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Executive Summary

The main objective of the report is to quantitatively estimate the economic-social impact of open data in Slovenia. Analysis is based on a direct application of Huyer & Van Knippenberg's 2020 methodology for quantitatively estimating the economic impact of open data in all those fields, where relevant data for Slovenia is currently available. The study reveals an estimated potential of 293 million € for Slovenia's open data market size growth until 2025 and estimated 7,441 open data employees in 2025 according to optimistic scenario forecasts. Moreover, the study estimates several potential efficiency gains and cost savings due to application of open data in Slovenia (e.g. 216 – 403 lives saved due to faster arrival of emergency services, 29 – 48 lives saved due to CPR administered by first responders, 97 thousand hours saved for train users, 885 terajoule saved in household energy consumption). At the end, two brief case studies of Slovenian organizations that have been using open data as part of their business model are presented.

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1. INTRODUCTION

The main objective of this report is to **quantitatively estimate the economic-social impact of open data in Slovenia**.

There is a common opinion among open data experts that it is difficult to measure, quantify and/or calculate the economic impact of open data (hereafter, OD).[1] Nevertheless, since 2005, there have been many attempts at quantitatively estimating different aspects of economic impact of OD. Yet according to Huyer & Van Knippenberg (2020, 13), these previous studies did not only apply different methodologies and approaches to measure the economic impact of OD, but they also demonstrated several important methodological shortcomings, such as:

- applied methodologies are not transparent,
- assumptions are not made explicit,
- unclear link between literature and methodology,
- the scope of open data is often unclear,
- either macro-economic or micro-economic approaches,
- reliance on selective number of secondary sources,
- studies are difficult to compare.

In 2020, these two authors (Huyer & Van Knippenberg) elaborated an extensive study on the economic impact of OD in EU (*The Economic Impact of Open Data; Opportunities for value creation in Europe*), in which they strived to overcome the above mentioned methodological shortcomings. According to our literature review, this study can be regarded as one of the ***currently most methodologically advanced and relevant publicly available studies on economic impact of OD***.[2] Therefore, we selected this study as the methodological basis for our analysis of the economic impact of OD in Slovenia which is presented in this report.[3] The following chapters (descriptions, methodologies, and calculations) are thus directly based on this study by Huyer & Van Knippenberg (2020), i.e. our analysis is a direct application of their methodology for quantitatively estimating the economic-social impact of OD in all those fields, where relevant data for Slovenia is currently available. Where there are other sources used for the purposes of the report, we explicitly reference them in the text.

Just like Huyer & Van Knippenberg's study, this report focuses on the economic impact of re-using OD (open government data + open data from the private sector). OD has significant potential when combined with other data (shared data, personal data) and that looking at the data economy holistically is the most fruitful and solution-orientated approach.

[1] The economic impact is incremental and not immediately visible (it is subtle and sometimes well hidden). Quantifying this impact is comparably complex because the most important and significant benefits are indirect (Huyer & Van Knippenberg 2020, 10).

[2] It considers OD as an enabler for the economy and looks at it from a holistic perspective (the economic impact of OD as part of the data economy as a whole). Methodologically, it aims at achieving accuracy in the applied methods. Calculations are fully transparent, and either explained in the text or added in the footnotes. This allows the reader to understand the thoughts behind the calculations, challenge, update or further develop them. It also allows to use similar formulas but combine them with local or national data to derive insights about a region or country. Where precision is not feasible or not reasonable, they are transparent about this fact. Results are derived in the ambition to understand the economic impact of OD better and not to promote it.

[3] Thus, for more detailed explanations and descriptions, please see the original study by Huyer & Van Knippenberg (2020).

Impact levels from immediate to complicity

The report, as it is common practice, distinguishes between different layers of impact depending on how immediate impact is created. Each example might have different levels of impact. Impact can range between:

- Direct impact: clear and immediate relation between the factors and the impact.
- Indirect impact: the relation between factors and impact can be shown using examples and arguments. Generally, more assumptions are used to derive statements.

Status, potential, and forecast

Open data impact can already be realized, or it can be a future potential. Instead of the current status, often, open data impact is indicated as a potential that can be reached if we would make more use of certain datasets and applications. This report, where possible, provides both current status and a forecast. When talking about the future we distinguish between a forecast and an evaluation of the potential. A potential does not include the likelihood or timespan of its realization. A forecast makes an assumption about the time span in which a potential can be realized.

2. THE OPEN DATA MARKET SIZE

2.1 Methodology for measuring the open data market size

Huyer & Van Knippenberg (2020, 18) suggest that the market size of OD could also be called the market size of products, services, and content improved or enabled by OD. Which share of this value is attributable to OD can only be estimated. Therefore, measuring the market size of OD is more complex and less precise.

In the report, the market size is expressed in Euro and is derived from the Gross Domestic Product (hereafter, GDP).

To express the economic impact of OD as Slovenia's market size, we use secondary and primary data, and adapt literature results to make informed and meaningful statements about the current market size and the potential growth to forecast the OD market size for 2025. The steps undertaken are listed below:

1. Reusing data from relevant literature.
2. Translation of results into share of GDP.
3. Calculation of the OD Market size.
4. Forecast of the OD market size 2025 using different growth scenarios.

2.2 The open data market size in 2019

Based on selected most important, mainly European, previous studies on economic impact of OD (e.g. EDP 2015, IDC Data Landscape 2019, ASEDIE 2019 etc.), Huyer & Van Knippenberg (2020, 23) found that the average OD share of GDP is 1.33 % and the median is 1.19 %. To derive the approximate current OD market size for the EU, they applied the median of 1.19 % to EU GDP. However, this median OD share of GDP does not show country-specific shares of GDP, which may possibly vary quite considerably among countries. To estimate a more country-specific share, adjusted to Slovenia, OD maturity level rankings[4] may be used. In 2019, the EU28 average OD maturity level was 66 % and Slovenia's level was 75 %, which is 13.6 % higher than the EU28 average (Blank et al. 2019). If we apply this ratio to the median GDP share of 1.19 %, we can estimate that the OD share of Slovenia's GDP was 1.352 % in 2019. The latest available official numbers for Slovenia's GDP in 2019 are 48,393 million € (SURS 2021). This leads to a Slovenia's total OD market size in 2019 of around **654.2 million €** (compared to 215.29 billion € in EU28+).

Total OD market size is composed of direct market size (direct impact) and indirect market size (indirect impact). It is possible to estimate the ratio between direct and indirect market size in the total market size. Huyer & Van Knippenberg (2020, 23) used a conservative 3.64 ratio between direct and indirect market size (based on two previous relevant studies). If we apply this ratio to the estimated Slovenia's total OD market size in 2019 (654.2 million €), then the direct market size was around 141 million € and the indirect market size was around 513.2 million € in 2019.

[4] European Data Portal annually calculates open data performance (maturity) rankings of EU countries and publishes them in annual Open Data Maturity reports.

2.3 The total open data market size in 2025

Based on the 2019 OD market size, a forecast for the growth until 2025 is calculated. To capture the spectrum of growth scenarios, we provide a baseline and an optimistic growth scenario.

Baseline scenario

The baseline scenario assumes that the impact of OD only grows at the same pace as GDP. In this scenario, no efforts towards increasing the impact of OD are considered.

UMAR (2020b) and IMF (Statista 2020) real GDP growth rates that include inflation corrections are used to forecast Slovenia's GDP and the OD market size. As shown in the table, the OD market size in 2025 is forecast to be **718 million €** in a baseline scenario (199.51 billion € for EU27+).

Table 1: Baseline open data market size growth forecast in Slovenia

Year	2019	2020	2021	2022	2023	2024	2025
GDP in million €	48,393	45,199	47,143	49,217	50,620	51,966	53,187
UMAR and IMF: expected real GDP growth in %		-6.6 (UMAR)	4.3 (UMAR)	4.4 (UMAR)	2.85 (IMF)	2.66 (IMF)	2.35 (IMF)
Baseline: OD market size in million €	654	611	637	665	684	702	718

Optimistic growth scenario

However, OD experts and several studies often use higher growth rates for the OD market size than GDP growth. Although calculations over the past years do not testify this growth potential for OD, there are several indicators that OD will indeed grow by a higher percentage than EU GDP.

- The new OD and PSI Directive and the specification and implementation of high-value datasets increase the economic impact of OD-driven services
- Increased uptake of data sharing which increases attention for OD in new target groups
- Habituation to GDPR and regain of confidence when reusing data
- OD sectors and fields like language technology, agriculture, and smart mobility drive OD growth
- Network effects increase and multiply the growth and increase specifically the indirect impact
- Increase in employment rates potentially leading to higher value creation.

In the Table 2 below, the optimistic forecast for the OD market size is shown. Instead of using the forecast Slovenia's GDP growth rates, a growth rate of 7.5 % is applied that considers data and OD specific aspects and trends. This growth rate is based on the growth scenarios from IDC (2019) applied to Slovenia, based on its individual OD maturity and OD maturity trend. This results in an OD market size of around **1.011 billion €** in 2025 (compared to 334.2 billion € for EU27+). The calculation is explained in more detail below (Defining the open data market size growth rate).

Table 2: Optimistic open data market size growth forecast in Slovenia

Year	2019	2020	2021	2022	2023	2024	2025
Optimistic growth: OD market size in million €	654	703	756	813	874	940	1,011

Defining the open data market size growth rate

The more recent growth rates from IDC (2019) are used to forecast the OD market size for 2025. The benefit of using the growth rates calculated by IDC is that these figures are based on data gathered in the past years. We assume that several factors included in this study, such as data market dynamics factors, and global megatrends affecting all technology markets are significant for the OD market as part of the data market. The three growth scenarios are:

- A baseline scenario (7.5 % growth rate): this scenario is based on the assumptions that the current growth trends and evolution would continue in a similar fashion.
- A challenge scenario (4.3 % growth rate): this scenario displays the situation where the data market grows more slowly than in the baseline scenario. This lower growth would be due to a less positive macroeconomic context and less favorable framework conditions.
- A high growth scenario (15.7 % growth rate): this scenario states that the data market enters a faster growth trajectory, due to more favorable framework conditions.

Individualizing the growth rates for Slovenia based on open data maturity and development trends

Because not all countries have the same OD growth potential, we map the OD maturity and the maturity trend specifically for Slovenia with the three IDC growth scenarios. The trend in the IDC study was derived from the maturity scoring since 2005 and categorized as low growth countries, medium growth countries and accelerating countries. It must be said that even in low growth countries OD impact can be high, e.g. if the overall maturity is high but simply not growing fast. We use the following rules to allocate the most realistic growth rate for Slovenia:

Table 3: Allocation of growth rates based on countries open data maturity and trend

High-growth countries with a maturity above 50. Medium-growth countries with a maturity above 60.	High growth scenario	15.7 %	Example: Czech Republic, Estonia or Spain
Medium-growth countries with maturity below 60. Low-growth countries with a maturity above 60.	Modest growth scenario	7.5 %	Example: Austria, Norway or Latvia
Low-growth countries with a maturity below 60.	Low growth scenario	4.3 %	Example: Hungary or Iceland

Based on the Slovenia's OD maturity scores from 2016 to 2020[5], Slovenia has predominately been categorized into the fast-trackers cluster with modest-growth of OD maturity in this period, especially in the last 4 years since 2017. Therefore, a modest growth scenario of 7.5 % (low-growth country with a maturity above 60) can be applied to Slovenia's optimistic OD market size growth forecast.

Growth potential for the open data market size until 2025 in Slovenia

Combining the two growth scenarios (baseline and optimistic), reveals a potential of **293 million €** for Slovenia's OD market size growth until 2025 (= difference in 2025 OD market size forecast between the two scenarios, see Tables 1 & 2 above).

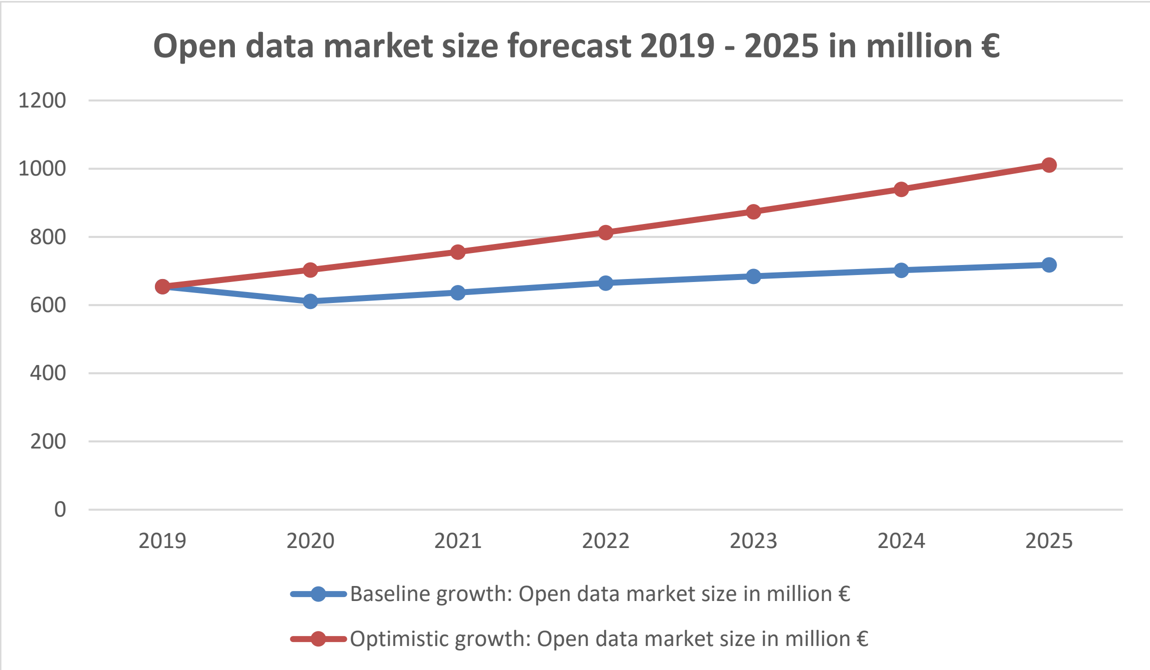

Figure 1: Visualization of the baseline and the optimistic open data market size forecast in Slovenia

[5] Slovenia's OD maturity scores in this period have been the following: 84 % in 2020, 75 % in 2019, 74.6 % in 2018, 82 % in 2017, 60 % in 2016 (see European Data Portal for full reports).

3. OPEN DATA EMPLOYMENT

The economic impact of OD can – in addition to its market size – also be calculated in terms of the number of people who are employed due to OD. The potential for job creation through publishing and re-using OD is significant.

3.1 Methodology for measuring open data employment

Since OD is important for both the public and the private sector, we estimate the number of employees that are employed due to OD for both sectors. The number of employees is a more precise indicator than the number of OD jobs because jobs are measured in full-time equivalent (FTE) while employees are often not fulltime employed on OD jobs.

The objective is to forecast the future number of employees in the public and private sector that are employed due to OD. The first step is to estimate the number of OD employees in 2019. The second step is to forecast the number of OD employees for the upcoming years until 2025.

3.2 Open data employment in 2019

The first step is to estimate the number of direct OD employees in 2019. To do this, it is necessary to know the total number of employed persons in Slovenia and a reasonable share (%) than can be used. Huyer & Van Knippenberg (2020, 32) estimated that countries in each of the following OD maturity groups – OD fast-trackers, followers, and beginners – employ 20 % fewer employees due to OD than the superior group. According to the OD Maturity Report 2019 (Blank et al. 2019, 5), Slovenia belonged to the group of OD fast-trackers which means that according to Huyer & Van Knippenberg estimations, Slovenia's share of OD employment in 2019 was 0.09 % (it is important to note that this share was estimated only for the private sector, therefore not including the public sector). In April 2019, there were around 893,000 employed persons in Slovenia (Brnot 2019), which means that by applying Huyer & Van Knippenberg estimations (0.09 %), there were around 800 direct OD employees in Slovenia in 2019. However, since 0.09 % estimated share includes only the private sector and knowing that the private sector represented 77 % of total employment in April 2019 (Ministry of Public Administration 2019), we extrapolate the number to a total number of 1,039 direct OD employees in Slovenia in April 2019.

Now that we know the number of employees that were according to the above estimation directly employed due to OD in 2019, we can calculate the number of employees that were indirectly employed due to OD. As an estimate, the earlier mentioned market size ratio of 3.64 (= an average value of two previous relevant studies, see chapter 2.2) can be used. By multiplying the number of directly employed persons with this ratio, it can be inferred that there were 3,782 persons indirectly employed due to OD. The number of direct and indirect OD employees together results in a total of **4,821 persons employed due to OD** in Slovenia in April 2019 (compared to estimated 1.09 million OD employees in 2019 for the EU27+).

3.3 Open data employment in 2025

Starting point for forecasting OD employment in 2025 is the number of OD employees in 2019, that is the above mentioned 4,821 persons employed. We forecast a baseline scenario and an optimistic scenario.

Baseline scenario

In the baseline scenario, we assume that the OD employment growth follows the overall employment growth in Slovenia. For this scenario, we use the forecast employment growth rates provided by the Institute of Macroeconomic Analysis and Development of the Republic of Slovenia (UMAR 2021a).[6] The baseline scenario forecasts **4,936 OD employees** in 2025 in Slovenia (compared to 1.12 million for the EU27+). This would mean that 115 additional OD employees are needed between 2019 and 2025. The results of the calculation are shown in the following table.

Table 4: Baseline open data employment growth forecast in Slovenia

Year	2019	2020	2021	2022	2023	2024	2025
Baseline: number of persons employed due to OD	4,821	4,763	4,758	4,805	4,858	4,902	4,936

Optimistic growth scenario

As explained in chapter 2.3 of this report, there are several indicators that OD can grow by a higher percentage than the GDP in Europe. For example, the new OD and PSI Directive and the specification and implementation of high-value datasets could boost the OD market size in the coming years. It is likely to assume that a bigger OD market size will also employ more employees. For the optimistic scenario, we assume that the OD employment grows with a higher percentage than the overall employment growth. This assumption is supported by the OD employment growth in Spain: the OD employment grew by 6.6 % between 2011 and 2017, although overall employment in Spain decreased with -0.3 %, in the same years. For the optimistic scenario, we use the same growth rate that we used to calculate the optimistic scenario of the OD market size (see chapter 2.3), which is an annual growth rate of 7.5 %. This includes the assumption that the value created by employee stays stable. The optimistic scenario forecasts **7,441 OD employees** in 2025 in Slovenia (compared to 1.97 million for the EU27+). This would mean that 2,620 additional OD employees are needed between 2019 and 2025. The results of the calculation are shown in the following table:

Table 5: Optimistic open data employment growth forecast in Slovenia

Year	2019	2020	2021	2022	2023	2024	2025
Optimistic growth: number of persons employed due to OD	4,821	5,183	5,572	5,990	6,439	6,922	7,441

[6] It is important to consider that these forecasts were made in a period of substantial uncertainty due to epidemiological circumstances, which can affect realization of the forecasts.

The Figure 2 below shows the forecast for the baseline as well as the optimistic scenario.

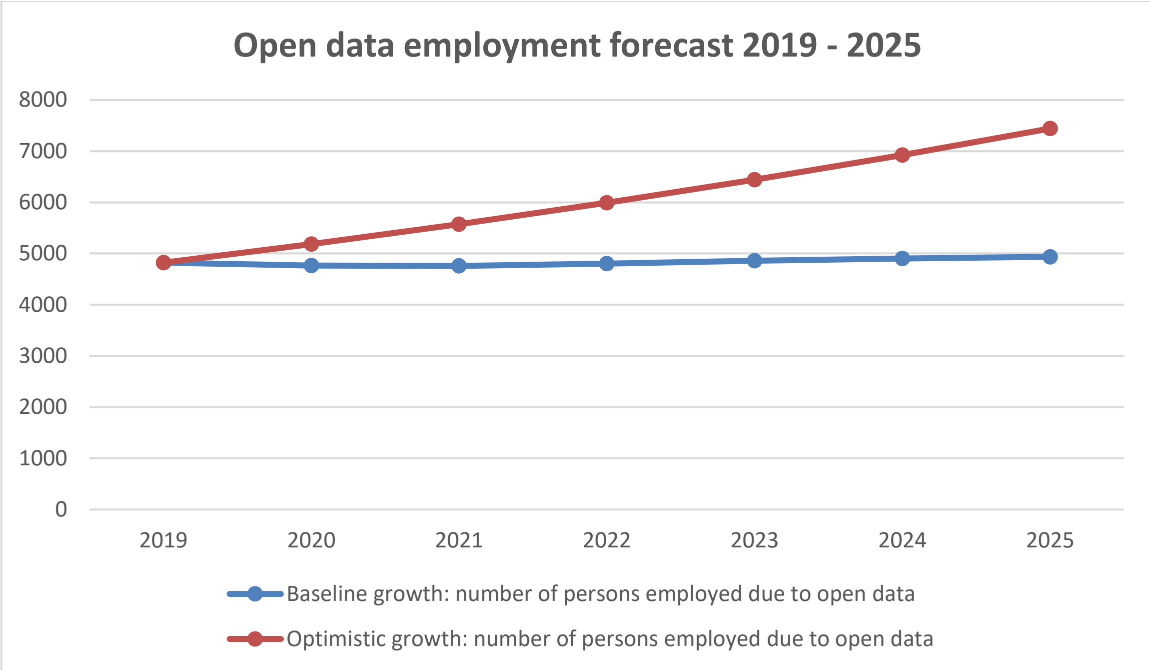

Figure 2: Visualization of the baseline and the optimistic open data employment forecast in Slovenia

3.4 Value created by open data employees

It is estimated that there were 4,821 OD employees in Slovenia in April 2019. Bringing these numbers into context with the different growth scenarios of the market size helps us to understand the OD employment and value creation better. The Slovenia's OD market size had a value of around 654.2 million € in 2019 (see chapter 2.2). Based on these numbers, we can estimate that on average, each OD employee created a value of **136 thousand €** in 2019. Because we based the OD employment forecast on the assumption that the value creation per employee stays stable, also in 2025 when the OD market size is predicted to reach a value of 1.011 billion € in 2025, the forecast 7,441 employees would still each create a value of 136 thousand € in 2025. The question is if the relationship: "more employees, more total value created" is the most likely. Value creation per employee is likely to change. An increase would lead to either a smaller workforce fulfilling the optimistic market size potential, or the forecast increase in workforce would create even more value.

4. EFFICIENCY GAINS DUE TO OPEN DATA

4.1 Methodology for estimating efficiency gains

The report aims to provide the reader with a thorough understanding of the causal chains through which OD can help create efficiency gains in several topics. Moreover, this report aims to quantify the potential efficiency gains as much as possible, e.g. as the potential number of lives saved, or the potential amount of time saved.

There are many societal gains from sharing OD and the products and services that are at least partially based on OD. These can reflect in (but are not limited to) efficiency gains related to:

- Saving lives in threatening situations, such as heart failures and traffic accidents.
- Saving time on various tasks, such as commuting via public transport or in traffic.
- Benefits for the environment, such as reduced air pollution or energy use, but also encouraging alternative energy sources.

For each of these types of efficiency gains, the causal chains and corresponding quantifications will be described. By using sound and transparent logic, reliable data sources such as SURS, and insights from academic peer-reviewed articles we aim to safeguard the reliability of our calculations and underlying assumptions. The calculations are always an approximation and if assumptions are made these will always be clearly marked as being assumptions.

In the following sections, the before mentioned efficiency gains for society will be elaborated on further. Each section will guide the reader through the calculations of potential gains.

4.2 Arriving faster to the scene of an incident

Due to a faster response time of ambulances getting to the scene of an incident, lives can be saved. Ambulances must be at the place of an incident on average within 7-8 minutes and must take no longer than 15 minutes in life-threatening cases (NL[7] & UK[8]). If ambulances need to be dispatched, OD can be beneficial to optimize the time to location, as the routing to the scene of an incident can be faster if informed by real-time traffic data.

Real-time open traffic data enables users of navigation applications to be navigated along the fastest route from A to B. This is especially beneficial if the route they would take otherwise – most likely the *shortest* route – is congested by traffic.

In the Netherlands, there were on average 53 life-threatening ambulance rides per 1,000 inhabitants in 2017.[9] In the United Kingdom, on average 99 life-threatening ambulance rides per 1,000 inhabitants were made.[10] Assuming that the same numbers can be applied to Slovenia, 53-99 life-threatening

[7] Ambulances in the Netherlands (2017) available at: https://www.ambulancezorg.nl/sectorkompas/ambulancezorgverlening-in-2017

[8] Ambulances in the United Kingdom; NHS Ambulance Services Report (2017) available at: https://www.nao.org.uk/wp-content/uploads/2017/01/NHS-Ambulance-Services.pdf Note: 51 % * 195 ambulance rides per 1,000 inhabitants

[9] Ambulances in the Netherlands (2017) available at: https://www.ambulancezorg.nl/sectorkompas/ambulancezorgverlening-in-2017

[10] Ambulances in the United Kingdom; NHS Ambulance Services Report (2017) available at:

ambulance rides per 1,000 inhabitants, which given the Slovenia's 2,100 thousand inhabitants (SURS 2021), would result in approximately 111,300 – 207,900 ambulance rides made in Slovenia.

A study examining emergency incidents in the Salt Lake City area (US) found that on average, a one-minute decrease in ambulance response times reduced the likelihood of death 90 days after an incident happened from 6 % to 5 %, i.e., a 17 % decrease in the total number of deaths.[11]

In the 12 most congested metropolitan areas of Europe, one minute can be saved using real-time traffic data in 19.4 % of rides during the day and 38.9 % of rides in peak hours.[12] If we assume that the same numbers can be applied to Slovenia as a whole, using real-time traffic data based on OD helps ambulances to realize a one-minute earlier arrival of emergency services in approximately 21.6 – 40.3 thousand rides in Slovenia.[13]

A 1 % decrease of the likelihood of death of people served by Slovenian ambulance rides (assuming the results of the Salt Lake City study can be applied to Slovenia) would result in, approximately 216 – 403 potential lives saved thanks to OD.

Approximately **216 – 403 lives** can be saved in Slovenia because emergency services arrive at the scene of an incident 1 minute faster.

4.3 Providing first aid to people having a cardiac arrest

In Slovenia, on average 69 per 100,000 inhabitants[14] have a cardiac arrest outside the hospital per year, which amounts to approximately 1,415 Slovenian citizens annually. Every minute without cardiopulmonary resuscitation (hereafter, CPR) and defibrillation reduces the chance of survival by 10 %.[15] If effective CPR is administered within three to five minutes and can double or triple a victim's chance of survival.[16] In Europe, it is estimated that if CPR is administered 1 minute earlier, it could save approximately 7,000 lives.[17]

A study by Gräsner et al. (2016) on out-of-hospital cardiac arrests (hereafter, OHCAs) across Europe found that CPR was started by a bystander 31.7 % of cases. CPR is started by emergency medical services in 35.2 %, and CPR is not attempted in 33.1 % of cases.[18]

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https://www.nao.org.uk/wp-content/uploads/2017/01/NHS-Ambulance-Services.pdf Note: 51 % * 195 ambulance rides per 1,000 inhabitants

[11] Wilde (2013) Study of 73,706 emergency incidents in U.S. available at: http://www.emdac.org/docs/Wilde_EMS%20Response%20Times%20&%20Outcomes_Health%20Econ_2013.pdf

[12] Capgemini research on the 12 most congested cities of Europe, considering 3 routes per city that take on average between 6.5-18 minutes.

[13] Assuming ambulance rides are evenly distributed in a day. The average 19.4% is calculated by considering 8 hours (06.00-10.00 & 16.00-20.00) as peak hours (38.9%), 8 hours (10.00-16.00 & 20.00-22.00) as off peak (19.4%) and 8 hours (22.00-06.00) as nighttime (0%).

[14] Gräsner, Lefering & Koster (2016). Study of 10,682 out of hospital cardiac arrests in 27 European countries. Available at: https://www.sciencedirect.com/science/article/pii/S0300957216300995#bib0155

[15] American Heart Association (n.d.) available at: https://www.zoll.com/-/media/uploadedfiles/public_site/core_technologies/real_cpr_help/cpr-fakten-pdf

[16] American Heart Association (n.d.) available at: https://cpr.heart.org/en/resources/what-is-cpr

[17] European Data Portal (2015) available at: https://www.europeandataportal.eu/sites/default/files/edp_creating_value_through_open_data_0.pdf

[18] Gräsner, Lefering & Koster (2016). Study of 10,682 out of hospital cardiac arrests in 27 European countries. Available at: https://www.sciencedirect.com/science/article/pii/S0300957216300995#bib0155

Another study by Bürger et al. (2018) of OHCAs in Germany found that there is a substantial difference in survival rates of people who do receive CPR from bystanders before the emergency services arrive (13.1 % - 22 % discharged alive) as opposed to those who do not (7.3 % - 12.9 % discharged alive).[19]

Let us assume that the survival rates of the German study can be applied to Slovenia in general. Of the 1,415 Slovenian citizens that have a cardiac arrest annually, approximately 449 people receive CPR from bystanders, 498 people receive CPR only when the ambulance arrives, and 468 people do not receive CPR at all. This, in turn, leads to an amount of people surviving of between 59 – 99 in case of bystander CPR and 36 – 63 in case of first CPR received by emergency services (see table below).

Assuming the amount of cardiac arrests and survival rates will remain the same, OD can be used to save lives by enabling more people to receive bystander CPR. There are several examples that are already in use, such as HartslagNu (NL), GoodSAM (UK), and PulsePoint (US). Additionally, examples such as Shock (Vienna) further help first responders with a map of available automatic external defibrillators (AEDs).

In Europe, approximately 69.4 % of out of hospital cardiac arrests occurred in a private residence and the remaining 31.6 % of cases are assumed to occur in a public place.[20] So, at least this group can potentially be aided by OD applications guiding first responders to the scene of a cardiac arrest. Let us assume that this ratio between private residence and public place can be applied to Slovenia. If 31.6 % of the groups currently not receiving bystander CPR could potentially get bystander CPR because of applications developed based on OD (i.e., 31.6 % of 498 = 157, and 31.6 % of 468 = 148), the group receiving CPR by bystanders would grow from 449 to 754 in Slovenia (449 + 157 + 148). Of this group, 13.1 % - 22 % survives and as opposed to the current situation, this would result in 29 – 48 potential lives saved. So, OD can be used to not only help people get bystander CPR faster, but also to increase the group of people receiving bystander CPR.

Approximately **29 – 48 lives** can potentially be saved in Slovenia because first responders administer CPR before the arrival of emergency services.

This number could potentially be even higher. It could be that, for example, in about half of those instances in a private residence there is someone else present or the person him-/herself is able to alarm others and open the door for help. This group could then be helped by the initiatives above in addition to the 31.6 % of cases that occur in a public place.

[19] Bürger et al. (2018). Study of 10,853 out of hospital cardiac arrests in Germany 2010-2016. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6156551/

[20] Gräsner, Lefering & Koster (2016). Study of 10,682 out of hospital cardiac arrests in 27 European countries. Available at: https://www.sciencedirect.com/science/article/pii/S0300957216300995#bib0155

Table 6: Overview of current vs. potential number of survivors depending on receiving CPR or bystander CPR in Slovenia

	Current		Potential with OD-based applications	
	Number of people with OHCAs	Number of people surviving OHCAs	Number of people with OHCAs	Number of people surviving OHCAs
First CPR by bystanders (13.1 % - 22 %*)	449	59 – 99	754 (449 + 157 + 148)	99 – 166
First CPR by emergency services (7.3 % - 12.9 %*)	498	36 – 63	341 (498 – 157)	25 – 44
No CPR (0 %)	468	0	320 (468 – 148)	0
Total	1,415	95 – 162	1,415	124 – 210
Additional lives saved				**29 – 48**
* = survival rate interval based on the arrival time of emergency services				

4.4 Time saved in public transport

In Slovenia, more than 12 million passengers use the national railway services each year (Slovenian Railways 2019, 71). Together they account for approximately 530 million passenger kilometers of train rides (*ibid*.) The punctuality rate in 2018 was 77 % (European Commission 2021b). The remaining train rides are delayed by more than 5 minutes (or might not ride at all – but that is not considered in the following calculation). Based on the numbers above, the total number of people on delayed train rides in Slovenia is estimated at approximately 2.9 million people each year.

Let us imagine that in an ideal OD-empowered world all these people are aware of the delay before they leave home because they can find that out thanks to an app on their phone. Applying the results of the Watkins et al. (2011)[21] study, this would on average lead to an actual waiting time reduction of 2 minutes per person each time a train is delayed, resulting in a total of approximately 5.8 million minutes (or 97 thousand hours) saved by all train users in Slovenia on a yearly basis. Moreover, the perceived reduction in waiting time can be even higher. Based on the findings by Watkins et al. (2011)

[21] Watkins et al. (2011) available at: https://www.sciencedirect.com/science/article/pii/S0965856411001030

and Papangelis et al. (2016)[22], perceived waiting time reduction ranges between 2.4 - 4.8 minutes[23], so 7 – 14 million minutes (or 117 – 234 thousand hours) perceived waiting time saved.

The above example ***is merely focused on train use, but the same principle can apply to any other mode of public transports***, thus potentially even more time can be saved in public transport with the help of open real-time data.

Moreover, as applications built on OD can reduce waiting and travel times, not only time is saved, but people can be more satisfied with the experience of public transport. In turn, OD can potentially help ***increase the willingness of people to use public transport as a more environmentally friendly alternative to private transport***.

OD can potentially save approximately **97 thousand hours** annually for train users in Slovenia.

4.5 Time spent in traffic jams

Research by TomTom (European Commission 2021a) shows that in 2017, the average driver spent 26.2 hours in road congestion annually in Slovenia; in Europe this ranges from 18 hours (Finland) to almost 46 hours (United Kingdom). In capital city Ljubljana, the average time wasted in traffic was 21 hours and in the city of Maribor 20 hours in 2019 (INRIX 2021).

Time saved in traffic

In the 12 most congested metropolitan areas of Europe, using real-time open traffic data can help decrease the time spent in traffic by approximately 3.8 % during daytime with 5.5 % during peak hours.[24] If we assume that the same numbers can be applied to biggest cities in Slovenia, using real-time traffic data based on OD helps to decrease time in traffic by 3.8 – 5.5 % across Slovenian cities. In Ljubljana, for example, this would mean that using real-time open traffic data can have a potential effect of 0.8 – 1.16 hours saved per driver (similarly in Maribor). In European cities on average, drivers could save 4.9 - 7.1 hours annually.

Open real-time traffic data can help decrease the time a driver spends in traffic by approximately **0.8 – 1.16 hours** annually in two major Slovenian cities.

Of the total 2,089,310 inhabitants in Slovenia in 2019, the total number of people in employment reached 881,861 (42.2 % of total population). In Ljubljana and Maribor, there were 405,053 inhabitants altogether in 2019 (SURS 2021). So, there are roughly 171,000 working Slovenian inhabitants living in Ljubljana and Maribor who could benefit potential time saved in traffic.

Between 60 % to 70 % of commuting from and to work is done by car in Europe.[25] Let us assume that on average 65 % of the working Slovenian population living in Ljubljana and Maribor commutes to work

[22] Papangelis et al. (2016) available at: https://www.tandfonline.com/doi/abs/10.1080/03081060.2015.1108085?journalCode=gtpt20
[23] The perceived time saved while informed by real-time information in the Papangelis et al. (2016) study is approx. 60% in rural areas which is applied to the numbers of the Watkins et al. (2011) study (i.e., 30% decrease is 2.4 minutes). So, if 30% decrease is 2.4 minutes, then 60% is 4.8 minutes decrease.
[24] Capgemini research on the 12 most congested cities of Europe, considering 3 routes per city that take on average between 6.5-18 minutes.
[25] Summary of studies in France, Germany, United Kingdom, the Netherlands, and Belgium. https://www.fleeteurope.com/en/smart-mobility/europe/features/car-remains-primary-means-commuting-western-europe?a=SBL09&t%5B0%5D=Traffic&t%5B1%5D=study&t%5B2%5D=France&curl=1 and

by car, i.e. 111,150 people. This group can save the previously mentioned 0.8 – 1.16 hours annually with the help of OD based real-time traffic applications. In total, this results in approximately 92,000 – 129,000 hours potentially saved each year by Slovenian drivers commuting to and from work in two largest Slovenian cities.

Open traffic data can potentially save **92,000 – 129,000 hours** for Slovenians commuting by car in two major Slovenian cities.

4.6 Reducing energy consumption

One of the ways in which OD can help attain the CO2 emission goal is by informing initiatives to encourage people to reduce their energy usage. In Slovenia, residential households account for 21.3 % of the total energy consumption of 207,801 terajoule (TJ), i.e., 44,270 TJ, in 2019 (SURS 2021). OD-based applications can serve as a tool to help households reduce their energy consumption by providing them with reports and suggestions on how to decrease energy usage. In these reports, open aggregated energy consumption data is combined with household energy data (not open). For example, by comparing the energy use of households to – anonymized data of – other households that are equivalent in terms of number of family members and consumption patterns, people can be socially motivated to pollute less by reducing their consumption while at the same time cutting on their energy bill costs. These reports thus aim to serve as a behavioral intervention that affects energy consumption habits.

A research by Alcott and Rogers (2014) on the effectiveness of home energy reports on energy reduction in the US found that the OD-based Opower program reduced energy consumption among treated households by 1.4 % - 3.3 %. The average reduction was 2.0 % or 0.62 kWh per day.[26] For illustration, 1 kWh can enable you to cook in a 2,000-watt oven for 1/2 hour or watch around 3 hours of television on a plasma TV.[27]

If we assume that the same average energy reduction of 2 % holds true for equivalent OD-based applications that could be used in Slovenia, the potential energy saved by households with the help of OD would be approximately 885 TJ each year. Moreover, the beforementioned energy reports could be applied to not only individual households, but also to organizations and public buildings, potentially leading to even higher energy savings.

OD-based tools could potentially save **885 terajoule** (TJ) by helping to reduce household energy consumption in Slovenia. This equals 4.4 % of annual electrical energy production of Krško Nuclear Power Plant in 2019.

4.7 Increasing sustainable energy use

In addition to using less energy, OD could also play a role in making it more attractive or making it easier for people to switch to alternative sources of energy. The 2018 EU directive on the promotion of

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Study in Poland http://www.research-pmr.com/userfiles/file/wp/wp_37_894_2013-01-23%20-%20The%20car%20is%20the%20most%20popular%20means%20of%20commuting%20to%20work%20-%2001.pdf

[26] Alcott and Rogers (2014) available at: https://www.povertyactionlab.org/evaluation/opower-evaluating-impact-home-energy-reports-energy-conservation-united-states

[27] Ovo Energy 1 kWh usage (n.d.) available at: https://www.ovoenergy.com/guides/energy-guides/what-is-a-kwh-kw-and-kwh-explained.html

the use of energy from renewable sources sets the target for the share of renewables in gross final energy consumption at 32 % for 2030.[28]

To help achieve this target, publicly available data on houses, utility usage, and location-based weather conditions can be used to provide tailor-made advice to people looking to make their house more energy neutral, such as using solar panels or a solar water heater. In addition, the cost of an energy improvement solution can be directly estimated to interested homeowners, enabling them to instantly evaluate costs, potential benefit and time needed to make a return on the investment.

One of the ways in which the gross energy consumption can be sourced from more renewable energy is through the increased use of solar panels for electricity production. In 2017, total electricity consumption was 13,623 Gigawatt hours (GWh). In 2017, the solar electrical energy production in Slovenia was just 284 GWh, approximately 2.1 % of the total electricity demand (SURS 2021).

A recent study by Bodis et al. (2019)[29] researched the extent to which buildings in the EU28 countries can provide the space for significantly increasing the use of solar panels. Using data from the European Settlement Map and European Urban Atlas, for example, as well as Cadaster data on buildings and solar irradiance data, the total available technical potential is calculated for each EU28 country. This is the expected annual electricity output if 100 % of the suitable rooftop systems are developed, independently of the cost. In addition, the potential for cost-competitive rooftop solar systems that produce electricity at a lower cost than the retail electricity prices in each country, i.e., the economic potential, is calculated.

Bodis et al. (2019) find that in the EU28 countries, there is a total rooftop area available for solar panels of 7,935 km2 with a technical potential of approximately 680 TWh per year. The economic potential is approximately 467 TWh in the EU28. Some countries show technical potential, but it is just not economically feasible yet for solar systems to compete on cost with traditional electricity production, e.g. technical versus economic potential in Poland (30 TWh; 0 TWh) or Hungary (18 TWh; 0 TWh). Slovenia belongs to this group (available rooftop area 29 km2, technical potential 2,704 GWh/year, yet economic potential only 54 GWh/year, economic potential share of consumption 0.4 %). On the other hand, there are also countries that show both huge technical and economic potential such as France (125 TWh; 125 TWh) and Germany (104 TWh; 103 TWh). Moreover, the weather, geographical, and economical features of eight European countries make solar energy suitable to cover a significant (> 20 %) share of the electricity consumption at competitive costs. (*ibid*.)

In Slovenia, there is thus currently an extreme discrepancy between technical and economic potential of photovoltaic electrical energy production. However, if due to technological advancements the production cost of energy by solar panels further decreases and/or the costs becomes lower than other energy sources due to European and national incentives, the full potential of rooftop solar systems can be achieved. In that case, OD can play a role in reaching the full technological potential of **2,704 GWh/year** of solar power in Slovenia, aiding to substantially increased share of renewables for total energy consumption. With the help of OD-based applications, Slovenian citizens, businesses, and public administrations can be activated to make their homes, offices, and buildings more energy-neutral.

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[28] Council of European Union Directive 2018/2001 of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (2018) available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1549740096222&uri=CELEX:32018L2001

[29] Bodis et al. (2019) available at: https://www.sciencedirect.com/science/article/pii/S1364032119305179

5. SAVING COSTS DUE TO OPEN DATA

In addition to adding value through lives saved, time saved, environmental benefits, and increasing knowledge transfer, there are also costs saved with the help of OD. These can refer to cost savings for organizations that simply open up their own data, cost savings thanks to acquiring others' OD for free or at marginal cost, and cost savings through efficiencies enabled by OD re-use.

With the availability of OD, organizations will be able to operate more efficiently and effectively as seen in the previous chapters. Time and money are the most important factors when looking at the economic impact. In this report – when it adds value – the value of time is expressed as money, knowing however that time is not an equivalent to it. The report refers to costs saved in euros.

Each of the topics discussed previously, i.e., lives saved, time saved, environmental benefits can have associated indirect cost savings. Although these benefits are not always easy to quantify into monetary benefits directly, some examples are provided below.

5.1 Saving costs due to bystander CPR

The life-saving medical procedure cardiopulmonary resuscitation (CPR) by bystanders is crucial to the survival of people having an out-of-hospital cardiac arrest (OHCA). Research shows that bystander CPR was positively associated with long-term survival.[30] As described in the chapter on lives saved, OD-based apps that guide bystanders to support a person with an out-of-hospital cardiac arrest can help increase the number of people receiving bystander CPR from 449 to 754 in Slovenia annually, i.e., 305 more people.

Research by Riddersholm et al. (2017)[31] found that the amount of days spent in a hospital after out-of-hospital cardiac arrest is lower for people who receive CPR by bystanders before an ambulance arrives. Their results show an average amount of days spent in the hospital of 20 days in case of no bystander intervention, 16 days if bystander CPR was administered, and 13 days if people were defibrillated by bystanders. Another research by Tan et al. (2017)[32] shows that the average patient-related care costs per day in the intensive care unit is 1,040 € in Germany, 1,243 € in the Netherlands, and 1,333 € in Italy. Based on these numbers, let us assume that the average patient-related care costs per day in the intensive care unit in Slovenia is 1,000 €.

OD can help more people get bystander CPR resulting in potentially 1,220 – 2,135 less days spent in the hospital intensive care and in potential annual healthcare costs savings of **1.22 – 2.14 million €** in Slovenia.

5.2 Saving costs due to less time spent in public transport

OD applications can notify people of the accurate departure times of public transport. In the time saved chapter, it is estimated that providing real-time public transport information with OD-based apps can help save 97 thousand hours annually for all Slovenian train travelers. The lives of travelers would be substantially impacted. To make a financial estimate of the value of these 97 thousand hours saved, we can use the estimated average hourly labor cost of 19.1 € in Slovenia in 2019 (Eurostat 2020b).

[30] Bürger et al. (2018). Study of 10,853 out of hospital cardiac arrests in Germany 2010-2016. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6156551/

[31] Riddersholm et al. (2017) available at: https://www.resuscitationjournal.com/article/S0300-9572(17)30295-2/fulltext

[32] Tan et al. (2017) available at: https://zfin.org/ZDB-PUB-170127-2

This leads to an approximate value of 1.85 million € total. The time saved could be used either productively or as relaxing time, i.e., sit a little longer on the couch before you leave your home, or relax a bit and detach from your tasks after a working day.

OD can potentially save **1.85 million €** due to time saved in public transport in Slovenia.

5.3 Saving costs due to less time spent in traffic

Research by TomTom (European Commission 2021a) shows that in 2017, the average driver spent 26.2 hours in road congestion annually in Slovenia. Based on previously mentioned estimated average hourly labor costs of 19.1 € in Slovenia, these lost hours in road congestion cost approximately 500 € per driver annually. In EU context, it is estimated that Europe's traffic hotspots could cost drivers 217.14 billion € by 2025 due to time wasted in traffic.[33]

OD can help save time in traffic by providing real-time traffic data, based on which road users can adapt their route in case of congestion. It is most likely that real-time car navigation apps such as Google Maps or Waze are already realizing this value, using OD as one of the sources to their algorithms in those countries where it is available. In the time saved chapter, it is estimated that this results in approximately 92,000 – 129,000 hours potentially saved each year by drivers in two largest Slovenian cities (Ljubljana and Maribor) commuting to work in urban areas. Based on the estimated average hourly labor cost of 19.1 € in Slovenia in 2019, this would lead to an approximate potential cost saving of 1.76 – 2.46 million € in labor costs.

Open real-time traffic data can potentially save **1.76 – 2.46 million €** due to reduced waiting times in traffic in Slovenia.

5.4 Saving costs by reduced energy consumption

In Slovenia, energy consumption by residential households account for 44,270 TJ in 2019 (SURS 2021). OD-based applications and services such as Opower (see chapter 4.6) are assumed to serve as a tool to help Slovenian households reduce their energy consumption by approximately 2 %.[34] The potential energy saved by households with the help of OD would be approximately 885 TJ each year. Of the total energy consumption by households, on average 27.8 % is electricity and 10 % is natural gas in 2019 (SURS 2021). If the potential 885 TJ saved with the help of OD reflects the same proportions, this would mean that 27.8 % (246 TJ) is electricity and 10 % (89 TJ) is gas. (*ibid*.)

Based on the average costs in Slovenia of 0.1448 € per kWh electricity (Eurostat 2020a) and of 0.0586 € per kWh natural gas (Eurostat 2020c) in the first half of 2020, the potential cost saved by households for electricity and gas alone could be approximately 11.3 million € annually.

OD can potentially help households reduce their energy bills by **11.3 million €** in Slovenia.

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[33] INTRIX Europe's Traffic Hotspots: Measuring the Impact of Congestion in Europe (2016) available at: http://www2.inrix.com/traffic-hotspots-research-2016

[34] Allcott and Rogers (2014) available at: https://www.povertyactionlab.org/evaluation/opower-evaluating-impact-home-energy-reports-energy-conservation-united-states

5.5 Saving costs by increased solar energy

In the environmental benefits chapter, it is shown that OD can be used to provide information on the optimal use of solar panels on rooftops. In Slovenia, there is a total rooftop area available for solar panels of 29 km2. Bodis et al. (2019)[35] studied the extent to which this rooftop area can be used to significantly increase the production of solar energy across Europe. They estimate levelized cost of producing electricity by solar panels[36] in each country to be between 0.0619 € and 0.3215 € per kWh. The research found that the potential for rooftop solar systems that produce electricity at a lower cost than the retail electricity prices in each country, i.e., the economic potential, is approximately 467 TWh in the EU28.

If we assume that the difference between the retail price of electricity per kWh and the cost of producing the same by solar panels is at maximum the difference between the average retail electricity price in Slovenia (approximately 0.12 € per kWh in the first half of 2020) and 0.0619 € per kWh (the lowest levelized cost of producing electricity as defined by Bodis et al. (2019)), and multiply that by Slovenia's economic potential, a potential cost saving of up to 3.14 million € each year could be realized in Slovenia. OD could play a role in increasing the solar energy production. These benefits might also be achieved without OD. However, OD provides the necessary information free of charge, enabling services (e.g. Sunenergia[37]) to make use of this information and thereby making it easier for households, businesses, and governments to use their buildings' rooftops for solar panels.

OD has the potential to help save up to **3.14 million €** annually in electricity bills by increasing solar energy production in Slovenia.

[35] Bodis et al. (2019) available at: https://www.sciencedirect.com/science/article/pii/S1364032119305179
[36] Levelized cost of producing electricity by solar panels is calculated using capital investment, operation and maintenance costs, electricity generation, discount rate, and investment period considered (for more detail see Bodis et al. (2019) available at: https://www.sciencedirect.com/science/article/pii/S1364032119305179)
[37] Sunenergia (n.d.) available at: https://sunenergia.com/en/

6. OPEN DATA STORIES FROM SLOVENIAN ORGANIZATIONS

To understand more fully the economic-social impact of OD in Slovenian organizations, semi-structured interviews were carried out with selected organizations (case studies), in which they provided us with their insights and information on the following key dimension of OD in organizations:

- their view on the ROLE of OD,
- their ''BUSINESS CASE'' related to OD,
- their INPUTS related to development of market products/services that are based on OD,
- key economic-social IMPACTS of these OD products/services,
- main RISKS and other obstacles that they have been facing with respect to OD.

At the end, respondents also provided some SUGGESTIONS for faster development of OD in Slovenia.

The following organizations participated in the study:

- **Bisnode**, d.o.o. (medium-sized, established company), https://www.bisnode.si/
- **Avtolog.si** application (part of the Slovenian national automobile and motorcycle association), developed by members of Data Institute Inforum, https://avtolog.si/

6.1 Role of open data

Organizations recognize a great role of OD in society (e.g. for increasing transparency, improving services). Openness and easy access to public data for all can be strong factors in the evolution of information society. Presently, we can observe processes in different countries that are on different levels of data openness/accessibility. The less data is open, the more there are negative phenomena in public agencies and on the market, there are obvious conflicts of interest, unfair competition etc. Opening up data can also bring along certain risks. However, the latter can be much more easily managed, if public agencies have active role in distribution and control of OD.

6.2 Business case related to open data

Bisnode: they acquire all available data, process them in order to increase their quality as much as possible, they enrich, upgrade and aggregate them and finally they deliver all these information to their users in way that is appropriate to them. They possess many generic and many custom-made solutions.

Avtolog application: it operates based on the database of registered motor vehicles in Slovenia that is publicly accessible at OPSI portal. It enhances data overview and offers a nice experience in overviewing present trends, as well as enabling detailed searching of data on individual vehicles.

6.3 Inputs

Bisnode: since OD usage is their core business, it was very hard to correctly estimate the extent of their inputs.

Avtolog: since application was developed by using internal resources, it was very hard to correctly estimate the extent of their inputs.

6.4 Impacts

Main impacts of OD usage in selected organizations are the following:

- easier management of highly automatized processes that require much less of human intervention and development power,
- new market opportunities,
- new services that will additionally expand transparency of the used vehicles market in Slovenia and abroad,
- higher awareness of users when buying a vehicle regarding environmental (harmful emissions, EURO standards) and safety aspects (buying imported vehicles, technical adequacy), especially when buying used vehicles,
- users being better informed and being exposed to less risk for frauds.

6.5 Risks

Main risks regarding OD usage in selected organizations are the following:

- potential basic technical problems,
- data creation at the level of suppliers (errors in data input, data not homogenous and correctly validated),
- substantial non-cooperation from relevant ministry (not understanding the role of OD and ICT development in the country, great reluctancy to support the OD project which would contribute to transparency, safety and environmental aspects).

6.6 Suggestions

Some of the main suggestions emphasized by selected organizations are the following:

- less bureaucracy,
- more prototypes and their support,
- internal staff education (OD administrators in agencies),
- clear vision at the country level and support at all levels (top to bottom),
- identifying a key stakeholder (OD representative) for communication with administrators,
- transparent reporting on administrators’ cooperativeness and repeated improvement of OD acquirement process,
- creating and financing a common symbiotic platform where enthusiasts of different profiles could develop OD usage (that would enable them to be recognized by commercial companies to further develop OD solutions).

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