high on the list of broadly re-usable data. (Cap C14, Spanish info-mediary sector C5, various cases)
- The Danish Roadmap for a system of base registers shows that creating such a system earns itself back in terms of government efficiency gains within 4 years, and is a net positive from the start if socio-economic benefits are taken into account. (C18)
- The direct economic impact of opening up Danish base registers (topography, addresses, real estate, companies) was very conservatively estimated at 70 million Euro per year. Compared in terms of GDP that would amount to about 9.5 million in Serbia. Network effects were deliberately left out of the business case, but were definitely expected. (C18). The Netherlands is opening all their non-person related base registers as well.
- Where fees charged for these type of datasets have been reduced to marginal costs level (the true additional cost of providing one specific additional re-user with the data, i.e. for digital data usually zero) or have been made free of charge, price elasticity is well above 1, meaning strong latent demand gets mobilised, resulting in additional tax revenues outweighing any loss of sales revenue. (POPSIS C4)

International impact compared to selected Serbian data and policy domains

In light of current Serbian (economic) policy priorities and corresponding data domains, it is of interest to look at how for various domains open data impacts have been noticed elsewhere in the world, and how these might translate to Serbian economic terms.
The Prime Minister's expose of June 2017 provides a useful overview of general policy priorities. First priority is digitisation itself, and enabling Serbian society to fully leverage the potential of digital technology. As stated in the previous paragraph a national open data infrastructure is a key driver in creating impact of open data in a digital society.
In the following paragraphs therefore international impact is summarized for a number of the base registers that should be part of such a national open data infrastructure. It is not coincidental that for these type of data sets impact research exists. These data sets even before digitisation were seen as high value and often monetized because of it. This allows for useful comparison when these data sets are then provided as open data. Topographic data, address data, cadastral data, company register data, statistics and meteorological and hydrological data are taken into account therefore.

Furthermore three other domains are also described in this chapter: transport, education and healthcare. EU research describes public administration as the sector where the biggest impact is possible for open data. Education and healthcare both are counted as part of the public administration sector in that research. Both also are part of the Serbian government priorities, with education being the second priority after digitisation. Transport and mobility is mentioned for similar reasons, as it is part of EU impact research, and transport and mobility data availability is part of global indexes and rankings. As the Serbian government has road and rail infrastructure as a priority, a closer look at transport and mobility is a good fit. In Chapter 5 two other domains are described, the judiciary and agriculture, that are not taken into account in this chapter. Although judicial reforms and digitisation of agriculture are priorities in Serbian government policy, there is little existing impact research that covers them. More anecdotal documented impact is mentioned in Chapter 5 for these two domains.

Data sets from the domains taken into account in this chapter are also those for which there are emerging good practices in Europe, allowing Serbia to accelerate adoption. Some of these, such as topographic data have been the subject of EU convergence for a long time, for instance through the INSPIRE program aimed at international harmonization and setting standards. Other domains such as healthcare are the subject of new proposals by the European Commission to facilitate open data and data sharing aimed at socio-economic impact and innovation.

Not all noted impacts can be directly translated and quantified for the Serbian context. The possible direct translations to Serbian context are comparisons on the basis of GDP and of population size. In a few unique instances, such as road fatality statistics, a direct comparison with existing Serbian statistics is possible. In most other cases the documented impact research, although quantifiable, is of a more qualitative nature: non-linear jumps in usage, shifts in types of usage and user groups, SME growth acceleration etc. In such cases it is significant that these qualitative

effects are observable repeating patterns, and the specific quantities involved matter less. What matters is that similar patterns can be expected in Serbia for similar circumstances.

Topographic data

This is as open data by far the most economically interesting data. Making topographic data free at the point of re-use leads to a strong non-linear jump in usage by both companies and private citizens. Areas of application that jump out are environmental issues (because of its size) and cultural purposes (as it is surprising to data holders) Internal cost savings are a direct effect of opening this data up. In terms of re-use this data is the most widely used dataset to combine other datasets with. Especially SME's benefit from having this open data available, with up to 15% faster growth shown in three sectors in Europe, in comparison for having no or only paid access to this data.

Noticeably:

- Europe-wide this data is seen as the most commercially interesting to re-use (Cap C14)
- Environment, soil usage, nature and spatial planning are the most important areas of application by commercial re-users of this data in the Netherlands. (Dutch Cadaster C25)
- The number of re-users jumps non-linearly after opening up, in the Netherlands a fivefold increase after two years. (Dutch Cadaster C25). Australia saw demand for this data rise by up to 172% per year. (38)
- Over half of Dutch public sector bodies using this data in the Netherlands state that after it becoming open data their costs of accessing, using and internally managing this data have decreased (Dutch Cadaster C25)
- The percentage of commercial re-users of this data in the Netherlands grew from 17% to 41%, and the percentage of private re-users from 3% to 22% in the first two years after this open data became available in 2012. This means that the percentage of government re-users about halved from 80% to 37%. Yet as mentioned the total numbers of re-users jumped fivefold, so even government usage of this data more than doubled in absolute terms.
- The time capacity re-users were spending on this open data of the Dutch Cadaster in 2013, to work with and improve upon the data, was estimated at 11,5 to 14,5 million Euro, of which 9 million directly contributable to open data. (Dutch Cadaster C25)
- The loss of revenue by the Dutch Cadaster amounted to about half a million Euro, which means that the societal investment by re-users exceeds that by a factor 18 to 29, and by proxy the minimum value re-users attach to this data as well.
- A fifth of re-users of this open data in the Netherlands indicated using it for cultural and creative purposes, a heretofore entirely unknown category of demand and usage for the Dutch data holder. (Dutch Cadaster C25)
- Private sector re-users often use this data to be able to combine and contextualise other data sources. This underlines the role of topographic data as a key part of a national (open) data infrastructure. 39% of Dutch re-users use it as part of providing products and services for third parties. (Dutch Cadaster C25)
- A shift in the nature of contact and interaction between re-users and the data holder towards deeper and more specific questions was noticed by the Dutch data holder. They perceive this as an improvement in the quality of relationships with the public. (Dutch Cadaster C25)

- Provision of open geo-data creates a non-linear growth in usage. Over time the additional tax revenue from activities resulting from this outweigh the loss of revenue that may occur if this data was previously available against a fee. The Danish base register road map showed the same effect. (Sawyer and De Vries C22, Danish Roadmap C18)
- Ordnance Survey in the UK estimated that in 2016 open geo-data (including addresses) would directly contribute 13 to 29 million GBP to the economy, resulting in 4,4 to 8,3 million GDP of additional tax revenue. (OS C24). Australian geo-data in 2009 provided a net contribution to the economy of 4,7 million AUSD. This net contribution is the result of 8 million AUSD benefit for private sector re-users, 10 million AUSD for government entities, while the production costs of the data were 13,3 million AUSD. The average socio-economic impact on the Australian economy in 2009 was estimated at 25 million AUSD per year. (Australian geospatial case C21)
- The Australian data holder realised cost savings of a third of the revenue lost, after opening up. This because of no longer needing to incur transaction and overhead costs of administrating fees. Private sector re-users similarly realised savings in overhead and transaction costs of up to 1,7 million AUSD. (Australian geospatial case C21)
- Austria made geo-data available against marginal costs (the costs of providing the data specifically to an additional re-user), starting in 2006. This meant a price reduction of 97%. Yet the turnover on data increased by 46%, because of a rise in heretofore latent demand. Sales of cartographic material rose by a factor 2, those of orthophotographs by a factor 70. Price elasticity was therefore much higher than 1. (Austrian case C20)
- In the Netherlands 250 business centered on geographic data in general (not just topographic data), generate around 1.5 billion Euro turnover. Compared by Serbia's 2017 GDP that is equivalent to 75 million Euro annually. Including the relevant public sector entities, 15.000 people work in this field in the Netherlands. The availability of base geo-data registers as open data is the fundament under this market, enabling new entrants.
- Small and medium sized enterprises were the biggest source of new demand for geo-data in Austria. (Austrian case C20)
- In general SME's and new market entrants benefit most from open data becoming available, in comparison to larger companies (who through their size have much lower relative thresholds for acquiring data they need). For architecture, engineering and technical consultancy, European SME's using this show up to 15% higher growth (7% on average in the first year, 19% in the second year) for companies having access to geo-data either for free or against marginal costs, compared with those needing to pay higher than marginal costs fees. For larger companies this effect was not visible (Koski C19)

Address data

Address data are of high re-use value. Existing commercial re-use, in part through new job creation, yields additional tax revenue. Micro-economic research into specific cases would be able to show this more directly.

Noticeably:

- The direct economic value of Danish address-data in 2010 (after being opened in 2002) was conservatively calculated at 14 million Euro, which constitutes a ROI of 70:1. Network effects and indirect benefits (such as its use in navigation software, or government internal impact by preventing double work/registration) were not taken into account. (Danish address case C17) That same year 1200 Danish companies directly accessed the data in bulk, 12 of which in turn had over 1 million direct end-users. Of all re-use 70% came from the private sector, 30% from the public sector. (Danish address case C17)
- The Danish experience with opening its address database was one of the elements in deciding to create and open up the Danish system of base registers, to realise an government internal cost savings of 30 million Euro per year, and a direct economic benefit of re-use of at least 70 million per year. (Danish Roadmap C18)
- Addresses were part of the package of open data by the British Ordnance Survey, which contributed 13 to 29 million GBP to the UK economy in 2016, resulting in 4,4 to 8,3 million GBP in additional tax revenue. (Ordnance Survey C24)
- SME's with free or marginal costs based access to geo-data, including addresses, grow 15% faster than SME's paying higher access fees. (Koski C19)
- In Belgium realo.be is a single recent commercial re-user of the Belgium base address register, which as a new company created some 20 jobs, with the resulting income tax revenue for the government.

Cadastral data

Cadastral data are of significant economic interest for Serbian companies, and opened up can help reduce administrative overhead costs of citizens and civil organisations.

Noticeably:

- The Spanish cadastral office saw a rise in data consultation, after opening up their data. Compared to 2004 it had grown 25-fold in 2010. (Spanish Cadaster case C23)
- Spanish citizens save between 8-15 million Euro per year by being able to access data digitally
- The number of companies re-using this data grew 15-fold, while the download volume grew 20-fold, and the downloading of cadastral maps grew 80-fold. This once more points to a price elasticity of well above 1.(Spanish Cadaster case C23)
- A growing number of non-traditional re-users, indicating a wider variety in how the data is applied. (Spanish Cadaster case C23)
- In 2008 the United Kingdom posited that the value of providing cadastral data against marginal costs would create a direct value to re-uses of 2,3 million GBP (Newbury C1)
- The Dutch Cadaster perceives an improvement of quality in its interaction with the public, after releasing open data, where received questions are more focused and specific.(Spanish Cadaster case C23)

Company registers

Company register data is one of the most sought-after open data sets. Access to this data as open data immediately reduces the cost of doing business for companies, and enable direct economic value creation. It is an important building block of national data infrastructure.

Noticeably:

- Company registers show a price elasticity above 1, and therefore providing them against at most marginal costs makes economic sense (Newbury C1), in order to allow for maximum value creation.
- The United Kingdom estimated the direct economic value of an open company register through mathematical modelling at 2.6 million GBP. Compared to the costs this is a ROI of 4:1 (Newbury C1)
- 47% of Spanish commercial data re-users indicate they also use data from the company register, meaning it is the second most used data set in Spain. (Spanish infomediary sector C5)
- Europe-wide company register data is the third most in demand data for commercial re-use. It is rated the as very broadly deployable across 8 of 16 sectors surveyed (Cap C14)
- In the Netherlands the key obstacle to providing the company register as open data is political, as it would require altering the financing streams of the data holder towards the general budget, where currently it also depends on income from paid-for data access. The company is however part of the Dutch system of base registers, and projected to be open and free at the point of use in the future.
- The Danish company register was opened up for free re-use at the start of 2013. The Danish Business Authority then launched a program ('Virk Data', meaning 'data put to work'), to make Danish companies aware of the potential and stimulate re-use. The data set is part of the previously mentioned Danish roadmap for base registers. (Danish Roadmap C18).

Statistical data

Statistical data, specifically concerning economy, transport and demography have proven to be very fit for re-use across the EU. Re-users are motivated by cost savings as well as economic value of re-use. Price elasticity for this data has been shown to be above 1, resulting in non-linear growth in demand. The availability of statistical data also directly impact the (financial) trust in government.

Noticeably:

- Statistics on demographics, economy and transport are seen EU-wide as broadly re-usable (Cap C14)
- Australian statistics have been made available free of charge. This meant a loss in revenue for the data holder of 4.5 million AUSD for services, which was taken over by the market. It also meant a direct internal costs savings of 1 million AUSD. In addition re-users saw costs savings of 5 million per year, while the socio-economic value (consumer surplus) was estimated at 4 million AUSD per year. (Australian statistics case C32)
- As a measure of pre-existing latent demand, traffic to the Australian statistics website grew by a third in the first year, while the number of data downloads tripled between 2003-2010. (Australian statistics case C32)

- Free access to German statistical data became possible at the end of 2008, and resulted in a strong non-linear growth of downloads, with a factor 7, in comparison to the end of 2007 (POPSIS C4)
- The IMF showed that stronger transparency concerning economic statistics significantly lowers the costs of borrowing for government. It also correlates with lower inflation, reduced budget deficits and higher foreign investment, even if causation is uncertain in these cases. (IMF C33)

Meteorological and hydrological data

Hydrological and meteorological data, after geo-data, is of most interest for commercial re-use. Usage growths non-linearly after opening up, with demonstrable impact on employment and tax revenue. Re-use in other domains creates impact in the area of (intelligent) mobility. Opening up this type of data is of economic significance.

Noticeably:

- After geo-data, meteorological data is seen as most interesting for commercial forms of re-use (Cap C14)
- The Norwegian meteorological institute saw a 300-fold increase in users of its data, and a doubling of the usage volume per user, meaning a 600-fold increase in usage of their data. The number of non-Norwegian users grew by 40% (Norwegian meteo case C30)
- In Norway new commercial activities emerged at the high-end of the market. In the Netherlands the number of high-end users rose by 250%. Many new users of the data emerged in Norway, mostly small and medium size enterprises (SME's) (Norwegian meteo case C30, KNMI case C31)
- Interaction with re-users leads to improving data quality, better internal efficiency and an improved public image. (Norwegian meteo case C30)
- Additional tax revenues from open data re-use grow and overtake the loss of revenue after opening up meteorological data. (Pettifer C29). In Norway such tax revenues doubled, and were higher than the revenue loss from halting meteorological data sales. In the Netherlands, in the period 1999-2010 new tax revenue amounted to 3.5 million Euros per year, while the costs of data provision were 0,5 million per year, a ROI of 7:1. On top of this the internal cost savings for the Dutch meteorological institute also were 3.5 million Euro. (Norwegian meteo case C30, KNMI case C31, Pettifer C29)
- In the Netherlands the turnover realised with this data by re-using companies quadrupled after the data became available, and the corresponding employment tripled. (KNMI case C31)
- The 2011 Pettifer study calculated that a complete switch to at most marginal cost fees for meteorological data would make the European meteorological data market grow by 1.4 billion Euro per year, and if not would fall back 16% behind the growth of the US market which had been opened up. The additional tax revenue across the EU was calculated to be 290-340 million Euro per year. (Pettifer C28, Pettifer C29)
- Without free data provision smaller companies are de facto excluded from the meteorological data market by the necessity to enter into data acquisition contracts with each nation. The costs of doing so are about 20 times the commercial value to be gained. (Pettifer C29)

- In the UK in 2008 the direct economic value of meteorological data when switching to at most marginal costs for data provision was estimated at 1.2 million GBP. At the same time the existing revenue represented less than 1% of the total budget of the Met-Office, the data holder. Estimated ROI would be 5:1, pointing to price elasticity being above 1. (Newbury C1)
- For hydrological data similar conclusions were drawn in the UK in 2008, setting its direct economic value at 1 million pounds, with price elasticity higher than 1 as well. (Newbury C1)
- The usage of Australian hydrological data grew explosively after being made available for free. The number of re-users doubled, the number of consultations of the data grew 1100-fold. (C34)

Transport and mobility data

Traffic congestion and delay is an important economic cost. Open data in this domain, like real time location and real time delays in public transport, traffic intensities on roads, or real time parking availability, are being used intensively across Europe by both companies and citizens. Other open data, like base registers of topography, addresses and companies, are often used in this domain as well. This reduces delays and improves logistic service delivery, and brings down road fatalities. EU-wide open data plays an important role in efforts concerning Intelligent Transport Systems (ITS).

Noticeably:

- Transport and mobility data are an important source of re-use, and transport and mobility also are an important domain for re-use. (Cap C14, Koski C19, McKinsey C8). In the EU the open data impact for trade and transport is estimated at 9,9 billion Euro directly in 2020, and 37,6 billion indirectly in 2020. (Cap C14). Scaled to Serbia's 2017 GDP this is equivalent to 24 million Euro and 90 million Euro respectively.
- McKinsey mentions transport as the second economic sector where open data can create tremendous value globally. This presumes not just open government data, but also wider data sharing across the sector and a high maturity of markets. Global potential impact is estimated at 720-920 billion USD per year. (McKinsey C8) In terms of 2017 GDP this corresponds to 366-468 million USD annually in Serbia.
- Sales of public transport data, or keeping such data closed is a recognized barrier to e.g. making multimodal route planning possible. Different EU countries have put effort into ensuring free availability of such data, and where public transport services are tendered out to the market ensured contracts stipulate data publication as one of the obligations.
- The average costs of congestion in Europe are between 1% and 2% of GDP. For Serbia this amounts to about half a billion Euro annually in terms of 2017 GDP. The EU projects to save 629 million congestion hours by 2020 from open data usage. (Cap C14) Compared by population size this is equivalent to 8,66 million congestion hours in Serbia.
- EU-wide open data is estimated to potentially save 5,5% of road fatalities, equivalent to 32 fewer fatalities annually in Serbia. (Cap C14)
- After Belgrade, now also re-usable public transport data for Novi Sad has become available. The Dutch OpenGeo/OpenOV foundation is assisting with turning PDF based information into machine readable formats (e.g. GTFS).

Healthcare

Healthcare is a domain where open data can lead to significant cost savings, without much investment. This is of interest due to the significant budgets involved in health care delivery, and the resulting strain on national budgets. Publication of health care service delivery data has been seen to directly positively affect outcome of medical practices. The healthcare domain itself is also a significant new re-user of for instance open geo-data.

Noticeably:

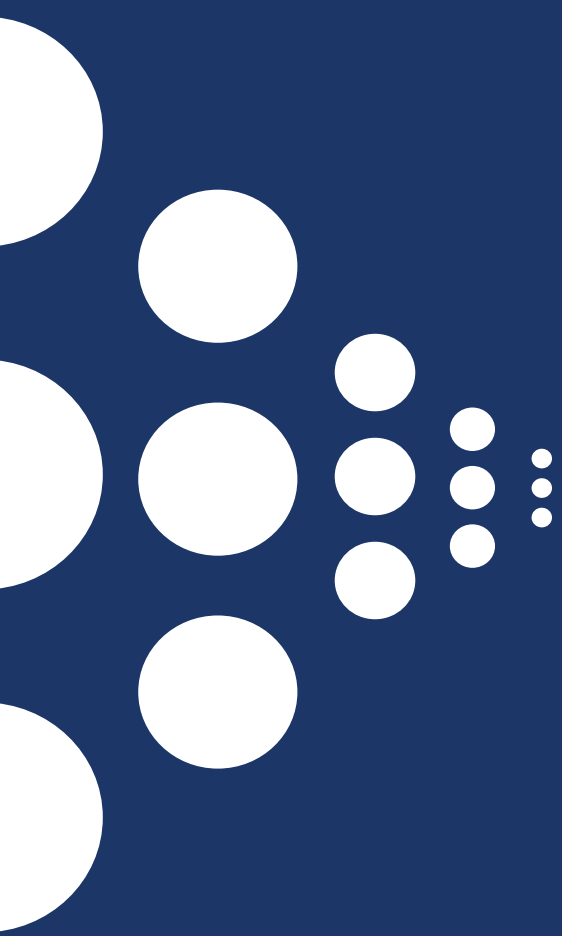
- Healthcare data is broadly re-usable across multiple sectors in Europe (Cap C14)
- For the US the health care open data potential was estimated at 300-450 billion USD, which based on GDP comparison is equivalent to 0.6 to 0.9 billion USD in Serbia. This presumes not just open government data, but also wider data sharing across the sector, and a high maturity of markets. (McKinsey C8)
- Healthcare services are important new re-users of geo-data (Austrian geodata case 37)
- The publication of healthcare data can lead to direct changes in behaviour by healthcare professionals. Publication of success and re-admittance rates concerning heart surgery patients, according to the British Society for Cardiothoracic Surgery, has led to 1000 fewer deaths per year in England (NHS cases C35). This has been quantified as being equivalent with a 400 million pound economic impact (Shakespeare Review C10). Because of this result in 2013 the NHS started publishing success rates about 10 additional medical specialisms.
- Similarly, publishing data on MRSA hospital infections, saw the number of deaths by those infections decrease by 76% (men) and 79% (women) in the period 2008-2012. (NHS cases C35)
- Data analysis of healthcare data can provide insight into large possible savings. A British research organisation looked at prescriptions made in England concerning statins in 2011. On principle GPs are only allowed to prescribe generic medicines, and not branded medicines. Yet an analysis of still prescribed branded medicines showed a savings potential of 200 million GBP per year in England. The British Medical Journal calculated that this would mean a savings potential for all prescriptions that year of 1.4 billion GBP. Even though generic medicines are formally already the norm. (NHS cases C35)
- Publication of healthcare data has significant impact on the results of medical practices, and therefore constitutes a cost free intervention in improving healthcare outcomes (NHS cases C35)
- For the region Stockholm the commercial value for 2016 of healthcare service data analyses through a 'Health Innovation Platform' was estimated at half a million Euro, even with clear issues of data quality (C36).
- The European Commission in the spring of 2018 has announced significant support for healthcare data sharing within the EU, while maintaining personal data protection safeguards, for its potential to improve healthcare outcomes, decrease costs, and trigger innovation.

Education data

Like healthcare, education is a key expenditure in the national budget, making even relatively small impacts financially significant. Education is currently also a key priority of the Serbian government. Worldwide education, as it includes (data driven) research and the resulting innovation, is seen as a key domain for value creation with (open). Through the usage of open data in education and the creation of new educational materials, as well as through open data about the education sector, concerning costs, quality and governance, and guiding parents choices. Open data is a broadly usable policy instrument in this domain. Actively promoting such usage of open data is needed however to more quickly see adoption.

Noticeably:

- Education is regarded by McKinsey as the largest domain globally for value creation with (open) data, up to 1.2 trillion USD or 1.5% of GDP globally, where such data originates mostly in other domains (McKinsey C8). This includes academic (data driven and AI) research, and resulting innovations. In 2017 GDP figures this corresponds to around 600 million Euro in Serbia.
- Publication in the Netherlands of all education related data as open data led to:
  - better questions being asked by the public to the Ministry,
  - more involvement of parents (like choosing schools through open data based platforms),
  - better access to financial and quality data by schools themselves to help their own governance.
  - the agency involved and the ministry now looking at whether the education related data can be correlated with labour market data, to see whether education delivers what society needs.
- It did take several years in the Netherlands before mature re-use of education related data emerged spontaneously. This underlines the importance to incorporate stimulation of re-use as part of open data policies, especially in those areas where government would like to see impact emerge (Zuiderwijk C6)



5 A closer look at 8 institutions in 6 domains

Interviews have taken place with eight public sector bodies. These interviews aimed to establish potential opportunities for open data to create an impact relevant to the data holder, and to assess current internally perceived readiness to open data as well as potential obstacles.

In this chapter the outcomes of these interviews are summarized in light of government priorities, as well pointers and examples provided that suggest where and how open data impact might be achieved.

The public sector institutions, roughly in order of priorities mentioned in the Prime Minister's expose of June 2017, which were interviewed, are:

- Ministry of Education, Science and Technology,
- Ministry of Agriculture
  - Veterinary Department
  - Farm Administrative Date Network & Agricultural Marketing Information System
- Geodetic Authority
- Serbian Statistical Office,
- Ministry of Justice
- Institute of Public Health of Serbia
- National Health Insurance Fund (RFZO)

The interviews took place with counterparts at varying levels within the respective organisations, yet three observations are common across them.
First of all that, largely in line with the findings of the 2015 ODRA, data holders are technologically capable of moving open data forward. The relevant data is available digitally, and existing infrastructure does not form a roadblock for opening up data.
Second, that high level approval will be needed for more open data, meaning that consent from the responsible Minister, and in some instances the involvement of the Ministry of Finance, is critical to increase the provision of open data in Serbia.
Third, that several institutions mention the high turnover rates of IT staff. An opportunity here is that institutions can more actively involve external policy relevant stakeholders in making open data a useful instrument. The public sector is not alone in their interest in making open data a source of value, and experience elsewhere has shown potential data users are willing to invest time and effort in assisting government bodies to make data available, improve data quality and devlop or apply professional and technological standards.

Ministry of Education, Science and Technology

Education is seen as a high priority by the Serbian government in ensuring that digitisation can play a strong role in strengthening the Serbian society and economy. Globally education is seen as the sector which can expect most benefits from more (open) data usage. As stated in the previous chapter this could mean up to 1.5% of GDP in value (McKinsey C8). This however mostly depends on the availability of data from other sectors, that can be used in education and research, to further the development of data professionals and the digital data economy. Of key importance in enabling the educational sector to use data, are those base registers that can form a national data infrastructure. This encompasses national data sets, such as maps, addresses and buildings, transport and mobility, meteorology and healthcare. It also encompasses internationally available data sets, such as the Sentinel open satellite data that is available from the European Union Copernicus program.

The Ministry of Education, Science and Technology has a key role in stimulating the usage of such data, especially when it newly becomes available to Serbian society, in education and research. In light of the current work to establish a new financing model for scientific research, the Ministry may incentivize such open data usage in the way it creates funding opportunities for scientific projects or evaluates submissions to them. Those same open data sources may also play a role in educational methods, as a free of charge ingredient. With establishing free educational e-services for primary and secondary education as a current policy effort, this is a likely opportunity.

In the education sector it is not just data from other sectors, that e.g. lend themselves to big data analysis, or can be used in research, that are of interest. Data about the educational sector itself, as well as the data underpinning current research is of societal value. Data about the educational sector itself can allow parents to make more informed choices for their children, and allow schools to improve their own governance by being able to benchmark outcomes against other schools. With renewed attention on dual and vocational training, performance data from the educational sector may also help determine how well education serves the labour market.
The European Commission over the years has worked towards making it increasingly mandatory that publicly financed research is published in open access journals, and that research data is publicly shared. In the latest proposals for the EU Directive on the Re-Use of Public Sector Information, data from publicly funded research in national or institution repositories is brought within scope, meaning a right for the general public to re-use that data. The ongoing work on establishing a new financing model for scientific research and scientific project funding can be a vehicle to increasingly align with the open access and open data principles and plans of the EU.

The Ministry of Education, Science and Technology has been one of the early adopters of open data efforts since the national open data readiness assessment in 2015, and is a member of the Open Data Working Group. However, the maintenance and extension of open data has been discontinued and no data is currently available after 2016. The Ministry is developing a new information system, which will be able to facilitate sustainable open data publication. Open data will be published after the final phase of the development of the open data platform at opendata.mpn.gov.rs. A new data release will encompass both 2017 and current data, and is expected to be available before December.

Currently possible steps	Expected impact
Publish education related data (in progress)	Supports school choices, including for further (vocational) training, supports school management team in benchmarking themselves
Incentivize open data usage in educational e-services	Supports digitisation of Serbian society
Stimulate provision and use of key government data (see base registers as national data infrastructure)	Creates digital resources for education and research
Incentivize open data usage in research through funding decisions for research proposals that do so	Supports increasing data science, big data oriented research, training more data scientists through free resources
	Contributes to realizing potential of data in education up to est 1.5% of GDP

Ministry of Agriculture

The agricultural sector is meant to strongly benefit from digitisation and technology according to Serbia's government plans. In terms of policy aims this is translated into aiming for a more competitive (inter)national market position, sustainable management of resources and environment, and adherence to various standards such as food safety, animal welfare and environmental protection.

The agricultural sector does not figure prominently in existing open data impact research. The 2015 EU report (Cap C14) ranks agriculture as one of the less significant sectors for open data impact in 2020 at a direct market size of 379 million Euro for the EU, and an indirect market size of 1.4 billion Euro. Compared by 2017 GDP that would be equivalent to 0.9 million and 3.4 million Euro respectively in Serbia.

Yet practical examples and micro-economic studies show that open data does play an important role in improving crop quality, land management and forest management and high precision agriculture. To a large extent this relies on data sets being available from other national and international sources. This includes the availability of open geographic data (maps, elevation), meteorological data, hydrological data, and feedstock market prices at the national level, as well as earth observation data, such as ESA's Sentinel data, at the international level. ESA documented

the use of Sentinel data for forestry management in Sweden, both by farmers as well as by government for inspection, and high precision agriculture in Denmark. Similarly, this data can be used to provide early detection of deteriorating plant quality in crops. Across the developing world earth observation data is often the only reliable data source for forestry management, compliance checks, and crop quality monitoring.
Geographic data is being used to provide farming equipment with exact GPS traces to follow, whereas hydrological and meteorological data can be useful not just for planning during a season but also for planning which leaseholds to acquire or stop using for certain types of crops.

These types of data usage create impact in terms of efficiency and effectivity gains for farmers but also create new employment with service providers and software companies, and efficiency gains for the public sector such as through easier compliance checks and inspections.
These types of impacts for the agricultural sector in the incorporated studies have not been documented in terms that allow transposition to the Serbian contexts, but are of significance. In 2013 the US start-up Climate Corporation, using machine learning to predict different agribusiness elements, amongst which weather, was acquired by biotech company Monsanto for over 1 billion USD. This acquisition was noted across the technology world as a large exit sum for an agritech business. Other impact research results such as the finding that SMEs may grow faster when having access to open geographic data (Koski C19), are in line with existing anecdotal material specific to agriculture, given that farms are SMEs too.

There is also data within the purview of the Ministry of Agriculture that is of value to farmers and service providers to the agricultural sector. This includes historic and current data of land usage (which crops were grown on which parcel over the years), as well as e.g. livestock numbers, and the provision of financial instruments such as agricultural subsidies. Historical land usage data for instance is very useful in determining which lease holdings are of interest to a farmer in a given season for a given crop.

Interviews were held with the Veterinary Department and the department responsible for the Farm Administrative Data Network (FADN) and the Agricultural Marketing Information System of Serbia (STIPS).

The Veterinary Department has been developing an internal information system since 2005, containing a register of all farms holding animals, vaccinations and inspections. Veterinary clinics and the Customs Authority currently have real time access to this data. This means a mature information system and infrastructure is in place. The department is well prepared to deliver more transparency, as long as privacy concerns are addressed. Based on jurisprudence within the EU, privacy concerns in the agricultural sector easily arise because a small farming business often coincides with a single farming household or individual farmer. This means different types of data (such as financial instruments) quickly become personally identifiable data. Another typical concern is that publishing data about a specific farming company can be potentially harmful economically, requiring a careful balancing of that potential harm versus the public interest in transparency, for each specific case.

The FADN database contains farm's administrative data, and STIPS contains periodically collected market price information of agricultural goods.
The FADN database is shared with the EU. After validity checks it is added to the EU FADN database. The European FADN database is publicly accessible online, and allows for downloads of selections and preselected reports in the machine readable format CSV, requiring users of the data only to attribute the data source. As this data is already being shared it should be possible to publish this data as open data in Serbia as well. Consultation of sector relevant stakeholders is likely useful to determine which parts of the data are of potential use, and whether any concerns need to be addressed.

The STIPS database findings are published online by the Ministry, with available data going back to 2004, where it can be provided in HTML and PDF. To make this data re-usable providing machine readable formats, covered by an open license are the missing steps. As with the FADN database a consultation of sector relevant stakeholders and current users of the online STIPS data can be useful to determine how this data can be provided in a more valuable way.

Currently possible steps	Expected impact
Stimulate provision and use of key government data (see base registers as national data infrastructure), as well as stimulate usage of ESA Sentinel open data in agriculture and agritech	Creates digital resources for precision farming, farm management and planning, allows creation of agritech services. Allows farms to be more effective.
Provide historical and current land use data	Creates digital resources for farm management and planning
Publish FADN data, as EU FADN database already does, in collaboration with external domain relevant stakeholders	Efficiency and effectivity gains for farmers, stimulates new service providers, reduces costs of compliance checks and inspections. Involving stakeholders allows insight into data needs, increases data quality through feedback.
Provide published STIPS data as machine readable open data, in collaboration with external domain relevant stakeholders.	Efficiency and effectivity gains for farmers, stimulates new service providers. Involving stakeholders allows insight into data needs, increases data quality through feedback.
Provide availability and depletion of agricultural subsidy data	Allows more efficient requests for subsidies, and better distribution of funds as consequence.
Do privacy assessment of veterinary data, in collaboration with external domain relevant stakeholders	Creates insight in what the usage value of specific parts of the data may be, what usage forms can be anticipated, to zoom in on more precise privacy issues. In order to both allow value creation through open data, as well as protect privacy where applicable.

Geodetic Authority

The data that the Geodetic Authority holds all belong to what are regarded as base registers and the key building blocks of a national (open) data infrastructure. As such Chapter 4 documents extensively the types of impact this data can have socially and economically when available as open data.

Already during the 2015 ODRA as well as in the conducted interview the Geodetic Authority said to be working towards a shift in role. This key data collecting agency, aims to shift from being a gatekeeper of their data, towards being a service provider. The intention is that, as part of this shift, public access to open data becomes reality.

Currently however, access is being sold to primarily larger clients. The previous chapters have presented that access fees are certain to hold back a very strong latent demand for the data the Geodetic Authority holds. This latent demand especially resides with small companies and starting businesses for which the fees constitute a barrier to market entry. Moreover it is equally certain that providing free access for re-use to the data will result in increased tax revenues exceeding the loss of revenue on current sales over time.

The currently required access fees also are a potential obstacle in the planned strategic shift. This is the case if the Geodetic Authority becomes a provider of services which are not part of their public tasks, and the access fees for others remain in place. In such a scenario the Geodetic Authority would be able to provide commercial services while not having the burden of paying for access to their data, whereas any potential competing service provider would be disadvantaged by always having to pay for access. Essentially the Geodetic Authority would be cross-subsidising its commercial activities from its public tasks. This may draw attention of the market and competition authority, as it has in other European countries.

To move forward with open data for the Geodetic Authority, it is of key importance to gain detailed insight into the access fees currently collected. These fees are mandated by the Law on Administrative Taxes, in part collected by local branches of the Geodetic Authority, and in all instances directly transferred to the Serbian Treasure. Establishing the number of paying users, their volume of usage and the access fees incurred is crucial information to determine a possible course of action. Such a course of action might involve re-evaluating registration fees (as they don't influence usage, though they might influence registry compliance), and general budget financing, and as such require the active involvement of the Ministry of Finance.

Apart from the mentioned strategic shift, other existing goals can be supported by a more active open data policy. Various goals concerning e-services, such as faster registration and better electronic exchange of formal cadastral information between relevant stakeholders, can benefit from being part of a wider open data approach, and any planned system changes are opportunities to embed open data principles in the IT functionality and information processes.
Finally, when it comes to building a high quality address database, as mentioned in the PM's expose and currently being explored by the Geodetic Authority, publishing open data may be of help too. France seeking to create a high quality address database, named BANO, actively worked

with other government agencies (such as the tax office), and with the open source / open data community, e.g. the Open Streetmap activists to create a high quality national address database. A prominent Open Streetmap activist became a member of the national open data team as part of this effort. Likewise the creation of a high quality Serbian address database may be assisted with knowledgeable civic organisations and groups, e.g. assisting in collecting data in the field where needed. Already publishing other available geographic data as open data can serve both as a starting point and as a clear signal of commitment to openness, which may bring such groups on board.

Currently possible steps	Expected impact
Document current revenue, usage volume, frequency, number and type of buyers of current data	Provides a baseline measurement. Allows balanced discussion on potentially abolishing fees.
Remove fees for data access	Very strong jump in usage, by current non-users as well as existing users, both in number and volume. Tax revenue on commercial types of re-use will overtake loss of revenue from sales. GA data serves as fundament making other types of open data re-usable.
Consider how open data plays a role in reaching goals concerning e-services, time saving procedures etc.	Reduces costs of implementation, and of doing business
Interact with external stakeholders, by showing open data commitment	Improves Q of data through feedback, Brings involvement of interested stakeholders that can be helpful building the address database

Serbian Statistical Agency

As with base register data, statistical data when it becomes available also creates a strong non-linear jump in usage. Previous chapters document this. The Serbian Statistical Agency is a member of the Open Data Working Group and actively publishing data already. Improving open data provision directly contributes to the Agency's public task of ensuring wide usage of high quality statistical data. European and international networks of statistical offices ensure synchronisation and convergence with international good practice in terms of processes as well as standards.

The organisation currently has goals pertaining mostly to internal processes. Such as improving the efficiency of primary and production processes, improving source data quality, and improve data and meta-data quality.
Open data usage brings more eyes to the data, and this allows outside stakeholders to play a role in increasing data quality. This does require active engagement by the Statistical Agency with professional re-users. Through better understanding by re-users of how data is collected and created, and in turn better understanding by the agency how external stakeholders engage with the data, both data quality and data provision may be improved. For instance the Dutch Bureau of Statistics intensively interacts with re-users since even before they started publishing all their base tables as open data. Currently these community connections allow them to test new ideas, ask for valuable feedback and ensure better quality of re-use. They are also actively engaging with local governments as re-users of their data, and providing value added services to them under the name 'Urban data centers', such as concerning working with privacy sensitive data.

Currently the Serbian Statistical Agency publishes both through the national open data portal, and through a tool on their own website that allows downloads in various formats of specific data selections. Listing these downloads, or static links to the underlying tables in the data portal will increase the findability of this data, and by extension its re-use. Extending external stakeholders engagement as mentioned above, and adding e.g. manuals or descriptions of how data can be responsibly used also likely increases re-use.

Currently possible steps	Expected impact
Engage with external re-users regularly	Provides feedback, improves metadata quality.
Ensure that all which can be downloaded after selection in the current online tool, is also available in the national open data portal as complete tables.Open up as much of the base tables as possible this way.	Increases exposure and re-use (likely creating a non-linear jump in usage)
In collaboration with external re-users provide guidance on data structures, data collection and responsible re-use forms.	Increases volume and quality of re-use, increases the reach of the Statistical Agency.

Ministry of Justice

In the available research on open data impact Ministry of Justice related data does not surface often. Two elements do get a regular mention:
First, crime statistics are seen by international indexes as one of the key data sets improving transparency. Second, in professional services (which as a sector does show a strong impact of open data of 22 billion Euro in 2020 directly, and 83,5 billion indirectly by 2020 in the EU) transparency of the judicial system, and corresponding e-services are seen as important to drive down the cost of doing business, as well as providing stability and predictability, thus reducing business risks.

Moreover jurisprudence is a source of commercial re-use (for instance Caselex, a service comparing market definition cases across all EU28+ countries). Historically publishers have been interested in both consolidated legal texts as well as jurisprudence.

The Ministry of Justice is delivering on the action plan for the implementation of the national judicial reform strategy. This includes transparency concerning evaluation and performance of the judicial system, and providing public access online to non-classified data. Additionally a court performance statistical database is part of e-Justice efforts.

Active court case progress can currently be tracked on the Ministry's online portal.

This year a number of analyses have been, or are planned to be performed, concerning the potential opening of commercial courts data, monitoring domestic violence prevention measures, misdemeanor courts data, general jurisdiction courts statistics. Two systems have been mentioned as central to these data, the AVP and SIPRIS systems.
Also work is ongoing to generate court performance statistics and publish these as open data.

After completion of the analyses the Ministry of Justice will come to decisions which of the relevant data should be opened first, including the creation of webservices, and for which additional resources must be found beforehand. A webservice for court performance reports should become available in the fall of 2018.

Active consultation of external stakeholders relevant to the field, such as lawyers, civil society organisations and commercial entities depending on a smoothly functioning judicial system, may provide additional information on which data is of most interest as open data, and likely to be re-used in ways of value to Serbian society.

Currently possible steps	Expected impact
Publish crime statistics as open data	Improves Serbia's ranking in international indexes
Publish the performed/planned analyses as far as possible.	Helps bring in involvement of external stakeholders/potential users concerning which data is of most interest
Publish jurisprudence as open (meta)data	Commercial re-use opportunity for services
Ensure transparency steps planned/taken and statistical performance database are also available as open data	Reduces costs and risks of doing business
Provide court case progress as open data	Predictability and stability help reduce costs and risks of doing business

Healthcare

Healthcare data is broadly re-usable across multiple sectors in Europe (Cap C14). The European Commission this year has put forward proposals for more healthcare data sharing within the EU, and already earlier for instance ensured the availability for re-use of clinical trial data for medicines on the European market. These steps are motivated by the apparent potential to improve healthcare outcomes, decrease costs, and stimulate innovation. At the same time attention is given to increased personal data protection safeguards.

As described in Chapter 4, the clearest examples of how re-use of healthcare data creates direct value in the sector itself, in the form of improved healthcare outcomes come from the English NHS. Specifically there the publication of the number and nature of procedures performed and their results in a number of medical specialisms has led to lower number of deaths. The availability and communication of data concerning hospital infections has led to a reduction in deaths of over 75%. Publishing such healthcare data has directly altered the behavior of medical professionals. Data analysis by research institutions of healthcare data, such as prescription data has led to point out potential cost savings within the healthcare system. This type of data analysis is of apparent interest to the scientific community and as such a valuable source of potential cases for increased attention to data analysis in education and science.

Waiting lists are a concern in various European countries, and are mentioned as a point of action in the Prime Minister's expose. Sharing data about waiting lists for various procedures at various healthcare facilities can aid in the reduction of waiting lists. In Sweden the availability of waiting list data was used to let the public be able to choose a different hospital, spreading out the demand more evenly over the system. Similarly Dutch healthcare insurers, in using waiting list data, take an active role to stimulate and guide patients to other facilities than the nearest one, amongst others in one-on-one phone conversations to discuss available options for a patient.

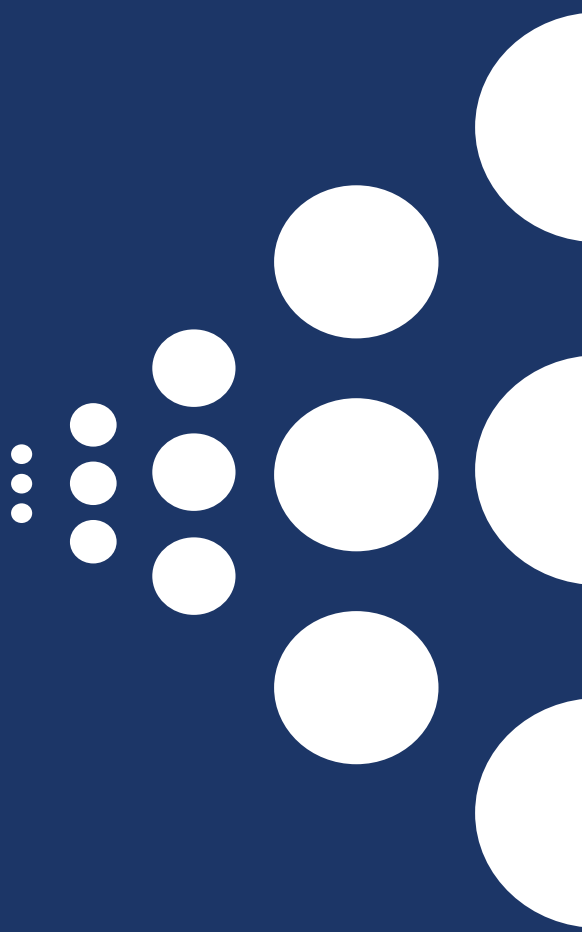
Interviews were held with the Institute of Public Health of Serbia, and the National Health Insurance Fund.

The Institute of Public Health is responsible for public health statistics, and corresponding analysis and planning for the improvement of quality of care. The institute reports statistics and findings to the government, the public and international organisations such as the WHO. These healthcare statistics, as they are already being published in some form, would take minimal work to also publish in machine readable format as open data.
Since recently also the integrated health information system (IZIS) falls within their purview, having been moved to them from the responsibility of the Ministry of Health. Performance and healthcare outcome data from this system could provide a valuable feedback loop to health care professionals in improving healthcare outcomes as described above and in Chapter 4.

The National Health Insurance Fund (RFZO) maintains a widespread information system across the country, with real time access by health care institutions and pharmacies to enter data. This means that highly granular data such as on prescription fulfillment, diagnoses and treatments, and waiting lists is collected in real time. This of course means stringent privacy safeguards as well. Given the experiences elsewhere in Europe determining which of the existing data can be used to provide direct feedback loops to medical professionals to improve healthcare outcomes (such as the English NHS documented), which data can be used to negotiate appointments with patients more evenly to reduce waiting lists, which data in aggregate form might be useful in aiding the public's healthcare decisions, and which anonymized and/or aggregated data is of value to data analysis and research into cost savings and the overall efficiency of the healthcare system.

A recent privacy breach issue with a mobile healthcare appointment application however has made all parties involved very cautious, so that any increase in data availability would need to be prepared in collaboration and with consultation of external stakeholders.

Currently possible steps	Expected impact
Form stakeholder engagement groups on open data and privacy considerations	Reduces apprehension and privacy risks, while increasing potential for value creation. Provides insight into existing (latent) demand for data.
Publish healthcare statistics (such as MSRA hospital infections), procedure outcomes, as feedback loop for professionals	Improves healthcare outcomes, reduces preventable deaths without additional costs.
Publish waiting list data	Allows patients and healthcare professionals to better distribute demand, reduces waiting lists.
Publish prescription and healthcare outcome data	Stimulates research and data analysis (also see its role in education earlier in this chapter), Detects cost saving potential



6 Tracking impact

(Im)possibilities of tracking open data impact

While it is tempting to ask for a 'killer app' or 'the next tech giant' as proof of impact of open data, establishing the socio-economic impact of open data cannot depend on that. Both because answering such a question is only possible with long term hindsight which doesn't help make decisions in the here and now, as well as because it would ignore the diversity of types of impacts of varying sizes known to be possible with open data. Judging by the available studies and cases there are several issues that make any easy answers to the question of open data impact impossible.

1. There are different varieties of impact, in all shapes and sizes. If an individual stakeholder, such as a citizen, does a very small thing based on open data, like making a different decision on some day, how do we express that value? Can it be expressed at all? E.g. in the Netherlands the open data based rain radar is used daily by most cyclists, to see if they can get to the rail way station dry, better wait ten minutes, or rather take the car. The impact of a decision to cycle can mean lower individual costs (no car usage), personal health benefits, economic benefits (lower traffic congestion) environmental benefits (lower emissions) etc., but is nearly impossible to quantify meaningfully in itself as a single act. Only where such decisions are stimulated, e.g. by providing open data that allows much smarter, multi-modal, route planning, aggregate effects may become visible, such as reduction of traffic congestion hours in a year, general health benefits of the population, reduction of traffic fatalities, which can be much better expressed in a monetary value to the Serbian economy.
2. The existing research shows that previously inactive stakeholders, and small to medium sized enterprises are better positioned to create benefits with open data. Smaller absolute improvements are of bigger value to them relatively, compared to e.g. larger corporations. Such large corporations usually overcome data access barriers with their size and capital. To them open data may even mean creating new competitive vulnerabilities at the lower end of their markets. (As a result larger corporations are more likely to say they have no problem with paying for data, as that protects market incumbents with the price of data as a barrier to entry.) This also means that establishing impacts requires aggregating that range of smaller impacts, which can be hard to do (see point 1).
3. The research shows the presence of network effects, meaning that the impact of open data is not contained or even mostly specific to the first order of re-use of that data. Causal effects as well as second and higher order forms of re-use regularly occur and quickly become, certainly in aggregate, much higher than the value of the original form of re-use. For instance the European Space Agency (ESA) commissioned a study into the impact of open satellite data for ice breakers in the Gulf of Bothnia. The direct impact for ice breakers is saving costs on helicopters and fuel, as the satellite data makes determining where the ice is thinnest much easier. But the aggregate value of the consequences of that is much higher: it creates a much higher predictability of ships and the (food)products they carry

arriving in Finnish harbors, which means lower stocks are needed to ensure supply of these goods. This reverberates across the entire supply chain, saving costs in logistics and allowing lower retail prices across Finland. When mapping such higher order and network effects, every step further down the chain of causality shows that while the bandwidth of value created increases, at the same time the certainty that open data is the primary contributing factor decreases. Such studies also are time consuming and costly. It is often unlikely and unrealistic to expect data holders to go through such lengths to establish impact. The mentioned ESA example, is part of a series of over 20 such case studies ESA commissioned over the course of 5 years, at considerable cost for instance.

4. Without context, of a specific domain or a specific issue, it is hard to asses benefits, and compare their associated costs, which is often the underlying question concerning the impact of open data: does it weigh up against the costs of open data efforts? Even though in general open data efforts shouldn't be costly, how does some type of open data benefit compare to the costs and benefits of other actions? Such comparisons can be made in a specific context (e.g. comparing the cost and benefit of open data for route planning with other measures to fight traffic congestion, such as increasing the number of lanes on a motor way, or increasing the availability of public transport).
5. Because open data provisioning is a prerequisite for it having any impact, the availability of data and the maturity of open data efforts determine not only how much impact can be expected (Shakespeare review C10), but also determines what can be measured (mature impact might be measured as impact on e.g. traffic congestion hours in a year, but early impact might be measured in how the number of re-users of a data set is still steadily growing year over year)
6. Whether open data creates much impact is not only dependent on the availability of open data and the maturity of the supply-side, even if it is as mentioned a prerequisite. Impact, judging by the existing research, is certain to emerge, but the size and timing of such impact depends on a wide range of other factors on the demand-side as well, including things as the skills and capabilities of stakeholders, time to market, location and timing. An idea for open data re-use that may find no traction in France because the initiators can't bring it to fruition, or because the potential French demand is too low, may well find its way to success in Bulgaria or Spain, because local circumstances and markets differ. In the Serbian national open data readiness assessment performed by the World Bank and the UNDP in 2015 this is reflected in the various dimensions assessed, that cover both supply and demand, as well as general aspects of Serbian infrastructure and society.
7. The notion of broad open data provision as public infrastructure (such as the UK, Netherlands, Denmark and Belgium are already doing, and Switzerland is starting to do) further underlines the difficulty of establishing the general impact of open data on e.g. growth. The point that infrastructure (such as roads, telecoms, electricity) is important to growth is broadly acknowledged, with the corresponding acceptance of that within policy making. This acceptance of quantity and quality of infrastructure increasing human and physical capital however does not mean that it is clear how much what type of infrastructure contributes at what time to economic production and growth. 2012 World Bank research (Estache and Garsous, IFC Economics Notes 1[1]) mentions a need of some 6.6% of GDP of infrastructure investment for the ECA region, in which Serbia falls, from 2012 until 2020. Within this, ICT infrastructure, under which open data provision can be

1 https://www.ifc.org/wps/wcm/connect/054be8804db753a6843aa4ab7d7326c0/INR+Note+1+-+The+Impact+of+Infrastructure+on+Growth.pdf?MOD=AJPERES

seen to fall, would require about 1% of GDP, to induce growth. Public capital is often used as a proxy to ascertain the impact of infrastructure on growth. Consensus is that there is a positive elasticity, meaning that an increase in public capital results in an increase in GDP, averaging at around 0.08, but varying across studies and types of infrastructure. Assuming such positive elasticity extends to open data provision as infrastructure, it will result in GDP growth, but without a clear view overall as to how much.

Most measurements concerning open data impact need to be understood as being proxies. They are not measuring how open data is creating impact directly, but from measuring a certain movement it can be surmised that something is doing the moving. Where opening data can be assumed to be doing the moving, and where opening data was a deliberate effort to create such movement, impact can then be assessed.

Apart from the difficulty of measuring impact and the effort involved in doing so, there is also the question of why such impact assessments are needed. Is an impact assessment needed to create support for ongoing open data efforts, or to make existing efforts sustainable? Is an impact measurement needed for comparison with specific costs for a specific data holder? Is it to be used for evaluation of open data policies in general? In other words, in whose perception should an impact measurement be meaningful?
The purpose of impact assessments for open data further determines and/or limits the way such assessments can be shaped:

1. Is it important to establish the total impact of parts or all of the available open data? Or is it enough to establish a minimum impact? The mentioned ESA case studies provide a range of very specific use cases and their value, and in total can be seen as the lower limit of the impact resulting from releasing satellite data during a certain time frame. It is however not a complete tabulation of the impact of that open data.
2. Is it important where the impact of open data usage accrues? Often the economic impact that government itself feels in terms of additional tax revenue for instance, does not accrue with the data holder on whose open data such economic impact is based. Unless it is about government efficiency as open data impact, or unless certain open data efforts are tied to specific policy goals of the data holder it will be hard to measure impacts in ways that are meaningful to a single data holder itself.
3. Is an impact measurement meant to be compared with other high level economic or social indicators (e.g. making comparisons between sectors)?

Finally, with any type of measurement, there needs to be awareness that those with a stake of interest into a measurement are likely to try and game the system. Especially so where measurements determine funding for further projects, or the continuation of an effort. This must lead to caution when determining indicators. Meaningful measurements based on direction and speed ('vectors') are more useful in such contexts than target related measurements ('points'). The former better measures actual dynamic, where the latter easily becomes a target in itself. For instance in the early days of national open data portals being launched worldwide, a simple metric often reported was the number of datasets a portal contained. This is an example of a 'point' measurement that can be easily gamed for instance by subdividing a dataset into several subsets. The first version of the national portal of a major EU member did precisely that and boasted several hundred thousand data sets at launch, which were mostly small subsets of a bigger whole. A 'vector' (direction and

speed) approach in this case might look at the total volume of data a public sector body holds, the percentage of it that is published as open data. Or it might look at the range of public tasks and what percentage of those tasks is covered by published open data. This allows measuring direction: is there movement towards 'open by default/design' i.e. total public data availability. Speed would be ascertained from the change of the mentioned percentages over time (is the data provision still growing, or is it stagnating before completion).

Policy goals as filter

Earlier in this document the role of open data as a policy instrument was described. Around the world open data is being used to both nudge and enable different stakeholders to take new or different action. This results in new socio-economic activity, but also e.g. helps reduce the strain on government services. Based on the knowledge that open data can have an impact, trying to purposefully trigger such impact in a specific policy domain around specific issues, makes it a policy instrument next to financing and regulation.

Where the release of open data is undertaken as an action tied to a certain policy goal, it becomes easier to assess impact as it should become visible in whether that policy goal is reached or not. Essentially using open data as a policy instrument means that a data holder up front has determined what specific type of impact it wants (towards a policy goal), and that it is releasing open data sets as part of its efforts. Then assessing impact can be limited as it is already known where the data holder wants to look for that impact. For instance where a city government wants to reduce car movements in the city center, it can take different measures. Like blocking roads, changing parking fees, or excluding specific types of older cars. It could also publish real time open data on the availability of parking spaces in the city's parking houses, and e.g. encourage its usage in navigation software. That would potentially reduce the time spent by a driver looking for a spot, and thus the intensity of car movements. When it comes to impact assessment only the impact on the stated policy objective would need to be ascertained. Any other impact of re-use, value created by other stakeholders, in other sectors etc., would be collateral benefits, very much welcomed but not specifically aimed for. These could be taken into account if easy to spot, but not necessarily to build the case for sustained publication of that open data.

Tying opening data to specific policy goals and public tasks in various policy domains also helps prioritise and select where to start with opening data, and avoids the likely disappointment of publishing 'randomly' and seeing no up-take.

Proposed indicators

Taking the above into account, a framework for open data impact indicators is proposed that is based on several dimensions.

First the dimension of balancing lead and lag indicators. Lead indicators show whether the right things to enable open data impact are happening (as no impact would be possible otherwise), and lag indicators to assess what impact is visible.

Second, establishing indicators along the entire value chain that leads to socio-economic impact of open data, as apparent from the reviewed research. This value chain runs from data provision, government efficiency gains, demand and adoption, time and resource investment by external stakeholders, re-use examples, policy implementation, ecosystem formation, to higher order usage and network effects.
For the different steps in that chain, both lead and lag indicators can be put forward, along with the methods to measure them where such experience exists in the research taken into account.

Third, indicators as much as possible should be of the 'vector' type (measuring direction and speed), which more likely leads to more objective measurements.

In the table below these three dimensions are combined into proposed indicators:

Aspects of the open data value chain	Lead indicators	Lag indicators
Open data provision	• % PSBs[2] (esp. core data holders) have Open Data Teams (consisting of a data expert, a domain expert, a team lead with (access to people) decision power) (F) • # PSB's who are members of the open data working group, growth/change of membership (F) • % PSBs have published inventories (F), • % PSBs have open data policy • % ministries have open data policy, inventory (F) • % of public tasks covered (using COFOG[3], 4 digits overall, 5 digits inside domains or PSBs) • Government readiness assessment in W3C Barometer (method at W3C online) (F) • Having an inventory and detailed insight into existing fees charged, tracking changes in charging practices (F)	• W3C Barometer and Open Knowledge Index indicators for core sets, (F) • % of national, regional PSBs publishing data, • % of PSB publishable data volume published (based on inventories PSBs made) • % of public tasks (using COFOG) covered with open data • # of datasets for which fees reduced to marginal costs / zero (comparison against overall inventory of existing fees made at start) (F)
Government internal impact	• # cases where government internal data sharing is moving from bespoke exchange to exchange as open data (anecdotal or survey) • # instances where usage of primary or authoritative (open) data sources is/becomes mandatory for all PSBs (monitor new regulation introduced) (F) • Names, # and % of PSBs that have explicitly formulated data governance policies in which openness, personal data protection, archiving and information security are all covered. (self-reporting/survey, information requests) (F) • Decision to create national government (open) data infrastructure, # and % change in base registers / datasets added to it. (monitor new regulation) (F)	• # self reported usage of other PSBs open data • % decrease in number of information requests received, (self-reporting) • % increase in portion of more complicated requests received (self-reporting) • time saved from no longer preparing bespoke data deliveries to other PSBs and externally (self-reporting, e.g. based on no longer needing specific data provision teams.) • money saved from reduced transaction costs (where changes in fees charged take place), overhead and contract negotiation for bespoke data provision (financial systems reporting) • decrease in procurement or collection costs of data due to filtering out double work (resulting from detecting double work in published data inventories) • increase in data quality from wider internal usage (errors, corrections submitted internally) (F) • # and % of local PSBs actively using national open data, such as base registers, and vice versa (self-reporting) • Government impact assessment in W3C Barometer (W3C method) (F)

2 The Commissioner for Information of Public Importance and Personal Data Protection publishes a list of PSBs within scope of their legal framework as open data. Where PSBs are mentioned refer to this list.

3 Where public tasks are mentioned, or policy domains, in this framework, COFOG is the intended reference list. Four positions for domains, five positions for public tasks.

External stakeholder adoption/interaction	• # of downloading entities (portal logs) (F) • # volume of downloads (portal logs) (F) • % growth of downloaders and downloading volume (portal logs over time) (F) • # of data corrections / feedback received from external parties (as proxy for increasing data quality) (F) • % of data holders with regular stakeholder group meetings/feedback on improving data provision (quality, currentness, formats, standards) / improving data portal interface & functionality (self-reporting, external stakeholder survey, public announcements) • % of data holders with regular organised stakeholder interaction about how to make open data more useful (self-reporting, external stakeholder survey, public announcements) • Business / society readiness in W3C Barometer (W3C method) (F)	• Time and effort spent by downloaders interacting/working with the data they downloaded, through a survey (repeating time investment is a proxy for perceived lower limit value to a re-user) (survey of identifiable or self-identified re-users) (F) • # of stakeholders interacting with data holder, by type and size (citizen, CSO/NGO, academia, SME, large corporation) (self-reporting by data holder)
Usage as policy instrument	• # of pilots/projects where open data used as instrument (anecdotal, self-reporting) • % of PSBs/policy domains (COFOG) that have such pilots/projects (self-reporting) • % of PSB open data policies that contain reasoning and plans for desired impacts (desk-research) • % of PSB open data policies that contain plans for continuous measurement of impact (desk-research) • % of PSBs that regularly reach out to policy relevant stakeholders to use relevant open data (stakeholder survey, self-reporting) • % of PSBs that on policy themes related sites point to relevant data sources (online research) (F)	• Existing policy impact assessments take open data effects into account (desk research, examples) • Costs comparison of open data based actions versus other policy actions in a domain / around an issue (internal business cases) • Type and extend of usage, perceived usage value by policy domain/issue relevant stakeholders (survey) • # of policy relevant stakeholders using open data from a publishing PSB (stakeholder survey, portal logs) • Political impact assessment from W3C Barometer (W3C method) (F)
Re-use	• % of base data sets providing an API (online research) (F) • #, % of API access, distribution of API access across re-users (server logs) • # of end-users that re-users reach, # of re-users that reach 500k end-users or more (survey) (F) • # sectors, agencies hosting round-tables on solving re-use issues (such as the Open Data Enterprise round table format) (anecdotal, survey, self-reporting) • # of groups, meet-ups, competitions, events, and number and type of participation organised/fully funded by government (online research, self-reporting)	• participation and prototypes resulting from competitions (organisers survey, participants survey) • collecting examples of re-use by sector from surveys or roundtables (anecdote collection) (F) • #/% jobs, #/% turnover companies directly tie to open data re-use (sectoral self reporting/survey) • estimates of additional tax revenue on income, profit and value added based on the above jobs/turnover numbers (calculation) • Economic and social impact assessment from W3C Barometer (W3C method) (F)

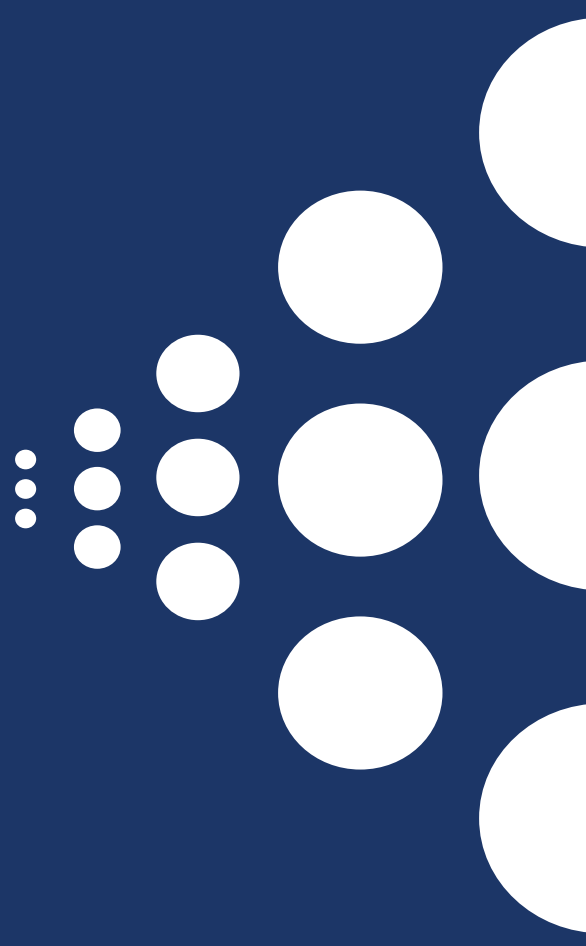
Ecosystem formation	• Stakeholder mapping, mapping growth of number, variety and interconnectedness of stakeholders actively using open data, directly engaging with PSBs about open data, or explicitly stating interest in open data usage (stakeholder mapping)	• # data brokers, data markets, over time (online research)
	• # groups, meet-ups, competitions, events, and # and type of participation, organised by others than government (online research, self-reporting) (F)	• collecting examples of re-use that involve multiple government and/ or one or more non-government data source (anecdote collection) (F)
	• # non-open data events where open data is on the agenda (sectoral meetings, etc) (desk research) (F)	• collecting re-use examples that depend on data provision / improvement by one or more first-order re-users (that directly work with government open data) (anecdote collection)
	• # interagency round-tables in sectors on solving data/re-use issues (self-reporting)	• # of companies, jobs in 'data economy' (sectoral surveys) (F)
		• #, % of young people seeking employment in data economy (job agency statistics, employment statistics)
Network effects	• % of PSBs/Ministries mapping value chains in various sectors for relevant policy domains (self-reporting, survey)	• # / descriptions of value chains identified where open data is used (deskresearch starting from collected re-use examples) (F)
	• # of PSBs that are nudging parties at the front of such value chains to use open data (self-reporting, survey, desk research of policy plans)	• Economic contribution of specific use cases, based (in-depth micro-economic studies)
		• comparison of SMEs that do/don't use certain open data (micro-economic surveys)

It may not be necessary or desirable to routinely assess all these proposed indicators, but it is strongly advisable to ensure selected indicators are spread out across the various aspects as well as the various types. This makes it possible to perceive a 'funnel' of how measured effects in e.g. data provision, later show up further down in the chain as effects on stakeholder interaction or as ecosystem formation for instance. Over time such 'ripples' should be visible from one step to the next through the value chain. This funnel itself is a vector-style measure of increasing maturity of both the supply and demand side of open data in Serbia.

In terms of measuring progress it is not useful to set target values as such. As this opens up the possibility of declaring things are done because those targets have been met, and cause stakeholders to see the measurements as goal in itself and game the measurements. What is possible is to set milestones (values you want to reach in a certain time), as they seek to influence direction and speed. This requires doing a first measurement for all indicators in use, and then e.g. within the open data working group formulate desired speeds and outcomes.

Working from the starting point that increasing data provision and raising both institutional and external readiness and awareness of the potential are of first importance, a range of likely useful indicators at this stage are marked (F, for first round of indicators) These include the existing W3C barometer elements, as they can be used to gauge whether more detailed indicators in segments of the value chain are becoming opportune. The Open Data Working Group has a key role in establishing the measurement framework as a tool to collectively track open data progress and

impact, as well as in establishing the current measurement values for the first round of indicators (marked F) before tracking them over time, next to inviting others to contribute material or evidence for any of the other indicators. Publishing the framework is useful to invite additional involvement of both government and non-government stakeholders. (See the final recommendation in the next chapter.)



7 Recommendations

General recommendations

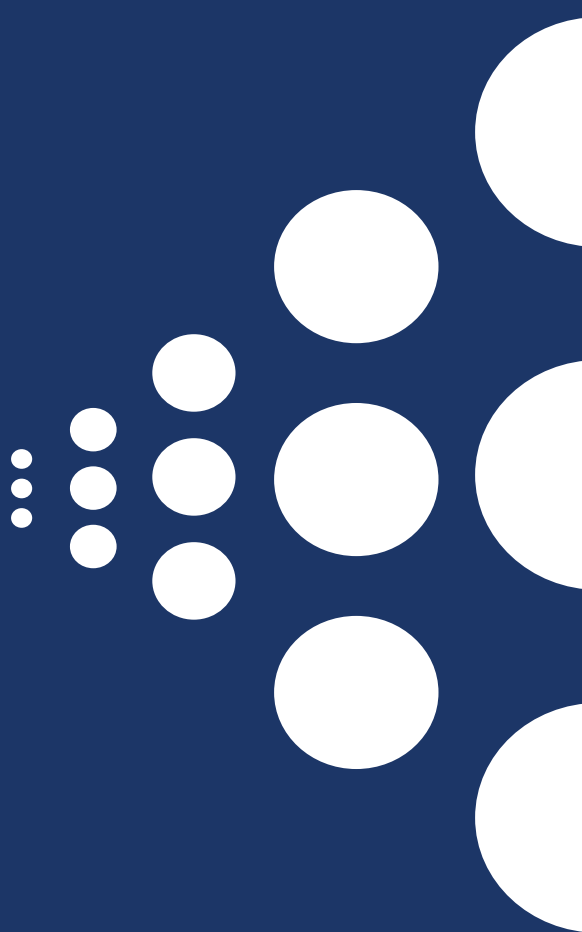
- It makes sense to think of government held data as a key resource (the production of which are sunk costs for the public task, making its further availability free), and making data available as building an infrastructure for Serbian society, with regard to the digital agenda and Serbia's ambitions in a global data economy.
- Improving open data provision (e.g. sustainably publishing core data sets) and increasing overall readiness on both the supply and demand side (e.g. awareness of potential to specific domains, and ability to collaboratively explore that potential) are currently the two main steps to enable impact of open data. Judging by the EU report (Cap C14) and the international indexes these are the prerequisites holding Serbia back the most.
- The overall final situation of open data is 'open by design and default' meaning that every data set that can be made public is actively made public as a routine part of the information processes inside public sector bodies. The transition to this end state can be gradual, by taking a next step every time the opportunity arises (e.g. when processes are changed anyway, new systems procured, new software or websites created). A gradual approach based on internal needs, external demand and technical opportunity also reduces the costs (often to the point where it is indistinguishable from other cost factors).
- Improving open data provision will have the highest impact if it first concerns the base data registers that government holds, which are also central to its own functions: topographic data, addresses, real estate, company register. These are of value across different sectors, and will yield both internal and socio-economic benefits. Core registers may carry fees currently, but revenue losses can be expected to be compensated by additional tax revenue and internal savings fairly quickly. Mapping those current fees and finding ways to address them is an important step in this.
- Additionally, identifying with policy relevant stakeholders which data sets are the most important to a specific policy domain, is useful to decide which data when opened up carries the highest likelihood of creating impact.
- Seeking sustained interaction with policy relevant stakeholders around data provision and data usage, also makes it possible in involving those external stakeholders in creating the needed processes, structures and systems. This in part mitigates the common institutional bottleneck of a lack of IT staff and capabilities.
- Seeing open data as policy instrument, that allows public sector bodies to think about where they would like to see impact, is an important element in making open data a routine part of public sector processes, of internal government data exchanges and of mature high quality data governance. This builds intrinsic motivation for data holders and makes open data normal over time. Where open data remains an additional thing to do next to regular tasks it will likely not become a sustainable and sustained effort, which will hinder socio-economic impact.

- Anticipating and getting out in front of European developments concerning open data and the data economy, by already adopting e.g. the proposed alterations to the EU PSI Directive -such as concerning public enterprises and utilities, research data, and the free availability of high value (base) data sets - or e.g. proposed frameworks concerning cross border data exchange between European countries, or the sharing and protection of healthcare data, will also result in rapidly setting better conditions to realise open data impact. It will also reduce compliance costs, as these are low when changes are anticipated upon and taken into account in regular changes in government processes and investment decisions.
- To ensure such principles and notions are anchored across the Serbian public sector, ensuring all public sector bodies have published inventories, and documented and published open data policies, that address a) open data provision planning (based on internal demand, external demand and current technical viability), b) general data governance, c) using open data as policy instrument, d) stakeholder interaction, e) desired impacts and f) impact assessment plans, is important.
- Through the previous points one can keep open data provision more closely tied to potential usage, as well as the transitional costs of open data provision lower. This in turn improves the ratio of effort versus impact.

Recommendations to track impact

- Determine both centrally as well as at the institutional level what the purpose of measuring impact is. Is it needed to inform specific decisions or discussions, is it to track agreed efforts, to measure progress towards targets or to motivate investment and incurring costs? This in turn determines the type of measurement that can be useful centrally, at the level of institutions, sectors or policy domains.
- Planning for impact measurement should be an integral part of all open data plans and policies at the institutional level.
- As existing conditions determine the currently possible impacts and different institutions and different domains will have differing readiness, a national approach of measuring impact should cover all the different steps from open data provisioning to overall network effects in society. Similarly for each of those steps both lead (are the right things being done) and lag (are those things creating results) indicators are needed.
- Creating a framework of indicators across those steps and dimensions, makes it possible for individual institutions to plan measurements and select indicators from the framework that fit their current overall open data readiness best.
- This framework itself as a whole is an indicator as well, as impacts should 'ripple' over time from one step to the next. This means that over time it would become visible how efforts in one step carry forward as opportunities or preconditions to the next, and how that enables impact further down the value chain.
- Centrally, by using the framework, it will then be possible to ascertain overall impact despite individual institutions being in very different contexts and at very different levels of open data readiness.
- Centrally tracking (or aggregating) a number of lead indicators e.g. concerning data provision, stakeholder interaction, and using open data as policy instrument, can be useful to instill a sense of broader momentum within the public sector, as well a sense of friendly competition.

- Micro-economic studies into the network effects of open data usage are a powerful way to establish impact, and the most direct and detailed type of proof. They do however require that they are done in cases where there is a good indication that there is sustained re-use, as there needs to have been time for network effects to occur, in order to be able to track them. Doing these studies is time intensive. Selecting promising use cases, and then doing e.g. one or perhaps more studies per year, are most likely to be possible around high value data sets and in priority policy domains.
- The existing Open Data Working Group has a role in centrally establishing and publishing examples or standard templates for open data policy plans, for how to conduct surveys amongst external stakeholders by data holders, and for how to deploy other types of measurement, or organise stakeholder interaction.
- Indicators in existing external methodologies to assess readiness and impact, such as the W3C Open Data Barometer, and the Global Index by Open Knowledge International, as well as the regular reports by the EU Data Portal team which includes the EU Accession countries, are suggested to be used as part of the measurement framework. This allows for easier international comparison while not requiring additional efforts. When new international indexes or rankings appear, it is useful to see which of the indicators included in them are useful to adopt in the framework for measurement.
- As Serbian public sector data holders become more mature in the earliest steps in the measurement framework, it will become possible to drop the corresponding lead indicators from the framework. It is advisable to up-front determine at which point an indicator loses its usefulness to the framework. This might be done by e.g. setting criteria for when the transition to open data is deemed to be finished.
- The open data working group, as a first step, plays a central role in establishing the measurement framework. It is advised to publish the framework, with a general invitation for others to contribute material for one or more indicators, which might be linked to from the published framework. The working group itself is well situated to formulate milestones and measure the current starting values of the first round of indicators (marked F), and publish these. This also makes the measurement framework a tool for self-assessment in moving open data forward, and prevents it being seen as an external 'exam' for which a sufficient mark needs to be scored.



Annex A

List of included studies, articles and cases by year

2008

- Models of Public Sector Information Provision via Trading Funds, Newbury, Bently and Pollock
- Does Transparency Pay?, Glennerster and Shin, IMF Staff Papers Vol. 55, No 1.

2009

- The Economics of Public Sector Information, Rufus Pollock

2010

- The Value of Danish Address Data, Danish Enterprise and Construction Authority

2011

- Pricing of Public Sector Information (POPSIS), Deloitte et al
- Review of Recent Studies on PSI Re-Use and Related Market Developments, [illegible]
- Does Marginal Cost Pricing of Public Sector Information Spur Firm Gro[illegible]h?, Koski (ETLA)
- Estudio de Caracterization del Sector Infomediario, Spanish Minist. y for Indu[illegible] Tou[illegible] Trade
- PSI in European Meteorology - an Unfulfilled Potential, Pettifer
- Case Spanish Cadastre, Koski
- Case Austrian Geographic Data, Koski
- Case Australian GeographicData, in Costs and Benefits of Data Provision - Report to t Australian National Data Service, Houghton (Victoria University)
- Pricing of PSI in the Meteorological Sector Blocks Market Development, Pettifer
- Case Norwegian Meteorological Service, Deloitte
- Case Dutch Meteorological Service, Deloitte
- Case Australian Statistics, in Costs and Benefits of Data Provision - Report to the Australian National Data Service, Houghton (Victoria University)
- Case Australian Hydrological Data, in Costs and Benefits of Data Provision - Report to the Australian National Data Service, Houghton (Victoria University)

2012

- About GMES and Data: Geese and Golden Eggs, A Study on the Economic Benefits of a Free and Open Data Policy for GMES Sentinels Data, Sawyer en De Vries
- Characterization Study of the Infomediary Sector 2012 Edition, Spanish Ministry for Industry, Tourism and Trade
- Case Prescribing Analytics, UK
- Case MRSA Hospital Infections, NHS, UK
- Good Basic Data For Everyone, Danish Digitization Agency within the Ministry of Finance

2013

- Open Data: Unlocking Innovation and Performance with Liquid Information, McKinsey
- Understanding the Impact of Releasing and Re-Using Open Government Data, Granickas, ePSIplatform Topic Report 2013/08
- Open Data Policies, Their Implementation and Impact: A Framework for Comparison, Zuiderwijk en Janssen, TU Delft, Government Information Quarterly 31
- Assessing the Value of Ordnance Survey OpenData to the Economy of Great Britain, Britse Ordnance Survey
- Case Society for Cardiothoracic Surgery, UK
- Shakespeare Review, UK
- Market Assessment of Public Sector Information, Deloitte, British Department for Business Innovation and Skills

2014

- What Does It Cost? - Research into the incremental costs of open data, De Vries, Dutch Ministry for Interior Affairs and Kingdom Relationships
- The Impact of an Open Base Register Topography After Two Years, Brengt, Grus en Eertink, Wageningen University and Dutch Cadastre
- Infomediary Sector Report 2014, Spanish Associacion Multisectoral de la Informacion

2015

- Open Data Challenge Series Final Report, PwC, NESTA, Open Data Institute
- The Value of Open Data, a Swedish Case Study of Healthcare Data, Larsson
- Copernicus Sentinels Products Economic Value: A case study of winter navigation in the Baltic, Sawyer and De Vries, European Space Agency
- Creating Value Through Open Data, European Commission / CapGemini
- The Impact of Open Data, Koski, Finnish Ministry of Finance
- Open Data Maturity in Europe 2015, European Open Data Portal

2016

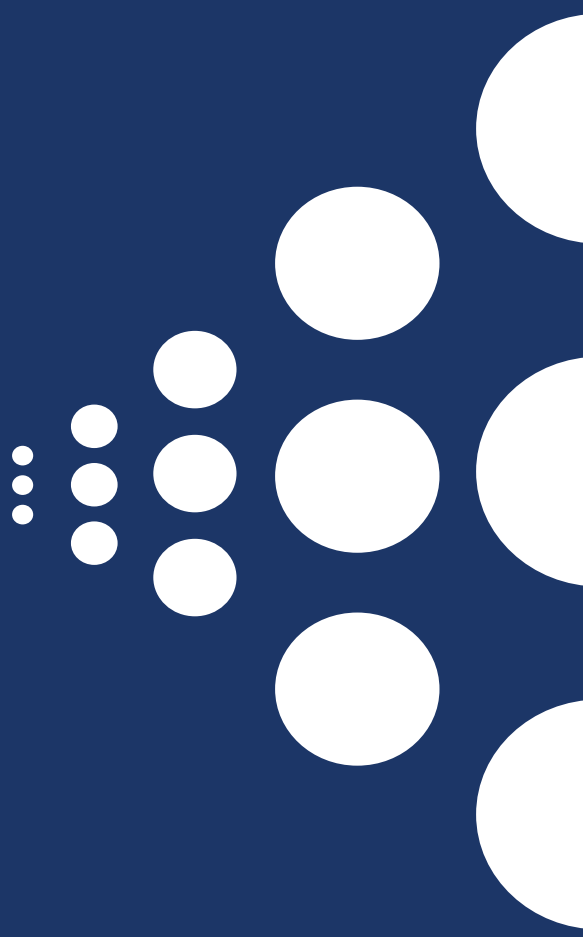
- Copernicus Sentinels Products Economic Value: A case study of forestry management in Sweden, Sawyer and De Vries, European Space Agency
- Copernicus Sentinels Products Economic Value: A case study of pipeline infrastructure monitoring in the Netherlands, Sawyer and De Vries, European Space Agency
- Open Data Maturity in Europe 2016, European Open Data Portal
- Open Data Trend Report 2016, Supreme Audit Authority Netherlands

2017

- Open Data Maturity in Europe 2017, European Open Data Portal
- The impact of the open geographical data - follow up study, Danish Agency for Data Supply and Efficiency/PWC

2018

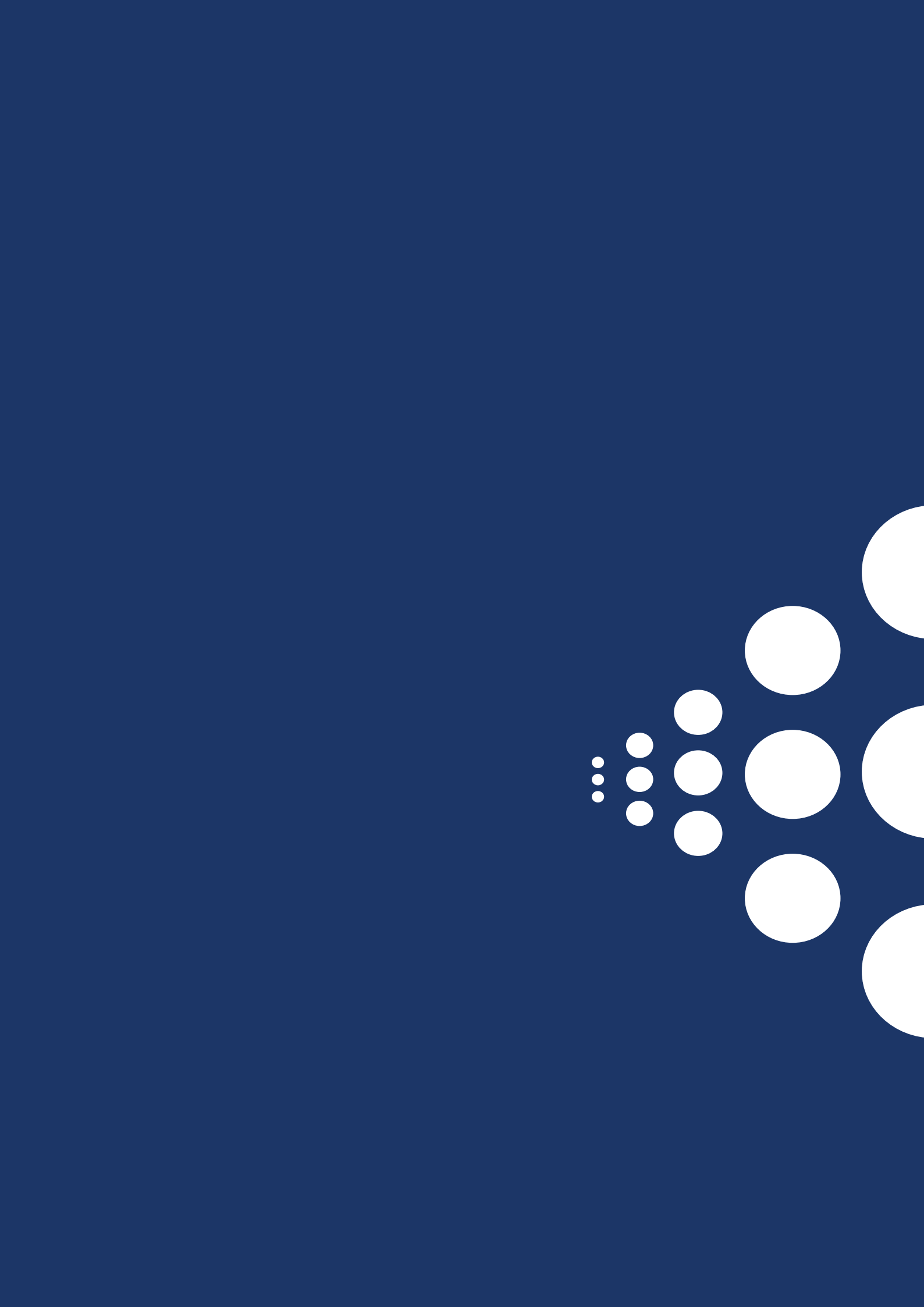
- Copernicus Sentinels Products Economic Value: A case study of Farm Management Support in Denmark, Sawyer Khabarov, and De Vries, European Space Agency



Annex B

Overview of Interviewees and Dates

INSTITUTION	DATE
Geodetic Authority	23-May-2018
Ministry of Justice	1-June-2018
Statistical Agency	1-June-2018
Ministry of Education, Science, and Technology	13-June-2018
Ministry of Agriculture - FADN & STIPS databases	21-June-2018
Ministry of Agriculture - Animal Safety / Veterinary Department	19-June-2018
Institute of Public Health of Serbia - "Dr. Milan Jovanović Batut"	18-June-2018
National Health Insurance Fund (RFZO)	6-Aug-2018



Annex C

Summarised results of included studies, articles and cases

For each of the research and cases taken into account the primary and most relevant results are listed below.

General and broadly oriented research

Name (country) **Models of Public Sector Information Provision via Trading Funds (UK)**	
Context	Assignment by the British Department for Business Enterprise and Regulatory Reform, and the British Treasury, by Newbury et al. Uses a mathematical analysis to look at the impact of making base registers available for re-use at marginal costs at most. Experiences of agencies already having taken such steps have been incorporated.
Outcomes	Providing access for re-use to base registers against at most marginal costs creates general and convincing socio-economic benefits. • Price-elasticity is higher than 1 (meaning when prices are lowered demand rises non-linearly) • On average it takes 18 months before such positive effects become visible. • Per data holder the net socio-economic benefits range from 0.5 to 4.5 million Euro, with the Ordnance Survey as outlier at 194 million Euro. • Loss of revenues from data sets currently being sold can partly be compensated by adapting existing registration fees, but otherwise need to be compensated from the general budget.
Data domain(s)	Company register, geographic data, meteorological data, hydrological data, vehicle registrations, cadastral data.
Years covered	1996-2008
Year of publication	2008
Source(s)	http://www.berr.gov.uk/files/file45136.pdf

Name (country) The Economics of Public Sector Information (UK)	
Context	By Rufus Pollock. Uses mathematical analysis to determine who should bear the costs of data provisioning, and what regulation is warranted. Looks at large and structured datasets, and assumes marginal costs being zero or close to zero when dealing with digital data. Transaction costs and costs of change management have not been taken into account in the impact assessment.
Outcomes	Providing important data registers against marginal costs at mosts, is effective, if supported by pertinent regulations. • Price elasticity is above 1 (although the evidence provided in this study is thin) • Marginal costing is the optimal solution where price elasticity is above 1. • Arguments in favour of marginal costing are lower market deformations, higher demand, increased competition, and that government bears the fixed costs anyway so the public should be able to make the most use possible of that. • Data holders should be subject to independent and transparant regulation to prevent issues concerning market deformation or budget changes.
Data domain(s)	General
Years covered	
Year of publication	2009
Source(s)	http://www.econ.cam.ac.uk/dae/repec/cam/pdf/cwpe0920.pdf

Name (country) Review of Recent Studies on PSI Re-Use and Relate Market Developments (European Union)	
Context	By Graham Vickery. At the request of the European Commission, as part of the impact assessment of the first EU PSI Directive. Looks at the impact of the adoption of the PSI Directive in 2006, and extrapolates sectoral and national impact research to estimates for the entire EU, based on GDP and ICT expenditures.
Outcomes	A large untapped potential resides in public sector information. • The direct economic benefit of open data is 40 billion Euro in the EU. • The indirect economic benefit is some 140 billion Euro in the EU. • The socio-economic benefits of moving to a free at point of re-use or marginal costing model are about 40 billion Euro in the EU. • The EU market for government data in 2010 is about 32 billion Euro • Costs savings by making data available related to environmental impact assessments potentially amount to 2 billion Euro in the EU. • Annually returning benefits of more accessible research data amount to about 6 billion Euro in the EU.
Data domain(s)	General
Years covered	2006-2010
Year of publication	2011
Source(s)	https://ec.europa.eu/digital-agenda/en/news/review-recent-studies-psi-reuse-and-related-market-developments

Name (country) Pricing of Public Sector Information Study, POPSIS (EU)	
Context	By Deloitte et al. At the request of the European Commission, as part of the impact assessment of the first EU PSI Directive. Looks at provision and pricing models, and the effects of changes in charging levels. Based on 21 separate cases.
Outcomes	The cases provide support that marginal costs for data provisioning yield the highest benefits. • There is an EU wide trend towards marginal costing models and the stimulation of re-use. • Data holders that use a full cost pricing model are barely able to demonstrate how they establish those costs. • The revenue of selling data are very low in comparison to the overall budget of a data holder, usually below 1% • Where a data holder moves towards data provision for free or at marginal cost, the number of users rises 10-100 times, demand 70 times, without the costs for the data holder rising. • Price elasticity is above 1 (meaning price decrease result in non-lineair growth in demand) • The quality of data increases with rising re-use, because of receiving feedback from users.
Data domain(s)	General
Years covered	2006 -2011
Year of publication	2011
Source(s)	http://ec.europa.eu/information_society/policy/psi/docs/pdfs/report/11_2012/models.pdf

Name (country) Re-use of PSI in Spain (Spain)	
Context	Research from 2011 and 2012 by the Spanish Ministry for Industry, Tourism and Trade, and from 2014 by the sectoral association ASEDIE, into the size of the infomediary sector, and the importance of re-use of government data.
Outcomes	• In 2010 turnover in the infomediary sector as a result of open data re-use was 600 million Euro in Spain, delivering 5000 jobs. • Open data was the source of 35-40% of turnover for the companies working with open data. • In 2011 lower numbers were found, 360-550 million and max 440 jobs respectively. • The 2014 report assigns 1.1 billion Euro turnover to the entire infomediary sector in 2012. This is consistent with the lower end estimate of the open data related turnover in 2011. • The for re-use most important data domains were geographic data (used by 51% of responding companies), company register data (47%), statistics and demographics (30%), laws and jurisprudence (28%), meteorological data (13%), transport data (13%), cultural data (10%).
Data domain(s)	General
Years covered	2010-2014
Year of publication	2011, 2012, 2014
Source(s)	http://datos.gob.es/saber-mas/Estudios/estudio_caracterizacion_2011 http://datos.gob.es/sites/default/files/files/Estudio_infomediario/121001%20RED%20007%20Final%20Report_2012%20Edition_vF_en.pdf http://www.asedie.es/assets/asedie-infomediary-sector-report-2014.pdf

Name (country) Open Data Policies, their implementation and impact (Netherlands)	
Context	This article by Anneke Zuiderwijk and Marijn Janssen (Technical University Delft) looks at existing open data policies of various national and lower level government entities, to arrive at a framework that allows for comparison.
Outcomes	• Open data policy plans are mostly internally oriented. • Sharing lessons learned as well as facilities helps reduce the effort and cost of formulating and implementing open data policies. • Data-publishing government entities should base their open data policies on desired impacts, and continuously adapt it based on changing data production, distribution and re-use. • Stimulating re-use of data should be part of any open data policy plan, as a crucial element to arrive at impact. • A culture in which data provision is the default norm, and open data policy a regular part of information processes is desired to realise the full benefit and impact on economic growth, innovation and transparency.
Data domain(s)	General
Years covered	
Year of publication	2013
Source(s)	http://www.sciencedirect.com/science/article/pii/S0740624X13001202

Name (country) Understanding the Impact of Releasing and Re-Using Open Government Data (EU)	
Context	A 'topic report' by the ePSIplatform, the precursor of the EU wide open data platform, where the European Commission shared knowledge, news and events relating to open data.
Outcomes	• Focuses on how to measure impact • Underlines the importance of measuring impact per sector and country. • Stresses the importance of interaction between data holders and re-users to balance provision and demand. • Calls for active monitoring of open data policies, in connection with impact measurement.
Data domain(s)	General
Years covered	
Year of publication	2013
Source(s)	http://www.epsiplatform.eu/sites/default/files/2013-08-Open_Data_Impact.pdf

Name (country) Open Data: Unlocking innovation and performance with liquid information (global)	
Context	Large scale report by McKinsey about the economic potential of data and open data in seven sectors: education, transport, consumer products, electricity, oil and gas, healthcare and financial consumer products. Contains macro-economic estimates.
Outcomes	• Estimates the total economic potential at over 3 trillion US dollar.(education 890-1200 billion, transport 720-920 billion, consumer products 520-1500 billion, electricity 340-580 billion, oil and gas 240-510 billion, healthcare 300-540 billion in the USA alone, and financial products for consumers 210-280 billion) • Does mention social impact potential, but does not consider it nor tries to quantify it. • The European share would be an estimated 900 billion dollar. • Opening up data is not sufficient, and active network and ecosystem of users is need, next to policy that continuously balances personal data protection and public availability. Investments in technology needed for sharing and using data is deemed needed. • Governments need to set the tone and pace for open data, both by publishing data as well as by shaping policy and legal frameworks. • Prioritising based on potential is needed.
Data domain(s)	General
Years covered	
Year of publication	2013
Source(s)	http://www.mckinsey.com/insights/business_technology/open_data_unlocking_innovation_and_performance_with_liquid_information

Name (country) **Market Assessment of Public Sector Information (UK)**	
Context	An exploration of the British re-use market in 2011/2012 by Deloitte as part of the Shakespeare Review, by request of the British Department for Business Innovation and Skills. Uses a macro-economic approach, partly based on cases.
Outcomes	• Estimates the direct value of re-use for consumers, businesses and the public sector itself in 2011/2012 at 1,8 billion pounds. • Says there is a much bigger second and higher-order impact in all sectors of society. This downstream impact amounts to millions and sometimes billions in the cases taken into account. Based on the cases the report makes a conservative estimate of this downstream value in 2011/2012 of over 5 billion pounds, which amounts to a factor 2 to 3 more than the direct economic value. • Points to geographic data, environmental data, transport data, healthcare data, and economic data as the most re-used data. • Points to the building and real estate sectors, the financial services and insurance sector, government, as well as arts and recreation sector as the most heavy re-users of data. • Shows selling data as an obstacle in realising re-use and impact, as well as fragmented data provision.
Data domain(s)	General
Years covered	
Year of publication	2013
Source(s)	https://www.gov.uk/government/publications/public-sector-information-market-assessment

Name (country) Shakespeare Review (UK)	
Context	Builds on the exploration of the UK re-use market in 2011/2012 by Deloitte. The Shakespeare Review, requested by the British Department for Business Innovation and Skills, describes the current situation of open data in the UK in 2012, and gives recommendations for improvement. Takes a macro-economic approach.
Outcomes	• Progress of open data in the UK, despite strong ambition and efforts has been slower than expected • Says increasing the impact of open data in the UK does not depend on more investments or more complicated regulations, but on broadening scope and goals, en better planning and monitoring. • Says that on principle publicly financed data should be available to the public. • Advises a clear and measurable plan for data publishing along two lines: a broad track to publish as much data as possible as quickly as possible, regardless of quality, and a system of national core reference data, where quality is guaranteed from the start. • Every data holder should publicly commit to publication targets. Clear and transparent should at the very least be which data a data holder has. • Not publishing data is of less value than publishing data of less or uncertain quality.
Data domain(s)	General
Years covered	
Year of publication	2013
Source(s)	https://www.gov.uk/government/publications/shakespeare-review-of-public-sector-information

Name (country) How much is it? (Netherlands)	
Context	Research by Marc de Vries for the Dutch Ministry for Interior Affairs and Kingdom Relationships, into the costs of moving towards an open data policy for data holders. Based on 5 cases of various Dutch government data holders.
Outcomes	• The costs of open data infrastructure for a dataholder are very limited. • Transition costs mostly concern freeing up time, up to 1 FTE. This is the main component of the overall costs of doing open data • After the transition costs the returning maintenance costs are small (up to 15.00 Euro per year) • These low costs are not an obstacle to doing open data • Government entities for which data provision is a core professional and public task usually already have the infrastructure to be able to publish open data in place. • These government entities have as the most important obstacle a possible exploitation issue if they currently sell access to data, despite open data being rational at the macro-economic level. The benefits of open data accrue with the tax office, whereas current revenue a data holder enjoys disappears. The solution lies in a more balanced division of costs and benefits, and transition-financing. • Government entities for which data provision is not a core public task (such as municipalities) have a key challenge in sustainably embedding open data efforts in their internal processes. All too often open data efforts are dependent on a single civil servant, or a small team, without open data policy being part of the responsibilities of e.g. the CIO. • When open data efforts converge with existing public tasks of data holders, it is no longer possible to make a meaningful difference between the costs of open data efforts and other operational costs. Where open data is an integrated part of internal processes, the discernible costs of open data is zero. • Advises to track costs and benefits more structurally. Benefits are much harder to track, and should incorporate looking at network effects.
Data domain(s)	General
Years covered	
Year of publication	2014
Source(s)	https://data.overheid.nl/sites/default/files/Wah%20kos'dah%20dan%20-%20onderzoek%20naar%20incrementele%20kosten%20van%20aan%20Open%20Data%20doen.pdf

Name (country) The Impact of Open Data, a preliminary study (Finland)	
Context	Exploration by Heli Koski for the Finnish Ministry of Finance into the possible ways of measuring the impact of open data.
Outcomes	• Summarizes the results of earlier (European) research • Points to the lack of ex-post measurements of open data impact at national level. (Only ex-post micro-economic studies on case level are currently available) • States there is need of systematically collecting data for impact assessments. In combination with a well thought through model to measure progress in open data provisioning. • Suggest to directly approach re-users to ask about usability and value of open data. This might also lead to finding 'good practice' examples to be further disseminated, with the aim to increase open data impact.
Data domain(s)	General
Years covered	
Year of publication	2015
Source(s)	http://vm.fi/documents/10623/1107406/The+Impact+of+Open+Data/1c432b3a-a5e8-41ea-a5ea-135280a69ea3?version=1.0

Name (country) Open Data Challenge Series, Final Report (UK)	
Context	End report of the open data challenge series, where the British NESTA and The Open Data Institute, have asked PwC to look at the expected economic value of providing support to 18 open data start-ups.
Outcomes	• Says the employment impact for the 7 winning start-ups is 75 to 141 full time positions (depending on the number of surviving start-ups, with a minimal assumed failure rate of 40%) • Direct economic added value is 5 to 11 million pound • Indirect impact value is 161 to 302 million pound • Environmental beneficial impact valued at 3,3 to 5,6 million pound • For every pound invested in supporting these start-ups the return over 3 years is a factor of 5 to 11.
Data domain(s)	General
Years covered	2014-2017
Year of publication	2015
Source(s)	http://opendatachallenges.org/wp-content/uploads/2015/10/Nesta-Final-report-26.10.15.pdf

Name (country) Creating Value Through Open Data (European Union)	
Context	Macro-economic research into the economic potential of open data in the EU for 2016-2020, building on the Vickery study from 2011. Undertaken as part of the launch of the pan-European open data portal by CapGemini for the European Commission.
Outcomes	• Predicts that the direct economic value of open data will be 75.7 billion Euro in 2020, a 37% growth compared to 2015. The cumulative value over 2016-2020 is predicted as 325 billion Euro • Predicts 75.000 jobs in open data in 2016, and 25.000 new jobs until 2020 in the EU.. • Predicts public sector savings in the EU of 1.7 billion in 2020. • The indirect value of open data in the EU is estimated at 193 to 209 billion Euro per year in 2015, growing to 265-286 billion Euro in 2020. • The cumulative value of both direct and indirect open data in the EU in the period 2016-2020 would then be estimated at 1,1 to 2,2 trillion Euro. • The public sector itself sees the largest direct impact of open data, predicted to be 22 billion Euro in 2020 in the EU. • For commercial usage of open data the domains of most interest are (ordered from more to less important): geographic data, meteorological and environmental data, economic and company data, social and healthcare data, traffic and transport data, tourism and recreation data, agricultural forestry and fishing data, natural resources, laws and regulations, scientific research data, educational materials, political information, cultural material. • Most widely usable (across multiple economic sectors) are data on geography, environment, economy, transport, energy and natural resources, demographics, agriculture, companies, planning, crime, healthcare, social and welfare services, art sports and culture public health, education, housing, labour market.
Data domain(s)	General
Years covered	2016-2020
Year of publication	2015
Source(s)	http://www.europeandataportal.eu/sites/default/files/edp_creating_value_through_open_data_0.pdf

Name (country) **Open Data Trend Report 2016 (Netherlands)**	
Context	Third and final edition of a yearly report by the Dutch supreme audit authority, looking at the progress of Dutch Ministries concerning open data and making international comparisons.
Outcomes	• Notices lots of unrealised potential, in terms of open data releases • Calls for a more structural approach in terms of a national open data infrastructure, to realise potential. • Calls for more mandatory as well as voluntary national coordination.
Data domain(s)	General
Years covered	2016-2020
Year of publication	2017
Source(s)	https://www.europeandataportal.eu/sites/default/files/edp_landscaping_insight_report_n3_2017.pdf

Name (country) **Open Data Maturity in Europe 2017 (European Union)**	
Context	Yearly EU Data Portal Study into the EU open data maturity, done by CapGemini. Edition 2017, building on editions of 2015 and 2016.
Outcomes	• Shows that more EU MS are increasingly running mature open data efforts. • Depending on removing more obstacles for data mobility, the growth potential for the general data economy is 4% of EU GDP by 2020. • Some 325 billion Euro, is the potential contribution of open data 2016-2020, with 30.000 new jobs created in 2020, and government costs savings 1.7 billion Euro across the EU. These figures are not significantly altered from the 2015/2016 editions. • Notes the encouraging signs of open data efforts by EU accession countries. • Notes a lack of new studies into macro- and micro- economic impact of open data after 2015.
Data domain(s)	General
Years covered	2016-2020
Year of publication	2017
Source(s)	https://www.europeandataportal.eu/sites/default/files/edp_landscaping_insight_report_n3_2017.pdf

Studies concerning core government registers

Name (country) The Value of Danish Address Data (Denmark)	
Context	The Danish government made the central address register publicly available free of charge in 2002. At the same time it became a compulsory authentic data source for all Danish public sector bodies. In 2010 an evaluation was carried out concerning effects, costs and benefits.
Outcomes	• Over the period 2002-2009 the costs of making the address dat available were 2 million Euro. • Over the period 2005-2009 the direct societal benefits were 63 million Euro, of which 5 million Euro in costs savings on overhead costs for both re-users as well as local governments who no longer needed to negotiate data provision contracts. • In 2010 the costs of data provision were 200.000 Euro, whereas directly generated benefits amounted to 14 million Euro, a growth of 10% compared to 2009. This constitutes an ROI of 70:1. • In 2010 about 1200 private companies used the address data in bulk directly from the source. Of these companies 1% had over 1 million end-users for that data. • 70% of re-users of the address data are companies, 20% national and regional governments, 10% local governments. • Indirectly generated value (such as through the use of addresses in GPS navigation systems, or costs savings from no longer collecting data in multiple locations was not taken into account.
Data domain(s)	Adresses and buildings (authentic source)
Years covered	2002-2010
Year of publication	2010
Source(s)	http://www.adresse-info.dk/Portals/2/Benefit/Value_Assessment_Danish_Address_Data_UK_2010-07-07b.pdf

Name (country) Good Basic Data for Everyone - a Driver for Growth and Efficiency (Denmark)	
Context	In 2012 the Danish central government published a road map to create a connected system of basic government data sources (individuals, companies, real estate, addresses/buildings, roads and area demarcations, topography). These data sources are collected, used and maintained by all public sector bodies collectively, and usage is compulsory for all public entities. At the same time all non person related data is meant to be published as open data for free of charge re-use by anyone.
Outcomes	• After 2 years the government internal benefits are larger than the costs of creating the system of basic data sources. • After 4 years the transition costs are completely compensated by the government internal benefits. • From 2017 there is a net costs savings within government of 28-34 million Euro per year. • In year 1 the value to the private sector is 27 million Euro, rising to 70 million Euro in 2017. • If the direct economic impact value is taken into account, there is a net positive benefit from year 1. • Benefits are found in better and faster public service delivery (provide once, less mistakes, pre-filled forms), less bureaucratie hurdles for companies, new services and products, better public-private collaboration, and improved data governance for government (less manual work, error rate reduction, faster processes, less sensitive to fraud)
Data domain(s)	individuals, companies, real estate, addresses/buildings, roads and area demarcations, topography (so-called base registers)
Years covered	2012-2020
Year of publication	2012
Source(s)	http://www.epsiplatform.eu/content/danish-basic-registries-roadmap

Research related to geodata

Name (country) Does Marginal Cost Pricing of PSI Spur Firm Growth (Finland, European Union)	
Context	Broadly scoped research, encompassing 14.000 companies in 15 countries by Koski, of ETLA, the research institute for the Finnish economy. The study analysed the consequences of changes in fees for access to geo data from government sources, for companies in the sectors of architecture, engineering and technical consultancy.
Outcomes	• The average annual growth of small and medium sized enterprises (SME's) was 15% higher for companies who had access to geo data for free or at most marginal costs. • SMEs saw the biggest impact of accessible geo-data on the increase of sales. For large enterprises the impact was not significant. • Average sales growth in the first year of access was 7%, 19% in the second year.
Data domain(s)	Geo-data
Years covered	2000-2007
Year of publication	2011
Source(s)	http://www.etla.fi/files/2696_no_1260.pdf

Name (country) **Austrian Geographic Data Case (Austria)**	
Context	Case from the aforementioned Koski study (ETLA) and POPSIS study. In 2006 the Austrian data holder reduced the fee for data provision to marginal costs, resulting in a 97% reduction of costs for re-users.
Outcomes	• Price elasticity well above 1, because of which turnover increased in the face of reduced prices. • Sales of various data products grew by a factor 2 (for cartographic material) to a factor 70 (for ortho-photos). • New demand for data came mainly from small and medium sized enterprises. • 46% turnover growth. • Growing international demand for the data, as well as a strong growth in demand for geo-marketing, location based services, and health care services. • Stabilisation of demand in 2011, but the number of customers, both domestic and international, keeps growing.
Data domain(s)	Geo-data
Years covered	2000-2007
Year of publication	2011
Source(s)	http://www.etla.fi/files/2696_no_1260.pdf http://ec.europa.eu/information_society/policy/psi/docs/pdfs/report/11_2012/summary.pdf

Name (country) Australian Spatial Data Case (Australia)	
Context	Case from the study Costs and Benefits of Data Provision - Report to the Australian National Data Service, by Houghton / Victoria University. Looks at the impact of making geo-data free at the point of provision.
Outcomes	• Convincing societal effects of free re-use. • Free re-use led to a costs saving by the data holder of 17-33% of the previously generated turnover, because of transaction costs falling away, and led to 1.7 million AUSD yearly cost savings on transaction costs for re-users. • Net economic value in 2009 amount to about 4,7 million AUSD. Data production costs were 13,3 million, the value to the public sector was 10 million and 8 million to private sector re-users (10+8-13,3=4,7) • Average socio-economic impact estimated at 25 million AUSD per year after making data provision free of charge. • Demand elasticity higher than 1, with a 172% yearly increase in demand..
Data domain(s)	Geo-data
Years covered	2002-2010
Year of publication	2011
Source(s)	http://ands.org.au/resource/houghton-cost-benefit-study.pdf http://www.crcsi.com.au/Documents/ANZLIC-Economic-Study---Stage-2-Report.aspx

Name (country) About GMES and Data: Geese and Golden Eggs (European Union)	
Context	Study into the economic sustainability of providing EU Sentinel satellite data as open data by ESA, authored by Sawyer and De Vries.
Outcomes	• Marginal costing or free provision are the logical economic choices for providing satellite data: demand rises non-lineairly when fees for data are reduced that way. • Similar steps in the USA led to a 100-fold increase in demand for data. • Data provision at marginal or no costs initially may mean less revenue, but increased demand. First positive effects then will be visible with companies directly using the data, where new tax revenue is created which does not yet compensate the loss of revenue. After that a wider effect occurs in terms of employment and socio-economic impact, resulting in new tax revenue that does exceed the loss of revenue. In total this means that after a few years it is a net gain for government. • In 2012 in the Netherlands, anticipating the free provision of Sentinel data, the government preemptively released the satellite data they already normally procured as open data. Sweden made a siimilar move earlier, and saw demand grow by well over a factor 100.
Data domain(s)	Geo-data
Years covered	2002-2010
Year of publication	2011
Source(s)	http://www.esa.int/Our_Activities/Observing_the_Earth/Copernicus/GMES_and_data_like_geese_and_golden_eggs

Name (country) Case Spanish Cadastre (Spain)	
Context	Case from the Koski (ETLA) study into the impact of marginal costing on re-use. In 2003 the Spanish Cadastre started with increasing their provisioning of geographic data. From 2004 free access was available for non-commercial usage. The Cadastre held regular training session to encourage re-use.
Outcomes	• Increase in data access, a 25-fold increase in 2010, compared to 2004. • Citizens save between 8-15 million Euro per year by having digital access • The number of companies using the data increased 15-fold, data downloads increased 20-fold, and downloads of cadastral maps increased 80-fold. • Increase in non-traditional re-users, such as a company seeking to focus marketing specifically on pool owners, using geodata for better targeting.
Data domain(s)	Geo-data
Years covered	2004-2010
Year of publication	2011
Source(s)	http://www.etla.fi/files/2696_no_1260.pdf http://ec.europa.eu/information_society/policy/psi/docs/pdfs/report/11_2012/summary.pdf

Name (country) **Assessing the Value of OS Open Data to the Economy of Great Britain (UK)**	
Context	Study by the British Department of Business, Innovation and Skills, into the predicted economic effects of providing open geographic data.
Outcomes	• The increase in GDP in 2016 by the Ordnance Survey Open Data Iniitative estimated at 13 to 29 million GBP, resulting in 4,4 tot 8,3 million GBP additional tax revenues. • The increase in effective spendable income in British society estimated at 10 to 24 million GBP in 2016. • Free data provision eens as part of a much wider policy to take at most marginal costs as norm. • Posits the need for Ordnance Survey to be sustainably financed from the general budget, using part of the increased tax revenues to offset loss of revenue from data sales.
Data domain(s)	Geo-data
Years covered	2013-2016
Year of publication	2013
Source(s)	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/207692/bis-13-950-assessing-value-of-opendata-to-economy-of-great-britain.pdf

Name (country) What are the effects of an open base register after 2 years? (Netherlands)	
Context	Study by Wageningen University and the Dutch Cadastre. Early 2012 the topographic base register (BRT) was released as open data. The study maps several effects. It does not calculate the created value from re-use but uses the amount of time and effort re-users invest into the data as a proxy. It also takes into account the interaction between the data holder and re-users, and the internal impact at the Cadastre itself.
Outcomes	• The number of re-users increased 5-fold. • Re-use by companies grew from 17% of the total in 2012 to 41% in 2014. • Re-use by private individuals rose from 3% of the total in 2012 to 22% in 2014 gestegen. • Time and effort spent by re-users on working with the BRT in 2013 estimated at 11,5 to 14,5 million Euro.. • Over 50% of public sector entities that use the BRT, indicated that its open data reduced their costs for acquiring, using and maintaining data.. • Environment, soil, nature and spatial planning are the most important areas of application. • Private re-users mostly used the BRT to be able to combine other data sets. • A fifth of re-users indicated that the data was being used for cultural and creative applications, a surprise to the data holder. • 39% of re-users does this as part of product and service delivery for third parties. • The Cadastre saw client questions become more focused and of higher quality. • The loss of revenue by the Cadastre amounts to about half a million Euro. The time and capacity invested by re-users is a 18-29 times higher.
Data domain(s)	Geo-data
Years covered	2012-2014
Year of publication	2014
Source(s)	http://www.kadaster.nl/web/artikel/download/Effecten-van-een-open-BRT-analyse-2014.htm

Name (country) Copernicus Sentinels Products Economic Value: case Winter Navigation in the Baltic (Finland)	
Context	Study by Sawyer and De Vries for ESA. A micro-economic impact study on the usage of satellite data by ice breakers in the Botnian Gulf..
Outcomes	• The usage of satellite data by Finnish and Swedish ice breakers creates a direct economic value between 24 and 116 million Euro per year. • Direct impact occurs in each step of the value chain: cost savings for the ice breaker, the ships, harbours, retail and logistics, consumers. • Micro-economic studies provide a more complete picture and better insights than (often predictive) macro-economic studies.
Data domain(s)	Geo-data
Years covered	2004-2015
Year of publication	2015
Source(s)	https://www.scribd.com/doc/286030736/Winter-Navigation-in-the-Baltic

Name (country) The impact of the open geographical data - follow up study (Denmark)	
Context	Study looking at the impact of the release of open geographic data in Denmark 2012-2016. As part of the 'Good basic data for everyone' roadmap 2011-2015, Danish geodata was released as open data at the beginning of 2013. Done by the Danish Agency for Data Supply and Efficiency and Pwc.
Outcomes	• Based on self-reporting by organisations, in this sense provides a minimum generated value through aggregation from those reports. • Looks at two factors of value both in the public and private sector: the production effects, where the open data is used for activities, products and services, and efficiency effects. • Shows a total reported impact 475 million Euro in 2016, of which 341 million Euro in production effects and 134 million Euro in efficiency effects. • Sees the strongest production effects for local governments (geodata is part of the base register program after all) at about 54% of the total, and strongest efficiency gains for private enterprises at about 73% of total.
Data domain(s)	Geodata
Years covered	2012-2016
Year of publication	2017
Source(s)	https://sdfe.dk/media/2917052/20170317-the-impact-of-the-open-geographical-data-management-summary-version-13-pwc-qrvkvdr.pdf

Meteorological data related studies

Name (country) PSI in European Meteorology - an Unfulfilled Potential (EU)	
Context	Study by Pettifer, chairman Association of Private Meteorological Services (PRIMET). Provides insight how metrodata is being exploited in Europe (mostly based on cost recovery pricing) and into how the entire market and its growth compares to the US market where this data is freely available.
Outcomes	• Cost recovery based charging appears to cause market deformation: • National metro-data holders are monopolistic sellers of data, to re-users with whom they also compete on services. • With complex and limiting licensing frameworks. • Cost recovery based pricing can raise prices beyond the point that makes commercial re-use viable, while that data is free for the data holder's own commercial services. • Switching to an at most marginal cost regime would allow the EU market to grow to 1.4 billion Euro per year, with some 290 million Euro in additional tax revenue per year (exceeding gains from existing sales). • A transparant separation between the public tasks and commercial services of national metro-data holders is necessary.
Data domain(s)	Meteo-data
Years covered	2002-2011
Year of publication	2011
Source(s)	http://www.primet.org/documents-mainmenu-29/424-psi-in-european-meteorology-an-unfulfilled-potential

Name (country) Pricing of PSI in the Meteorological Sector Blocks Market Development (EU)	
Context	Study by Pettifer, chairman Association of Private Meteorological Services (PRIMET). Exercise in showing where market deformation occurs using hypothetical scenario's.
Outcomes	• Commercial re-use of metro-data makes avaiilability of this data from multiple countries prerequisite. • Smaller companies do not have access to the market at cost recovery pricing by meteo data holders, because of the need to negotiate contracts with each European country, which makes competition with large incumbents impossible. • The minimally needed meteo-data to be able to use them for commercial services has a value of 6 to 30 thousand Euros per contract, but it would cost on average 84 yo 400 thousand per contract to gain access to data from public data holders. • The loss of sales revenue at public metro-data holders is very low compared to the additional tax revenue on re-use of that data. • The tax revenues, in comparison to the US market, would rise by 340 million Euro per year in the EU. • The US market, where data is available at marginal costs, grows 15.8% faster than the European market.
Data domain(s)	Meteo-data
Years covered	2002-2010
Year of publication	2011
Source(s)	share-psi.eu/papers/primet.pdf

Name (country) Casu Norwegian Met Office (Norway)	
Context	Case from the POPSIS study, looking at models for provision and pricing, and its effects on re-use. In 2007 the Norwegian meteo institute made their data freely available.
Outcomes	• Free data provision needed a compensation from the general budget of 125.000 Euro. • Re-users that want provision guarantees pay for an SLA. • The number of weekly unique users rose 300 times, the usage per user doubled. • New commercial players emerged at the high-end of the market • The number of re-users outside of Norway rose by 40% • Many new re-users appeared, mostly small companies • Interaction with re-users (5000 e-mails per year), helped improve data quality, increased internal efficiency and improved their external image. • The tax revenues from re-use doubled at least and exceeded the loss of revenue.
Data domain(s)	Meteo-data
Years covered	2007-2010
Year of publication	2011
Source(s)	http://ec.europa.eu/information_society/policy/psi/docs/pdfs/report/11_2012/summary.pdf

Name (country) Case KNMI (Netherlands)	
Context	Case from the POPSIS study, looking at models for provision and pricing, and its effects on re-use. In 1999 the Dutch meteo institute KNMI ceased their commercial activities and focussed on re-use. The price of data access was reduced by 80% to marginal costs, and data provision for re-use came to be seen as part of the public task.
Outcomes	• A competitive and innovative market emerged, with new business models. • The turnover of re-using companies quadrupled • The number of high-end re-users grew 250% • Employment with re-users tripled. • A growth of 3.5 million Euro per year in tax revenue (35 million from 1999-2010) • Internal efficiency gains of 3,5 million Euro as well. • The additional tax revenue is 7 times the cost of data provision.
Data domain(s)	Meteo-data
Years covered	1999-2010
Year of publication	2011
Source(s)	http://ec.europa.eu/information_society/policy/psi/docs/pdfs/report/11_2012/summary.pdf

Statistical data related studies

Name (country) Case Australian statistics(Australia)	
Context	Case from the study Costs and Benefits of Data Provision - Report to the Australian National Data Service, by Houghton / Victoria University. Looked at the impact of freely available statistical data. From 2005 all publications and data were available online, from 2008 also with an open license.
Outcomes	• The total costs of free provision estimated at 3,5 million AUSD per year. This consists of 1 million cost savings per year and a revenue loss on services of 4.5 million. • Total costs savings on the side of re-users is 5 million per year. • Website traffic grew a third in the first year, and the number of downloads tripled over the period 2003-2010. • Additional socio-economic benefits (consumrer-surplus) estimated at 4 million AUSD per year.
Data domain(s)	Statistiics
Years covered	2003-2010
Year of publication	2011
Source(s)	http://ands.org.au/resource/houghton-cost-benefit-study.pdf

Name (country) Does Transparency Pay? (global)	
Context	Research by the IMF into the influence of freely available economic statistics on e.g. the borrowing costs of nations. Focus on thei mplementation of the Article IV transparency requirements of the IMF. Aimed only at the accuracy and frequency of making these economic statistics available to the public.
Outcomes	• Increased transparency of economic statistics significantly influences the costs of borrowing for nations in a positive way. • Also references studies that show correlations between economic transparency and lower inflation, lower budget deficits and higher foreign investment. It is possible that in these cases higher transparency is an expression of well functioning institutions.
Data domain(s)	Statistics on economy and trade
Years covered	1999-2002
Year of publication	2008
Source(s)	http://ands.org.au/resource/houghton-cost-benefit-study.pdf

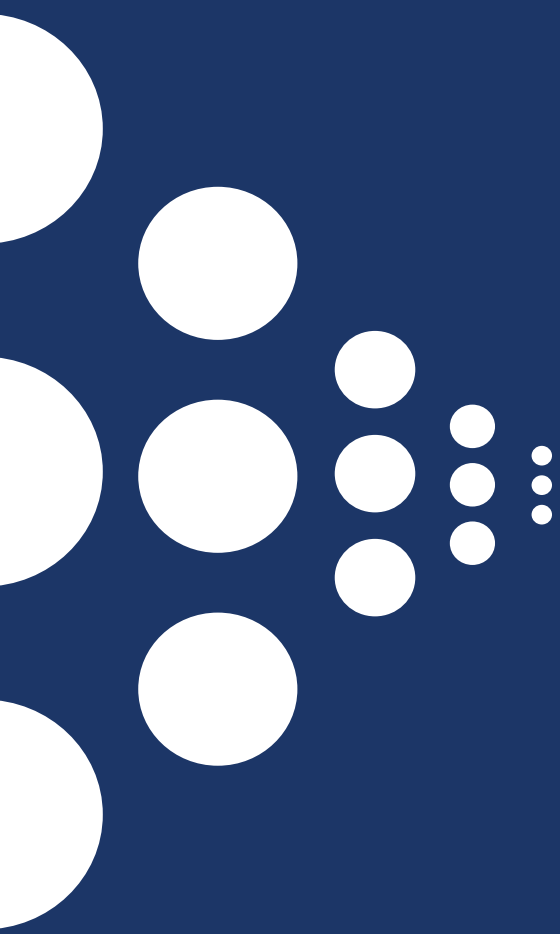
Research related to hydrological data

Name (country) Case Australian hydrological data (Australia)	
Context	Case from the study Costs and Benefits of Data Provision - Report to the Australian National Data Service, by Houghton / Victoria University. Looks at impact of freely available hydrological data From 2008 the Australian Bureau of Meteorology (BOM) published hydrological data on water reserves, usage and rights, with an open license.
Outcomes	• Water data is widely used if freely available. The number of consultations grew 1100 times, the number of re-users of the full data set doubled. • The emerging market around water management with a value of 2.8 bilion AUSD in 2009, is supported by freely available data.
Data domain(s)	Hydrological data
Years covered	2005-2011
Year of publication	2011
Source(s)	http://ands.org.au/resource/houghton-cost-benefit-study.pdf

Research related to healthcare data

Name (country) Three NHS cases (UK)	
Context	The British National Health Services (NHS) publiishes large volumes of detailed data on procedures and healthcare outcomes. Several cases are documented on the NHS website.
Outcomes	• The Society for Cardiothoracic Surgery reports that publishing outcomes of hart surgery data since 2005 results in 1000 fewer deaths per year. Because of this result as of 2013 outcome data from 10 other specialism are published. • The Shakespeare Review quantifies those 1000 lives saved yearly at 400 million GBP. • Publication of data on MRSA hospital infections and the number of resulting deaths, reduced the number of deaths by 76% (men) and 79% (women) in the period 2008-2012. • A company analysed the 2012 data on prescriptions for statines, concerning generic and branded medicines. It concluded that the number of branded medicines still being prescribed constitute a 200 million GBP savings potential in 2011 alone. • The British Medical Journal calculated that this savings potential from generic medicines, even though already mandatory, amounts to 1.4 billlion GBP per year across all presciriptions. • Publication of data has significant influence on the results of healthcare procedures, and is therefore a free intervention improving healthcare outcomes.
Data domain(s)	Healthcare data
Years covered	2005-2013, 2008-2012, 2011
Year of publication	2012, 2013
Source(s)	http://www.england.nhs.uk/ourwork/tsd/data-info/open-data/examples/ http://www.ons.gov.uk/ons/rel/subnational-health2/deaths-involving-mrsa/2008-to-2012/stb---mrsa.html http://theodi.org/news/prescription-savings-worth-millions-identified-odi-incubated-company

Name (country) Health Innovation Platform Stockholm (Sweden)	
Context	A case study looking at the development of a predictive software service (SenseMate) for healthcare proividers, using the open data of the Health Innovation Platform, for the Stockholm region.
Outcomes	• The Health Innovation Platform launched in 2016 • The case study calculated a commercial value of half a million Euro in the Stockholm region for the designed product, even though the data quality of the available healthcare data wasn't as detailed as desired.
Data domain(s)	Healthcare data
Years covered	2016
Year of publication	2015
Source(s)	http://www.slideshare.net/erikboralv/vrdet-av-ppna-data



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