Open Government Data

Volkswirtschaftliche und gesamtgesell-schaftliche Potentiale von Open Data

Report on the Impacts of Open Data V2

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Preliminary Notice

The first part of this report comprises an analysis from the academic literature and practice concerning the impacts of open data in the following dimensions: 1) Social and Political impacts, and 2) Economic impacts. Using a systematic literature review approach, combined with embedded study that looks at the publication and use of open government data (OGD) in Austria, this study provides an overview of the current state-of-the-art on the impacts of open data research and practice, as well as recommendations on how to maximize the benefits of Open Government Data implementation. The analysis resulted in twelve insights regarding the impacts of open data and policy five recommendations.

The second part of the report takes an initial look at major economic impact studies conducted to measure and estimate the monetary value of open data, open government data, personal data and public sector information. In order to identify the monetary value of Open Data we examine the direction taken by four recent macroeconomic studies to approach the accurate measurement and estimation of the economic value created by open data in the Austrian context.

Executive Summary

How can governments guarantee the full benefits of open data? How can open data be implemented in Austria responding to its context and founded on existing theoretical and practice recommendations? To address these questions and to highlight the value of open data the objective of this study is to present a comprehensive overview from the academic literature and practice on the impacts of open data in the following dimensions: 1) Social and Political impacts, and 2) Economic impacts. Using a literature review approach this study provides an overview of the current state-of-the-art on the impacts of open data research and practice, as well as recommendations on how to maximize the benefits of Open Government Data implementation. This briefing introduces 12 insights generated from this research, offered as a basis for further recommendations.

1. **Open data can foster innovation in public service provision,** when governments make public sector information available to a range of non-institutional actors – from the private sector, the non-profit sector, the general public – and actively solicit their input to create new services and to renew existing ones.
2. **The release of open data contributes towards the empowerment of individual citizens** by altering the nature and scope of role they play in the process of governance.
3. **The opening of data will have a significant effect on citizen participation, citizen collaboration, and proactive civic engagement** by modifying the relationship between citizens and the government, and by changing the nature of the role played by citizens in the governance process.
4. **The opening of data has profound implications for notions of public transparency.** The impact of open data on transparency may be discussed with the context of two propositions: First, the provision of access to government data makes public decisions, actions, and results easy to follow. Second, the provision of government data removes opacity, and in doing so allows for greater public scrutiny, both of which increases trust in the state.
5. **Open data, supported by the right technology and policy framework, can be a powerful enabler of public accountability.** The disclosure of public data facilitates a new level of public scrutiny by making existing information on government readily accessible, easier to analyse, and free to combine.
6. **Open data has the potential to modernize and streamline government operations,** especially when used in combination with technology and appropriate regulatory frameworks.
7. **The opening up of government datasets for use by the general public has a particularly significant implications for data protection and individual privacy,** as governments collect and hold large amounts of personal information about their citizens.

8. **The release of government data can have a significant, positive impact on civil society organisations, and the role they play in governance processes.** These sorts of organisations have the potential to become not just active co-creators of public services, but interpreters of government data and disseminators of open data-led social insight.

9. **Open data is an important enabler, catalyst, and corner stone of entrepreneurial activity.** In business terms, the real contribution of data to economic value comes from the business insights extracted from it. The most creative of these insights come from entrepreneurs.

10. **The use of open data has a net positive impact on the creation of economic value through increased rates of innovation.** Lower prices for data, resulting largely from increased access and usage, are likely to stimulate the rate of innovation within and across different sectors of the national economy.

11. **The provision of open data by government and private organisations enables the efficient use of existing economic resources.** Economic efficiency can also be achieved by cutting processing costs through the forging of strategic connections between economic entities and the empowerment of key actors.

12. The widespread availability of open data has had a profound impact on the emergence and adoption of new data-centric business models or *Open Data Business Models* (OD-BMs). These business models are similar to other data-driven ways of doing business, except that they specifically place open datasets, tools and techniques at the heart of strategic business decision-making and product delivery.

Policy Recommendations

1. **Open data is seen to play a significant role in the generation of social capital.** The unfettered disclosure of data can foster innovation in public service provision, making hitherto inaccessible information readily available for imaginative re-use by a range of non-institutional actors who co-create and renew public services alongside the government. In doing so, the release of open data also contributes towards the empowerment of individuals within a society by altering the nature and scope of role that they play in the process of governance. In providing the public with the data necessary to take well-informed decisions and actively engage with each other and with government, the release of open data has the potential to make citizen collaboration more meaningful. This has particular implications for data protection and individual privacy, where a balance needs to be struck between protecting the latter and leveraging the enormous potential benefit afforded by the release of government data into the public domain.

2. **Open data is also important for the creation of value within the economic context.** Here, both governments and commercial entities have a role to play in the creation of business and regulatory frameworks conducive to the leveraging of the full economic potential afforded by free access to data. For instance, in order that the full business potential of open data be harnessed, governments must encourage and sustain environments that stimulate its increased accessibility and creative re-use. People must also be encouraged to innovate with open data, and risk-averse behaviour must be overcome with well-targeted incentives. The provision of open data must be supplemented with government policies that encourage its use and result in its conversion from mere information into an asset that actively generates monetary value. Commercial entities must also contribute, adopting new business models which place open data and associated tools at the heart of strategic decision making and product/service development.

3. **Open data can contribute to the advancement of good governance** and to the building of political capital. Publicly accessible data can be a powerful enabler of public accountability, where information on the workings of government is readily-accessible, made easier to analyse, and is available to combine. Open data also has the potential to modernize and streamline government operations, especially when used in combination with technology and appropriate regulatory frameworks. However, merely publishing large amounts of data will not lead to gains in transparency or increased trust in government. Citizens need to not only be able to see data, but to understand it and place it in context. For civil society organisations, in particular, to harness the transformative power of open data, these organisations need to actively engage with open data resources and convert basic information into public goods.

4. **Open data for policy making** is one of the consequences of digital transformation in government. The decision-making process in government can reach a new level through data-driven and automated techniques that have their foundations on emerging digital technologies such as big data analytics, artificial intelligence, machine learning, and smart things. Open data provides input for evidence-based policy-making, which can be achieved through new tools and technologies such as big data analytics and theories like mega-modeling. Mega-modeling as a comprehensive theory and technology of model construction can be applied to policy-making, and built in a world-of-modeling platform, empowering different stakeholders for creating realistic and understandable simulations in a collaborative way.

5. **In order to maximize the benefits of open data in moving towards open governance,** it is recognized that data needs to be open, that the re-use of data should be facilitated to achieve social and economic value, that interdisciplinary collaboration should be legiti-

mized, and that participation and engagement practices in decision making be encouraged. This is because, as a concept, open governance is strongly correlated to processes of collaborative governance, wherein the availability of open data increases the opportunities for knowledge development, hybrid decision making, and cross-disciplinary participation. Thus data openness, along with transparency, participation, and collaboration remain the fundamental principles of open government. Bearing this in mind, it is vital then that the appropriate legal and regulatory framework be put in place to leverage the full potential of open data in the domain of democratic governance.

A study of open data strategy in Austria supports these claims.
Austria is a world leader in the field of e-government, and is one of Europe's earliest adopters in the domain of open data publication and use. While Austrian open data initiatives started to spread on a municipal level, the federal government now provides datasets that are much more centralised. With the support of non-governmental stakeholders, open data platforms and promotional programmes that form a link between public and private data are being created. On this basis the decisive approach is to encourage the usage of open data and to highlight its role in creating sustainable public policies. To facilitate this utilization and ensure an optimised data quality, the availability of the respective metadata must be considered. After enhancing and expanding existing open data infrastructures, the subsequent step would be the connection of the data. The creation of Linked Open Data, even internationally or across sectors, involving for example open science, may therefore be seen as a guiding principle while heading for the optimal exploitation of open data principles.

Monetary added value of open government data

This section takes an initial look at major economic impact studies conducted to measure and estimate the monetary value of open data, open government data, personal data and public sector information. What monetary value Open Data offers? What is the additional benefit of publishing Open Data? To address these questions we examine the direction taken by four recent macroeconomic studies to approach the accurate measurement and estimation of the economic value created by open data.

The expected economic benefits of open data in Austria are:

- a steadily increasing market potential that shows a trend to be able to comprise 1 % or more of Austria's GDP
- cost savings of € 39 million of the government expenditure in 2020
- a 32 % increase of jobs in the field in Europe, including up to 2000 direct employments in the area in Austria in 2020
- an increased efficiency in political decision-making, time spent waiting in traffic, the health sector, the deployment of life saving measures in emergency and environmental gains
- non-monetary and indirect benefits by an enhanced transparency, the development of innovative applications and an increased potential through linked open data

To exploit these added values, a central focus has to be the deployment of open data.

Kurzzusammenfassung

Wie können Regierungen den vollen Nutzen von Open Data ausschöpfen? Wie kann eine Umsetzung von Open Data in Österreich erfolgen, die sowohl auf den entsprechenden Kontext, als auch auf bereits bestehende theoretische und praktische Empfehlungen eingeht? Um diese Fragen zu beantworten und den Mehrwert von Open Data hervorzuheben, soll diese Studie einen verständlichen Überblick über die akademische Literatur und Praxis bis hin zu den Effekten von Open Data schaffen. Dabei werden die folgenden Dimensionen betrachtet: 1) soziale und politische Effekte und 2) ökonomische Effekte. Mit Hilfe einer Literaturanalyse liefert diese Studie einen Überblick über den aktuellen Stand der Effekte von Open Data in Forschung und Praxis. Zusätzlich werden Empfehlungen zur Maximierung der Wertschöpfung aus der Umsetzung von Open Government Data gegeben . Diese Kurzfassung präsentiert 12 Einblicke aus dieser Arbeit, welche als Basis für weitere Empfehlungen zur Verfügung gestellt werden.

1. **Open Data kann Innovation bei der Bereitstellung** öffentlicher Services fördern, wenn Regierungen Informationen aus dem öffentlichen Sektor für eine Auswahl nicht-institutioneller Akteure – aus dem privatem, dem non-profit Sektor und der allgemeinen Öffentlichkeit – veröffentlichen und ihren Input aktiv bewerben, um neue Services zu schaffen oder bestehende Services zu erneuern.
2. **Die Veröffentlichung von Open Data trägt zur Stärkung der Individualität von BürgerInnen bei,** indem sich deren Rolle im Regierungsprozess hinsichtlich ihrer Natur und ihres Umfangs verändert.
3. **Die Öffnung von Daten hat einen bedeutenden Effekt auf Teilhabe, Kollaboration und proaktives Engagement von BürgerInnen,** da die Beziehung zwischen BürgerInnen und der Regierung ebenso verändert wird, wie die Rolle, welche BürgerInnen im Regierungsprozess spielen.
4. **Die Öffnung von Daten hat tiefgehende Auswirkungen auf Konzepte öffentlicher Transparenz.** Der Effekt, den Open Data hat, kann im Rahmen zweier Thesen diskutiert werden: Zum Einen macht die Bereitstellung des Zugangs zu Regierungsdaten öffentliche Entscheidungen, Handlungen und Ergebnisse leicht nachvollziehbar. Zum Anderen beseitigt die Bereitstellung dieser Regierungsdaten Undurchsichtigkeit und erlaubt damit eine genauere Überprüfung durch die Öffentlichkeit. Jeder dieser Effekte erhöht das Vertrauen in den Staat.
5. **Open Data kann, im Rahmen des entsprechenden technologischen und politischen Rahmens, ein mächtiger Förderer öffentlicher Rechenschaftspflichten sein.** Die Offenlegung öffentlicher Daten ermöglicht ein neues Level öffentlicher Kontrolle, indem bestehende Informationen zur Regierung leichter zugänglich, einfacher zu analysieren und frei kombinierbar werden.
6. **Open Data besitzt das Potential Regierungstätigkeiten zu modernisieren und zu optimieren,** besonders wenn diese in Verbindung mit Technologie und angemessenen Regelungsrahmen genutzt werden.
7. **Die Öffnung von Regierungsdatenzur Nutzung durch die allgemeine Öffentlichkeit hat besonders schwerwiegende Auswirkungen auf Datenschutz und individuelle Privatsphäre,** da Regierungen große Mengen an persönlichen Informationen über ihre BürgerInnen sammeln und speichern.
8. **Die Freigabe von Regierungsdaten kann signifikante positive Auswirkungen auf zivilgesellschaftliche Organisationen und deren Rolle in Regierungsprozessen haben.** Diese Organisationen haben nicht nur das Potential, aktive Mitgestalter öffentlicher Services zu werden, sondern auch als Übersetzer von Regierungsdaten und Vermittler von sozialen Einsichten zu fungieren.

9. **Open Data ist ein wichtiger Initiator und Förderer, Katalysator und Grundstein unternehmerischer Tätigkeit.** Wirtschaftlich gesehen liegt der reale Beitrag von Daten zur ökonomischen Wertschöpfung in den betriebswirtschaftlichen Erkenntnissen, die daraus extrahiert werden. Die kreativsten dieser Einblicke stammen von Jungunternehmungen.

10. **Die Verwendung von Open Data hat durch gesteigerte Innovationsraten einen rein positiven Effekt auf die Schaffung ökonomischer Wertschöpfung.** Aufgrund eines verbesserten Zugangs und gesteigerter Nutzung sinken die Datenpreise. Dies wiederum steigert mit einer hohen Wahrscheinlichkeit die Innovationsrate innerhalb, aber auch über die Grenzen verschiedener Sektoren der nationalen Wirtschaft hinaus.

11. **Die Bereitstellung von Open Data durch die Regierung und private Organisationen ermöglicht die effiziente Nutzung bestehender ökonomischer Ressourcen.** Wirtschaftliche Effizienz kann auch durch die Senkung von Verarbeitungskosten erreicht werden, indem zum einen strategische Verbindungen zwischen wirtschaftlichen Einheiten geschaffen werden und zum anderen die Stärkung von Schlüsselakteuren vorangetrieben wird.

12. **Die weit verbreitete Verfügbarkeit von Open Data hat wesentliche Auswirkungen auf die Entstehung und Adaption neuer, daten-zentrierter Businessmodelle oder Open Data Business Modells (ODBMs).** Diese Unternehmensmodelle ähneln anderen datengesteuerten Arten zu wirtschaften. Hier werden jedoch spezifisch offene Datenbestände, Werkzeuge und Techniken in den Fokus der strategischen unternehmerischen Entscheidungsfindung und Produktlieferung gestellt.

Empfehlungen für das Regierungs- und Verwaltungshandeln

1. **Open Data spielt eine bedeutende Rolle bei der Generierung von Sozialkapital.** Die uneingeschränkte Offenlegung von Daten kann die Innovation bei der Bereitstellung öffentlicher Services begünstigen, indem bis dahin unzugängliche Informationen für die einfallsreiche Wiederverwendung durch nicht-institutionelle Akteure abrufbar gemacht werden, welche öffentliche Services neben der Regierung mitgestalten und erneuern. Damit trägt die Veröffentlichung von Open Data zusätzlich zur Stärkung des Individuums in der Gesellschaft bei, indem die Natur und der Umfang der Rollen im Regierungsprozess verändert wird. Indem die Öffentlichkeit mit den nötigen Daten für eine gut informierte Entscheidungsfindung und für aktives Engagement innerhalb der Gesellschaft und mit der Regierung versorgt wird, hat die Veröffentlichung von Open Data das Potential der Zusammenarbeit zwischen BürgerInnen eine größere Bedeutung zu verleihen. Deshalb sind die Auswirkungen auf den Datenschutz und die individuelle Privatsphäre zu bedenken. Hier muss eine Balance zwischen dem Schutz dieser und dem potentiellen Nutzen, den die Freigabe von Regierungsdaten in das öffentliche Gut mit sich bringt, gefunden werden.

2. **Open Data ist außerdem für die Schaffung von Wert im ökonomischen Kontext bekannt.** Dabei haben sowohl Regierungen, als auch kommerzielle Organisationen eine Rolle im Schaffen wirtschaftlicher Rahmenbedingungen zu spielen. Diese Rahmenkonzepte müssen dem Erreichen des vollen, bei freiem Zugang zu den Daten vorliegenden, wirtschaftlichen Potential zuträglich sein. So müssen Regierungen zum Beispiel jene Umgebungen ermutigen und bewahren, die verstärkten Zugang und kreative Weiterverwertung begünstigen, um das vollständige unternehmerische Potential von Open Data auszuschöpfen. Des Weiteren ist eine Ermutigung der Menschen nötig, Open Data zur Entwicklung von Innovationen zu nutzen. Risikoaverses Verhalten muss durch zielgruppengerechte Anreize umgangen werden. Die Bereitstellung von Open Data muss durch Regierungsstrategien ergänzt werden, die die Nutzung der Daten und auch deren Transformation von einer bloßen Information hin zu einem Vermögensposten der aktive Geldwerte generiert, begünstigen. Kommerzielle Organisationen müssen dazu beitragen, indem neue Unternehmensmodelle angewandt werden, welche Open Data und damit verknüpfte Werkzeuge in den Fokus der strategischen Entscheidungsfindungen sowie der Produkt- und Serviceentwicklung rücken.

3. **Open Data kann zur Weiterentwicklung guten Regierungshandelns ebenso beitragen,** wie dazu, politisches Kapital auszubauen. Öffentlich zugängliche Daten können dort starke Befähiger einer öffentlichen Rechenschaft sein, wo Informationen über die Regierungsarbeit bereits verfügbar, leicht zu analysieren und kombinierbar sind. Open Data verfügt zusätzlich über das Potential, Regierungshandeln, zu modernisieren und zu optimieren. Dies ist besonders bei sinnvoller Kombination von Technologie und angemessenem Rahmenwerk der Fall. Jedoch wird die ledigliche Bereitstellung großer Datenmengen nicht in höherer Transparenz oder mehr Vertrauen in die Regierung münden. BürgerInnen müssen Daten nicht nur sehen, sondern zusätzlich verstehen und in den jeweiligen Kontext einbetten. Besonders Organisationen der Zivilgesellschaft müssen aktiv mit Open Data Ressourcen arbeiten und grundlegende Informationen in öffentliche Güter umwandeln, um die transformative Kraft von Open Data nutzen zu können.

4. **Open Data als Grundlage des Regierungshandelns** ist eine der Konsequenzen digitaler Transformation in der Regierung. Der Entscheidungsfindungsprozess innerhalb der Regierung kann mit Hilfe datengesteuerter und automatisierter Techniken, die auf digitalen Technologien wie Big Data-Analysen, künstlicher Intelligenz, lernenden Maschinen und *smarten Dingen* basieren, eine neue Stufe erreichen. Open Data stellt Vorgaben und

Anstöße für evidenzbasiertes Policy-Making bereit. Dieses kann durch neue Werkzeuge und Technologien wie Big Data-Analysen oder Theorien wie Mega-Modeling erreicht werden. Letzteres kann als eine verständliche Theorie und eine Technologie der Modellkonstruktion auch auf Policy-Making angewandt werden. Im Aufbau einer „world-of-modeling" Plattform können verschiedene Stakeholder durch das Schaffen realistischer und verständlicher Simulationen auf eine kollaborative Art und Weise gestärkt werden.

5. **Um den Nutzen von Open Data auf dem Weg zu Open Governance zu maximieren,** ist anerkannt, dass die Daten offen sein müssen, dass die Wiederverwendung der Daten gefördert werden muss, um sozialen und wirtschaftlichen Mehrwert zu generieren, dass interdisziplinäre Kollaboration legitimiert sein muss und dass Partizipations- und Engagementpraktiken in der Entscheidungsfindung ermutigt werden müssen. Dies kommt daher, dass Open Governance, als Konzept, eng mit den Prozessen kollaborativer Governance korreliert. Dabei steigert die Verfügbarkeit von Open Data die Möglichkeiten der Wissensentwicklung, hybrider Entscheidungsfindung und disziplinenübergreifender Partizipation. Daher bleibt die Offenheit von Daten, zusammen mit Transparenz, Partizipation und Kollaboration ein fundamentales Prinzip von Open Government. Vor diesem Hintergrund ist es essentiell, angemessene rechtliche und regulierende Rahmenbedingungen zu schaffen, um das volle Potential von Open Data im Bereich demokratischen Regierungshandelns ausschöpfen zu können.

Eine Studie über Open Data-Strategien in Österreich belegt diese Empfehlungen.
Österreich hat eine weltweit führende Position im Bereich E-Government inne und zählt zu jenen Ländern in Europa, die am frühesten von der Veröffentlichung und Nutzung von Open Data Gebrauch machten. Obwohl die österreichischen Open Data Initiativen ihren Anfang auf regionaler Ebene nahmen, sind nun auf Bundesebene deutlich stärker zentralisierte Datenbestände vorhanden. Mit der Unterstützung von Stakeholdern aus dem NGO-Sektor, werden Open Data-Plattformen und Unterstützungsprogramme, die eine Verbindung zwischen öffentlichen und privaten Daten schaffen, ins Leben gerufen. Auf dieser Basis ist der entscheidende Ansatzpunkt, die Nutzung von Open Data zu stärken, und die Bedeutung offener Daten für die Schaffung nachhaltiger öffentlicher Verwaltungsstrategien hervorzuheben. Um diese Nutzung weiter zu fördern und die optimale Qualität der Daten zu gewährleisten, muss zudem der Zugriff auf die entsprechenden Metadaten bedacht werden. Sind die vorhandenen Open Data Infrastrukturen verbessert und ausgeweitet, so wäre die Verknüpfung dieser Daten ein nächster Schritt. Die Schaffung von Linked Open Data, möglicherweise über Landes- oder fachliche Grenzen hinaus, zum Beispiel unter Einbezug des Themenfeldes Open Science, könnte als Richtlinie für die optimale Wertschöpfung aus Open Data angesehen werden.

Finanzieller Mehrwert von Open Government Data

Dieser Abschnitt nimmt erste Betrachtungen grundlegender ökonomischer Wirkungsstudien vor, deren Ziel es ist, den finanziellen Wert von Open Data, Open Government Data, Persönlichen Daten und Public Sector Information zu messen und einzuschätzen. Welchen finanziellen Wert bietet Open Data? Was ist der zusätzliche Nutzen, der durch die Veröffentlichung von Open Data entsteht? Um diese Fragen zu thematisieren, wird die Richtung untersucht, welche vier aktuelle makroökonomische Studien einschlagen, um akkurate Messungen und eine Einschätzung des wirtschaftlichen Wertes von Open Data zu erreichen.

Zu den ökonomischen Vorteilen, welche durch Open Data in Österreich zu erwarten sind, gehören

- ein stetig steigendes Marktpotential, dass Tendenzen zeigt, mehr als 1% von Österreichs BIP zu umfassen
- zu erwartende Kosteneinsparungen von 39 Millionen € im Bereich der Regierungsausgaben in 2020
- eine Steigerung der Beschäftigung in diesem Feld um 32% in Europa und bis zu 2000 Stellen in direktem Zusammenhang mit Open Data in Österreich 2020
- ein Zuwachs an Effizienz in politischen Entscheidungsprozessen, bei Wartezeiten im Verkehr, im Gesundheitssektor, bei der Einleitung lebensrettender Maßnahmen im Notfall und bei umweltschützenden Maßnahmen
- nicht-finanzielle und indirekte Vorteile durch höhere Transparenz, die Entwicklung innovativer Anwendungen und eine Steigerung des Potentials durch Linked Open Data

Um diese Mehrwerte voll auszuschöpfen, muss der zentrale Fokus zunächst auf der Anwendung der als Open Data bereitgestellten Daten liegen.

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Part I:

Social, Political and Economic Impacts of Open Data

1. Introduction

Digital technologies have been applied in different domains and sectors, being responsible for huge changes in society (Scholz, 2016). In the public sector, new possibilities for innovating governance have been created by the growth in data, computational power and social media (Janssen & Wimmer, 2015), which signal a new Era that is *data-driven*. "Open data is one step further the knowledge-based society and economy" (Hossain, Dwivedi and Rana, 2016, p.35). Despite the clear potential of data for innovation (OECD, 2015; Zuiderwijk, Janssen & Davis, 2014) and the growing on the amount of data that have been opened by several levels of government around the world, there are still doubts as to whether open government data (OGD) will achieve all the expected benefits (Danneels et al, 2017).

Open data has become a topic of increasing importance in research and practice, with a particular expansion in recent years (Gonzalez-Zapata & Heeks, 2015; Safarov, Meijer and Grimmelikhuijsen, 2017). Despite being investigated with greater focus on public sector settings, open data studies are exclusively related to open government but with some also conducted in private settings (Hossain, Dwivedi and Rana, 2016). "The foundation of the information provided by the government is referred to as open data, sets of data published by government that can be read and interpreted by either humans or machines" (Melloulia, Luna-Reyes and Zhang, 2014, p.2). This study pays particular attention to data opened by governmental organizations, but we use the terms *open government data* and *open data* interchangeably for convenience.

The main impacts of open data initiatives in local governments are related to the use of data to improve decision-making and to better meet the needs of citizens (user side), as well as promoting transparency (provider side), due to the fact that governments provide access and stimulate re-use of public sector information (Pereira et al. 2017; Hossain, Dwivedi and Rana, 2016). Transparency was also identified by Attard et al. (2015) as one of the main objectives of opening government data, together with the direct impact provided by information access, increase in accountability and new possibilities for citizens to participate in the governance process. Thus, open government is also highly related to the smart governance concept, especially considering that the promotion of participatory governance is one of the drivers of open government; in which by opening up data, citizens are better informed and can be involved in decision-making (OKF, 2017). According to OKF (2017) transparency as one of the main objectives of opening government data is related not only to access of the information but also to sharing and reusing it to create meaning. That brings to fore the complementary main effect of open data on releasing social and commercial value, with the creation of innovative business and services (OKF, 2017).

Three recent literature reviews explore the OGD topic focusing on the utilization of OGD (Safarov, Meijer and Grimmelikhuijsen, 2017), on assessing OGD initiatives (Attard et al. 2015) and providing insights from open data research (Hossain, Dwivedi and Rana, 2016). Although the first two provide some discussion about the impact of OGD on stakeholders and main effects of OGD utilization, an overview of the current state-of-the-art in open data is lacking.

Proponents of OGD believe that the new role of the public sector as an information provider will have an impact on the creation of social and economic value and on attaining good governance (Safarov, Meijer and Grimmelikhuijsen, 2017). Cultural challenges of open government data initiatives have strong relation to awareness about the benefits and potential of open data (Attard et al., 2015). In order to highlight the value of open data, the objective of

this study is to present a comprehensive overview from the academic literature and practice on the impacts of open data in the following dimensions: 1) Social and Political impacts, and 2) Economic impacts.

The social and political section covers the influence that the opening of data has on social and political institutions. For instance transparency and accountability are identified as the core expected effects of OGD initiatives (Safarov, Meijer and Grimmelikhuijsen, 2017) as well as citizen empowerment and democracy (Ruijer, Grimmelikhuijsen & Meijer, 2017).

The second topic, economic impact, is often measured in monetary terms and the generation of revenue. For example, when analyzing the effects of OGD utilization (Safarov, Meijer and Grimmelikhuijsen, 2017) economic development is considered the second most prominent aspect.

The main theoretical contribution of this study pertains to the provision of an overview of the current state-of-the-art in open data research as one of the first comprehensive reviews with a focus on the various impacts of OGD. The practical implications affect policymakers and governmental institutions by providing recommendations on how to maximize the benefits of OGD implementation, especially but not limited to the Austrian context.

This document starts by presenting the methodology applied to this study. The research design is followed by the analysis and results of the literature review. The next section explores the open data scenario in Austria. The following section then presents policy recommendations. Finally, concluding remarks and an agenda for future research are discussed.

2. Methodology

In order to analyze the existing knowledge on the impacts of open government data we conducted a literature review based on Webster and Watson (2002). The design of the review consisted of: defining the search terms; select the sources; applying the search in the sources; going backward by reviewing the citations for the articles, selecting the sample based on the abstracts and finally based on the full-text.

The sources included the Government Information Quarterly Journal as it is recognized as one of the main sources in the government community as well as the Scopus database. The search terms includes "open data" and "open government data" for the first step, resulting in 537 papers. The second round included terms such as "impact", "effects", "implications" for identifying specific aspects of open data, resulting in 80 papers. Finally, based on the citations from the identified articles in the first step we determine further material that was also relevant for the analysis.

2.1 Austria: A Study of Open Government Data

Complementary to the analysis of impacts of open data we investigate open government data in Austria. Austria is a middle-European democracy with less than 9 million inhabitants. Its federal administration structure and the strive for innovation provide the basis for a relevant and interesting study.

Regarding the literature that deals specifically with the application and existence of open data in Austria there is still room for further research. A literature research on the platform SCOPUS with the search terms "open data" AND "impact" AND "Austria" resulted in merely one article (Tenorico et al., 2016). Disregarding the matter of the impact open data may have, the search for "open data" AND "Austria" gave thirteen results including the one found in the first search. These thirteen articles include articles in English and German. An additional search for German material with the search terms "open data" and "Österreich" only provided one of the aforementioned articles and no additional information (Buschmann et al., 2015). A more extensive examination of open data policies from a theoretical perspective can be found in the "Open Government Data Implementation Evaluation" (Parycek et al., 2013).

Additional documents were selected if they were referenced in any of the given studies. These documents are selected project reports or action plans which have been published by the European Commission or national stakeholders, including the "EU eGovernment Action Plan 2016–2020" as well as the "e-Infrastructures Austria Activity Report 2014–2016".

Especially these reports show that Austria is an exemplary case within the field of open government data. As one of the first countries in Europe, Austria launched its open government data portal first in 2011. While the introduction of open data platforms in Austria began on the regional level, Austria now provides more than two nationwide open data portals with a wide range of associated and integrated applications. Numerous initiatives and projects provide the basis for an elaborated open government agenda as well as further enhancement of e-government services and the digital infrastructure. This can be achieved through analysing

and evaluating implemented measures and by orienting further efforts on international best practices as well as innovations from the private sector.

3. Terminology: Open Government, Open Data and Open Government Data

"The creation of an open government needs extensive transformation of the public sector as well as the relationship between government and the public and needs to be mediated by information and communication technology (ICT)" (Janssen et al., 2017, p.3). The principles of open government are data openness, transparency, participation, and collaboration (Veljković et al., 2014; Parycek & Sachs, 2010). Veljković et al. (2014) summarize the concept of open government based on data transparency, government transparency, government accountability, participation and collaboration. Data transparency refers to opening and promoting access to public sector information data for citizens and entrepreneurs. Government transparency is related to making the process and operations of government open to the public whether accountability refers to explaining decisions and actions to the citizens. Engaging citizens in decision making is defined as participation and enabling cooperation among the stakeholders is referred as collaboration. Thus, based on these principles, the idea of open government is to establish a modern cooperation among politicians, public administration, industry and private citizens (Bauer & Kaltenböck, 2011).

Open data refers to any data and content that is freely available and accessible and can be used, modified, or shared by anyone for any purpose (Janssen, Charalabidis & Zuiderwijk, 2012; OKF, 2012). Open Data is related to data and information beyond just governmental institutions, including those from other relevant stakeholder groups such as business/industry, citizens, NPOs and NGOs, science or education (Bauer & Kaltenböck, 2011).

Open Government Data can be considered as a specific subset of data which lies on the open data and government data domains (Kučera, Chlapek & Nečaský, 2013). Government data is referred to the generation of value through reuse public sector information, e.g. all information that public bodies produce, collect or pay for (European Commission, 2013). Open Government Data (OGD) thus refers to the act of making public sector information available in open formats making it possible for public to access and exploit the data (Kalampokis, Tambouris, & Tarabanis, 2011).

4. Findings on the impacts of open data

One of the primary objectives of this research paper is to delineate and discuss in adequate detail the different domains within which open data bears significant effect so as to construct the foundation of a policy roadmap for the future release of information and knowledge. As discussed previously, a list of impacts pertaining to open data have been extracted through a systematic literature analysis of indexed scientific works, and are presented to the reader in this chapter.

Our research findings are organized in the following manner: based on the results of a thorough review of the scholarly literature, the chapter is divided into two sections. The first section is concerned with the social and political implications of open data. The second section deals with open data's economic implications. Each derived proposition is then classified as one or the other, and listed, and then discussed.

4.1 Societal/Political impact of Open Data

This section outlines and discusses the social and political impacts of open data. A review of indexed scholarly literature has led to the identification of 8 areas within which the unfettered release of data, and in particular government or public sector information, has the potential to impact the formation of social and political capital. These are: public services and public service innovation; citizen empowerment; citizen participation, collaboration, and proactive citizen engagement; transparency and trust; public accountability; public sector efficiency and effectiveness; personal data and privacy of the individual; and civil society organisations.

4.1.1 Impact on Public Services and Public Service Innovation

Open data can foster innovation in public service provision, when governments make public sector information available to a range of non-institutional actors – from the private sector, the non-profit sector, the general public – and actively solicit their input to create new services and to renew existing ones. In other words, by publishing public sector information datasets, governments encourage stakeholders from across civil society to reuse their data innovatively to co-create new public services (Attard et. al., 2016) and to tackle old problems (OECD, 2017).

The process of open data provision is often regarded as the natural complement to approaches focused on citizen-centric public service design; involving as it does the involvement of non-institutional actors in the creation of public services, and the inclusion of their experiences and feedback into the governance process (OECD, 2017; Pollard, 2011). Opening public data can also result in improved public service standards, as citizens and civil society organisations have immediate access to service-related information that enables them to rapidly make accurate comparisons across different sectors of the public sphere and to take informed decisions based on robust data (Pollard, 2011).

In this respect, the provision of open data changes the roles of actors involved in the process of governance. At its most basic, the opening of government and other data creates new opportunities for a wide range of individuals and organisations to re-use and create information a-new through collaborative social networking and the application of other interactive

solutions (Nafis et. al., 2015; Janssen et. al., 2012; Chun et. al., 2010). In particular, the creation of data-driven networks and partnerships has significant implications for the roles played by government and citizens in the production and consumption of public services; in short, a transformation of governance and the social contract, wherein the focus of service provision shifts from a citizen-as-customer approach towards shared responsibilities via government-citizen collaborations (Linders et. al., 2012).

On the one hand, the availability of open data has the potential to change the role of individual citizens and civil society actors, turning them from passive consumers of government services into active co-producers engaged in social entrepreneurship (Pollard, 2011). Citizens now possess the ability and means to creatively combine their particular expertise with insight gained from using existing public services to develop functionalities and applications for the public good that go beyond what public servants are capable of creating on their own (OECD 2017; Bichard & Knight, 2012; Linders et. al., 2012).

Opening government data also changes the part played by government in society (OECD, 2017; Daglio et. al., 2015). The provision of public sector information makes it accessible and re-usable by other actors in civil society and creates a two-way dialogue that changes the role of government from it being the sole developer of public services to a co-creator of innovative solutions. To deliver effective public services, therefore, governments have had to become increasingly open, transparent, accessible, consultative, and collaborative (Ham et. al., 2015).

However, data availability and accessibility alone are not sufficient conditions for the leveraging of this potential of open data to generate value in the governance process (Jetzek, 2014). Political and social innovation only arises through the re-use, dissemination and linking up of open government datasets. The provision of the appropriate functionalities to enable the linking up of data must be provided, therefore, precluding the creation of a data value network wherein different actors participate in creating value by engaging in related activities that consist of one or more value creation techniques (Attard et. al., 2016).

4.1.2 Impact on Citizen Empowerment

The release of open data contributes towards the empowerment of individual citizens by altering the nature and scope of role they play in the process of governance. Making public sector information readily available and easily accessible for re-use enables, in the first instance, the establishment of a collaboration and participation culture among the main stakeholders in the governance process (Casalino et. al., 2013; Geiger & von Lucke, 2012). For non-institutional actors, and particularly individual citizens, this implies their involvement in the co-creation of public goods and services, and their transformation from mere consumers of data and services into active producers or "pro-sumers" of public goods (Geiger & von Lucke, 2012). Therefore, in consequence, by facilitating the emergence of networks of collaboration and co-creation, the provision of open government data can translate into the empowerment of individuals within a society (Craveiro et. al., 2016).

The open data movement has changed the mindset of citizens, and consequently the manner in which they participate in the governance process (Weerakoddy et. al., 2017; Geiger & von Lucke, 2012). Geiger & von Lucke (2012) contend that provision of public data engages citizens in governance processes, and allows for the evolution of a more personalized and individual-centric dialogue between them and their government. Ready access to data ensures that citizens have the opportunity to become well-informed actors in these interactions, using 'low-threshold' data to sustain 'high-quality' discussions (Ibid.). Further, Weerakoddy et.

al.(2017) maintain that citizens no longer want to, or expect to be, mere passive recipients of legislation; and instead seek out constructive means to enhance their civic responsibilities.

The role of technology played in the furtherance of citizen empowerment through the provision of open data must not be understated. In particular, the emergence of collaborative technologies and social software at the heart of open data production has led to an acknowledgement of the influence of social networks and the roles of stakeholder-actors within them(Maier-Rabler & Huber, 2011). Thus, according to Pitt et. al. (2013), the integration of social and sensor networks have the potential to transform big data captured within the smart city context into 'a higher form of collective awareness that can motivate users to self-organize and create innovative solutions to various socioeconomic problems' [p.XX].

Another key empowering aspect of open data platforms is that the provided technology makes it easier for individual citizens to communicate their ideas, formulate opinions, and interact constructively with public administrators and political representatives over fundamental societal issues (Ruijer et. al., 2017; in press). To this end, Álvarez García et. al. (2014) see the generation and subsequent provision of information products based on analysis, treatment and visualization as the creation of new outlets for citizen empowerment. In sum, the access to open government data, and the availability of tools and technologies to combine it creatively, lead to a better understanding of government activities and a more active role for citizens as they are empowered to monitor public service provision, provide feedback, and contribute to development of governance initiatives.

4.1.3 Impact on citizen participation/collaboration/proactive civic engagement

It is envisaged that the opening of data will not only transform the provision of public services but will, in modifying the role citizens play in the governance process, have a significant effect on citizen participation, citizen collaboration, and proactive civic engagement. In theory, the provision of free datasets to the public will not only empower citizens as consumers of public services, but will also encourage them to take an active interest in their co-creation and increase individual engagement with the providers of such services (Zuiderwijk & Janssen, 2014; Zuiderwijk et. al, 2014; Conradie & Choenni, 2014).

In other words, open government data transforms not only how public services are conceptualized and delivered, but also changes the role played by private citizens in the consumption and development of those services (Jetzek et. al., 2012). Jetzek et. al. (2012) contend that the combination of open data and information technology "enables increased citizen participation and collaboration, leading to improved citizenship and collaborative behavior through crowdsourcing activities" [p. 5]. Further, being able to access accurate information about public services, it is thought, will enable citizens to engage in meaningful dialogue with government, thereby helping service providers to better address their needs (Kassen 2013).

From a technology and policy standpoint, it is recognized that the combination of open data with state-of-the-art technology have a profound impact on a citizen's capacity to participate actively in the governance process. Johanssen et. al. (2015) demonstrate, for example, that public service provision involving a combination of open data and mobile e-services for public service provision has the propensity to encourage the regular and meaningful involvement of citizens in e-government processes. Zuiderwijk & Janssen (2014) consider citizen engagement in the form of regular user interaction on open data platforms an important facet of open data policy, and a direct consequence of the provision of high-quality data within an open data ecosystem.

The open data ethos, through the free-access provision of information and tools, will also engage private citizens by encouraging them to individually develop creative solutions to complex societal problems (Kassen, 2013). Based on his analysis of an open data initiative in Chicago (USA), Kassen concluded that open data creates a 'favourable environment for proactive citizen engagement by providing a real opportunity for independent developers to create applications by using available datasets from the web-portal without any official permission [p. 512]'. Taking this idea further, Johanssen et. al. (2015) determined that the use of open data in the provision of public services not only extended the service life-cycle of existing public services, but also created new avenues for citizen participation; allowing individuals to generate new data and to shape the nature and direction of governmental processes.

The release of open data has, thus, the potential to make citizen collaboration a more meaningful democratic process, by providing contributors with the data necessary to take well-informed decisions and actively engage with each other and with government. These efforts can, with a little guidance from public service providers, further be channeled into issues identified as priority areas. The key to the impact of open data on citizen participation as a result of open data lies in the provision of such data giving rise to active and regular public engagement measured against the achievement of tangible societal and political outcomes.

4.1.4 Impact on Transparency and Trust

The opening of data has profound implications for notions of public transparency. The impact of open data on transparency may be discussed with the context of two propositions: First, the provision of access to government data makes public decisions, actions, and results easy to follow. Second, the provision of government data removes opacity, and in doing allows for greater public scrutiny, both of which increases trust in the state.

Transparency is one of the three key principles around which the open government paradigm has been constructed (Franceschetti, 2016; Orszag, 2009). The concept is regarded as one of the preconditions of democratic society (Janssen & van den Hoven, 2015; Bertot et. al., 2010). While there exist in the scholarly literature many definitions of what transparency consists of in practice, it may at its most basic be considered as 'the ability to see what is happening within the government by the public' (Janssen et. al. 2017; p. 3).

According to Piotrowski (2007) cited in Bertot et. al. (2010), Government transparency generally occurs through one of four primary channels: the proactive dissemination by the government; the release of requested materials by the government; via public meetings; and via leaks from whistleblowers. In this context, a major objective of releasing open data for governments has become the promotion of public transparency (Hardy & Maurushat, 2017; Sivarajah et. al., 2016), wherein a multitude of stakeholders from civil servants to citizens stand to benefit (Weerakoddy et. al., 2017) and generate economic and social value (Jetzek et. al., 2014).

Most recently, Information and Communication Technologies (ICTs) have been deployed by governments as cost-effective tools to promote openness and transparency and to reduce corruption (Bertot et. al., 2010). However, while ICTs are considered as key enablers of open government (Luna-Reyes et al., 2014), Janssen et. al. (2017) contend that the conscious opening of data by government bodies in formats readable by the new ICTs will not automatically lead to increased transparency. They argue that while current efforts by government administrations have focused on releasing data, the opening of data is seldom accompanied by mechanisms to facilitate the better understanding of that data by citizens. Open data is, therefore, not always easy to follow.

Evidence from Sweden underlines this viewpoint (Temiz & Brown 2017). The idea is also taken further by Kornberger et. al. (2017), who emphasize that the progression from an open government to a transparent one is not altogether straightforward as often made out to be, and that a more actor-centric approach needs to be adopted in harnessing technology needed to achieve open government. O'Hara (2012), considers the pros and cons associated with the issue of how open data and transparency helps fosters trust in politics. Trust is, according to O'Hara, not always a direct consequence of openness. In weighing the merits of these argument, Triviño (2016), citing experiences from Ecuador, posits that open government data initiatives that aim solely for the attainment of transparency via the use of ICTs are limited in their outlook.

In conclusion therefore, merely opening data does not appear to lead to increased transparency. Without providing adequate procedural and participatory mechanisms to help citizens make sense of provided government data, only limited transparency is created as the public will remain unable to either comprehend fully the inner workings of government or make use of the data to actively monitor what government officials are doing. Trust in government will not necessarily follow as a consequence of data provision either.

4.1.5 Impact on Public Accountability

Building on notions of transparency, public accountability refers to 'the institutionalised practices of account-giving by government, characterised by a certain degree of openness or accessibility by citizens' (Bovens, 2005; p. 183). Arcelus (2012), citing Lopez-Ayllon & Arellano (2008), determines further that the concept of accountability consists of a dimension of 'answerability' that involves two components: information and justification. On the one hand, the information component implies, according to Arcelus, that an authority is obliged to provide information that a citizen has a right to access. The justification component, on the other hand, implies the justification of actions by government to citizens and the creation of a dialogue between the two actors (Arcelus, 2012; p.83).

Yu & Robinson (2012) posit that open data can be a powerful enabler for public accountability; that the disclosure of public data in a readily-accessible form allows for a new level of public scrutiny by making existing information 'easier to analyze, process, and combine than ever before' [p.182]. This proposition is widely supported in the scholarly literature, wherein it is held that the publishing of government data online in a machine-readable and easily interpretable format for consumption by citizens and firms facilitates the holding up government actions to general scrutiny (Agrawal et. al., 2014; Gueret et. al, 2014; Misuraca & Viscusi, 2014).

Four case studies from Australia, Russia India, and the United Kingdom serve further to underline this viewpoint.

- Hardy & Maurushat (2017), from their study of the Australian open data context, contend that there is a strong case in for the disclosure of statistical and policy data produced by government agencies to drive transparency.
- Koznov et. al. (2016) in their study of the impact of open data in the Russian Federation further underline the importance of governmental information disclosure for good governance.
- Saxena & Janssen (2017) conclude, from their study of the Indian open government context, that open government data initiatives foster increased interaction between the government and the public, thereby promoting greater public accountability.

Bichard & Knight (2012) maintain that the release of data held by the UK government could, under open license, result in the sort of public accountability that spurs innovation and drives the improved provision of public services and facilities.

Misuraca & Viscusi, (2014), in agreeing that the publishing of government data online has a positive impact on accountability, emphasize that differences in governance systems affect the way in which in which the open governance model is interpreted and implemented. This, they say, has repercussions for notions of public accountability. The idea is underlined by Lourenco (2015), who maintains that open government data portals need to be designed to fully support ordinary citizens engaged in public accountability efforts. To this effect, Lourenco suggests a number of important structural and organizational design elements to be incorporated into national data repositories.

Discussions in the scholarly literature concerning the shift towards the provision of big open data by government, particularly examples taken from country-based studies, has made the imperative for public accountability of government even greater (Sivarajah et. al., 2016). We argue, therefore, it is not enough that data be provided in open format by a government to citizens, but that the conduct of government leading to the collection of that data must be explained, and the ways in which government uses and intends to use datasets in the future be described.

4.1.6 Impact on Public Sector Efficiency and Effectiveness

Open data has the potential to modernize and streamline government operations, especially when used in combination with state-of-the-art information and communication technologies (Attard et. al., 2016; Donker et. al., 2016; Jetzek et. al., 2014; Liu, 2014). In fact, the improvement of operational efficiency has been listed by scholars as one of the primary reasons for governments to open their data to the public (Weerakoddy et. al., 2017; Janssen et. al., 2012).

Jetzek et. al. (2014) maintain that public sector efficiency can be attained via opening government data through 'the consolidation of overlapping repositories, the improvement of information infrastructure, by encouraging inter-agency coordination, and the introduction of better financial controls' [p.6]. In responding to the need to close the circle, calls for governmental transparency and increased operational efficiency resulting in the propensity for public services to deliver tangible benefits to a given population have prompted the increased provision of open data by public organisations to deliver on public sector efficacy as a pre-condition for good governance (Graves & Hendler, 2014).

4.1.7 Impact on Personal Data and Privacy of the Individual

The opening up of government datasets for use by the general public has a particularly significant implications for data protection and individual privacy, as governments collect and hold large amounts of personal information about their citizens. The debate on Open Data and Data Protection focuses on individual privacy, and how the latter can be protected while taking advantage of the enormous potentialities offered by the disclosure of big data and the application of big data analytics to processes of governance (Floridi, 2014). While open data initiatives aim to create public value through the promotion of innovation and transparency, increased openness may also lead to breaches in privacy and to security violations as data containing personally identifiable information (PII) is released into the public domain (Hardy & Maurushat, 2017).

According to Scassa (2014) open government policies can impact the notion of privacy in three different ways:

1. The first impact pertains to the balancing of the transparency and accountability objectives of open government with the individual's right to privacy [pp. 402–405]. Increased transparency and accountability require the disclosure of government information, a lot of which consists of collected personal information. Tensions arise when personal infor-

mation is considered "public" and governments have to decide on the degree to which this sort of data is then made available.

2. The second impact arises from the disruption of traditional approaches to privacy as a consequence of the "collapse" of the distinction between public sector and private sector actors [pp.405–407]. Typically, private sector and public sector entities have been governed by different privacy regimes; however, with the interlinkages formed through the use of private sector models, platforms and tools the lines between private and public sector components of governance are fast being blurred.

3. The third impact relates to the potential for individuals to be identified within government datasets once this data is released into the big data ecosystem and combined with other available data [pp. 407–408]. Government datasets may appear to be free of personal information or might have been anonymized, but in combination with other available data can pose real risks to privacy.

Of the three effects of open data on privacy outlined above, it is the emergence of big open data from the release of public datasets that has been discussed elsewhere in the scholarly literature. The unfettered collection and opening of big data for re-use by the public may conflict with privacy, resulting in individuals being re-identified and having their personal details exposed; even when at first glance the data are anonymized or aggregated (Meijer et. al., 2014). There is strong possibility of such circumstances arising as, according to Hardy & Maurushat (2017), the linkage and cross-referencing of different high-quality granular datasets can, in creating economic and social value, ascribe identifying characteristics to released data, making it personal.

To prevent privacy breaches, therefore, it is necessary to eliminate all privacy-sensitive attributes prior to the opening of data. (Meijer et. al., 2013). Hardy and Maurushat (2017) propose the de-identification of data , defined as 'the removal, stripping or obfuscation of directly identifying elements from a dataset such that the data is not immediately identifiable as associated or linked with a particular individual' [p. 32], as one possible solution to reduce these risks. However, it is still unclear as to whether current techniques are sufficiently reliable to protect individuals from being re-identified from anonymized data (Keenan, 2012).

Further, important questions need to be asked about the types of data collected for use by government or private entities, who collects this data, who has legitimate access to datasets, which data can be opened up to public usage, and what constitutes an appropriate privacy framework for the linkage of different data (van Zoonen, 2016).

4.1.8 Impact on Civil Society Organisations

Open data as a raw material is not very useful when taken on its own (Jetzek et. al., 2014), instead it requires creative re-use and cross-pollination for any value to be extracted. Even when made available online, together with the tools necessary to extract meaning out of raw data, only a small fraction of available linked data is usually accessible to the general public for immediate consumption (Sadiq & Indulska, 2017). The rest of the supply of linked public sector information requires structuring and further analysis before it can be understood by a wider audience. One direct consequence of this has been the emergence of a new breed of data intermediaries within open data ecosystems; individuals or organisations that play an important in role in creating awareness about open data and identifying types of (mainly statistical) information that have intrinsic social value (Attard et. al., 2016).

In such a situation, the opening of government data would have a significant positive impact on the role played by civil society organisations in the process of governance (NDI, 2013). Non-profit organisations focused on government accountability would find themselves ideally positioned to play this critical role (Manyika et. al., 2013). What is required is a willingness on

the part of civil society actors to engage with open data portals: to actively acquire information as it is made available, analyse it to create useful information, and structure findings in a manner that is immediately accessible to the general public.

The release of open data thus also modifies the role played by civil society actors in the governance process, involving this group of stakeholders in the active scrutiny of government and in the active co-creation of public services. Again, proactive input in the form of expertise and experience is required from civil society organisations if they are to best serve the populations they claim to represent.

Open information on the location of resources and on the quality of existing systems can help civil society organisations identify areas where need is greatest and resources are lacking (Manyika et. al., 2013). Insight here can help both in the planning of day-to-day operations, in the development of a long-term vision or strategy. Manyika et. al. (2013) argue that the ability of civil society organizations to mobilise volunteers on a large-scale can also contribute to the development of socially useful applications and tools. Volunteers with data-related skills from around the world can be brought together by organisations with international reach to fill local, regional or global talent gaps.

Meng (2014), however, contends that while open datasets support dialogue or collective deliberation with public officials, the interests of marginalised groups represented by civil society organisations are not immediately served by the provision of machine-readable data online. This researcher concludes, therefore, that civil society organisations need to actively engage with open data resources to transform provided information into resources with social value. In doing so, open data would contribute to the advancement of an organisation's advocacy and policy goals.

4.2 Economic impact of Open Data

This section outlines and discusses the economic impacts of open data, and its use as a business resource in the creation of economic value. Four domains wherein open data has the propensity to influence the generation of economic value-added through its use by (primarily) private actors have been extracted from the scholarly literature. These are: entrepreneurship; business innovation; economic efficiency and resource usage; and business models and process chains.

4.2.1 Impact on Entrepreneurship

Data in today's knowledge economy is an asset, but its real contribution to economic value comes from the business insights that are extracted from it (Kamal, 2012). And the identification of true creative business insight is the job of the innovative entrepreneur.

Lakomaa & Kallberg (2013) highlight the importance of open data as an enabler, catalyst, and foundation for innovative entrepreneurial activity. They identify five ways in which open data can make a contribution to the generation of economic value through a study of Internet start-up firms [pp.561–562]:

1. Simulate potential viability to secure funding: Open data platforms can provide first-time entrepreneurs with a data-rich environment within which they may test their ideas and build evidence to support the actual viability of the proposed project.

2. Provide Information about Potential Markets: The sheer breadth and depth of data collected and published by government provides entrepreneurs with the information they need to identify potential niche markets for their products and services.
3. Reduce Development Lead Time to Application Market: High quality and robust public sector data requires very little processing and can be fed directly into the product development process by enterprising entrepreneurs.
4. Drive Innovation Beyond Applications: Small businesses and entrepreneurs can creatively combine different open datasets with existing company data to drive product development beyond current application suites.
5. Enhance Existing Online Services and Offerings: Open data can be applied by entrepreneurs to existing products and services to aid them in the generation of new ideas, structures, and perspectives.

The United States of America under former president Barak Obama has also recognised the significant role that open data can play in promoting entrepreneurial activity. In a memo on big open data written for the White House blog in 2014, Meyer wrote that 'freely available data from the U.S. Government is an important national resource, serving as fuel for entrepreneurship, innovation, scientific discovery, and other public benefits.' (Meyer, 2014).

Manyika et al. (2013) maintain that open data creates opportunities for entrepreneurs to develop new revenue streams and increase the productivity of their business operations. Such individuals, in their quest to carve out niche markets are best placed to bring together information and knowledge from different sectors of the economy, and to combine these business insights with proprietary data to further their business ambitions.

When it comes to social entrepreneurship as a business culture, one must also consider the role played by public servants and their attitude towards open data initiatives. In a study conducted to determine the key determinants for the successful uptake and application of open government data within public organisations, Janssen et. al. (2012) discovered that one of the key institutional barriers to the adoption of open data amongst public was the prevalence of a risk-averse culture or a lack of entrepreneurial spirit. We suggest here, therefore, that the key to advancing innovation within government lies in overcoming well-entrenched risk-averse behaviour and developing strategies around open data that promote a culture of social entrepreneurship amongst public sector employees.

4.2.2 Impact on Business Innovation

It is widely accepted that the use of open data will have a positive impact on economic value creation by supporting increased rates of innovation (Donker et. al., 2016, Zuiderwijk et. al., 2015; Misra & Mishra, 2015; Susha et. al., 2015; Zimmermann & Pucihar, 2015; Jetzek et. al., 2014; Juell-Skielse et. al., 2014; Lakomaa & Kallberg, 2013; Pollock, 2009). In particular, the release of public sector information as open government data can result in tangible economic gains through the promotion of increased entrepreneurial activity that supports creative innovation in business (Lakomaa & Kallberg, 2013).

Data has become the life-blood of modern national economies, and is even regarded as a new class of economic asset (Brown et. al., 2011). Pepper et. al. (2016) argue that a consistent flow of data implies not only the exchange of raw information, but also '…the sharing of ideas and the dissemination of knowledge as well as the emergence of collaboration and cross-pollination amongst individuals and companies' [p. 40]. Thus, the free flow of 'liquid' or open data is a significant driver of innovation within a data-driven economic context (Manyika et. al., 2013).

Lower prices for that data, resulting largely from increased access and usage, are likely to stimulate the rate of innovation within and across different sectors of the national economy (Pollock, 2009). Entrepreneurs and small-scale business owners having sustained access to open data, and most especially open government datasets, can use the information and knowledge to grow their businesses and make them more competitive (Pepper et. al., 2016; Jetzek et. al., 2014). Analytics based on open data can inform the development of new products and processes by aiding in the trending of consumer preferences, the uncovering of anomalies in cost, and the comparing of variations in business performance (Manyika et. al., 2013).

The use of open data creates for companies multiple business opportunities: both established firms and first time entrants can use open data in combination with existing proprietary data to develop new products and services, improve existing offerings, and drive forms of innovative entrepreneurship that are at once commercially profitable and beneficial for the public good (Donker et. al., 2016; Manyika et. al., 2013).

The European Commission (2011) describes data as an 'innovation currency' and asserts that open data matters for Europe as it 'is an essential raw material for a wide range of new information products and services that build on new possibilities to analyse and visualise data from different sources" [p.3]. Manyika et. al. (2013) refer to open data as 'liquid data', stating that firms seeking to harness the opportunities afforded by such a valuable economic resource '…can seek out and inventory sources of liquid data, develop strategies to influence others to make valuable data more available, invest in the development of tools that can transform open data into products and services, and dedicate staff to developing insights and designing products using open data [p. 11].

However, it is equally recognized that the full business potential of open data to create new products, services or business processes cannot be harnessed if governments withhold access to certain datasets over others (Carrara et. al, 2015). The provision of data, therefore, needs to be balanced with concerns for privacy, as often governments will not publish those data which contain personal information (Floridi, 2014). Jetzek et. al. (2012) identify the ability to mash up different sets of data to gain new insights and knowledge as a significant determinant of success in harnessing the innovation potential of big data.

4.2.3 Impact on Economic Efficiency and Resource Usage
The provision of open data by government and private organisations enables better use of existing resources. Better data creates economic efficiency by enabling the better, more responsible allocation of existing resources and minimizing waste (Buchholtz et. al., 2014). The European Data Portal (2017) states to this end that 'the aim of efficiency is to improve resource allocation so that waste is minimized and the outcome value is maximised, given the same amount of resources…' and that '…Open Data can help in achieving such efficiency'.

Another facet to this argument is concerned with the contribution of open data to the generation of economic value. Value generation occurs through effective resource allocation and efficient resource use (Jetzek et. al., 2014). Carrara et. al. (2015) maintain that the sharing of openly available data can have significant impact in the creation of economic efficiency and value; enabling 'faster and easier access to information, better resource allocation, increased automation, standardisation and interoperability' [p. 86]. Ready access to data can also reduce asymmetries of information, and result in more equitable resource allocation (Jetzek et. al. 2014; Manyika et. al., 2013).

Economic efficiency can also be attained by cutting processing costs through the forging of strategic connections between economic entities and the empowerment of key actors (Jetzek et. al., 2014). Open data portals, as a form of digital platform, do this by bringing together individual market participants with one another in real time, around the clock; thus facilitating the rapid creation and exchange of economic and social value between participants at near-zero marginal cost (Libert et. al., 2016).

The provision of open data and the promulgation of policies encouraging its use can result in the conversion of data from idle resources into assets that actively generate economic and social value.

Similar to the efficiency gains accruing to public services through the improved use of robust data, open data can be used by commercial entities and civil society bodies for accurate economic planning and better analyses of cost-saving potential, thus resulting in greater operational cost-efficiency for the organization concerned.

4.2.4 Impact on Business Models and Process Chains

The widespread availability of open data, and especially open government data, has had a profound impact, not only on the establishment of new companies, but on the emergence and adoption of new data-centric business models (Zeleti et. al., 2016; Koski, 2015; Bonina, 2013). Current trends have already seen firms change their business models to become more data-driven; relying less on intuition and more on factual evidence to drive product development, service provision and expansion into new markets (Hartmann et. al., 2014).

In order to leverage the economic value associated with open data, commercial entities have had to develop new business models that place this data, together with the tools for manipulation made available, at the heart of their production, supply, and decision-making processes. Such models are known as Open Data Business Models (ODBMs) in the scholarly literature (Koski, 2015).

5. Open Data in Austria

5.1 Literature

As chapter 2.1 explained, Austria can be identified as an exemplary case in the regard of open government data application. While the extent of literature on the issue may be scarce, Austria still is recognised as "one of the leading countries in the EU with regard to sophistication and availability of e-government services" (Egger-Peitler and Polzer, 2014; p. 143) on a European level and even as "one of the top-emerging leaders in the development of e-government" (ibid.) worldwide. Especially Vienna is portrayed to "present[s] itself to be one of the exemplary operators in terms of open data at local level in the German-speaking world" (ibid.; p. 144). This is especially remarkable as an example for the municipalities, which are identified as the main drivers within the Austrian context, while the federal open data policies have been rather reluctant in the first place and concentrated on the coordination of emerging initiatives (ibid., p. 143). Nonetheless a report on the European Data Portal identifies Austria "as a role model looking at centralising access to data" (European Data Portal, 2016; p. 12).

A basis for the national open data strategies in the European nations can be found on the European level. The European Commission published a "EU eGovernment Action Plan 2016–2020" as a guideline for the implementation of national eGovernment infrastructures, and states the following objective:

> "By 2020, public administrations and public institutions in the European Union should be open, efficient and inclusive, providing borderless, personalised, user-friendly, end-to-end digital public services to all citizens and businesses in the EU. Innovative approaches are used to design and deliver better services in line with the needs and demands of citizens and businesses. Public administrations use the opportunities offered by the new digital environment to facilitate their interactions with stakeholders and with each other." (European Commission, 2016; p. 2)

While open government and eGovernment might not cover exactly the same phenomena, the implementation of open government data (OGD) programmes and platforms and the initiative regarding eGovernment services might often occur within the boundaries of the same national digital agenda. Some eGovernment services might also be based on the usage of certain publicly available datasets. Therefore, open data is an important instrument, especially for countries that strive for leading roles in public digital innovations, such as Austria.

The here introduced "EU eGovernment Action Plan 2016–2020" is a follow-up project of the launch of an "open data strategy for Europe" in 2011. This strategy and initiative has been a measure of the European Commission, who wants to strengthen its role as a "good practitioner" (Egger-Peitler and Polzer, 2014; p. 138) in the field of public sector information (PSI) through the use of open data as a "vehicle for innovation, growth, and transparency" (ibid., p. 138). With this intervention of the supranational level, the foundation for a European harmonization of open data policies has been established.

So, Egger-Peitler and Polzer (2014) further introduce the importance of the influence European Commission efforts have on national open data ambitions. Directives and projects on

the supranational level could influence the actions of national governments and maybe even citizen demands. On the other hand, the establishment of a free market, as it can be found within the EU, may foster the international exchange of open data towards interconnectedness.

The decisive measure to fulfil the objectives within the Europe 2020 Agenda are National Reform Programmes, respectively NRPs. Not only state Egger-Peitler and Polzer (2014) that these programmes in general lack to address PSI, but they also identify that "The Austrian NRP reflects the need of PSI provision and the European Commission's open data initiative as barely as those of the other member states" (ibid., p. 142). However, Austria still deals with the implementation of open data in a broad range of projects and even several platforms. Further details on those issues are explained in chapter 6.2, which introduces "Projects and Practical Examples".

Especially Vienna serves as an example for Egger-Peitler and Polzer (2014). While data.wien.gv.at got its first datasets in 2011, the portal is now included in the federal platform data.gv.at, as research of the link shows. But is early as in 2014 the Viennese portal contains 89 applications, which were created on the basis of the publicly available datasets. Even a four-step model of OGD implementation for the Austrian capital is introduced. These steps are: increasing the data transparency of OGD, the improvement of open participation, the enhancement of open collaboration, and, finally, the realisation of ubiquitous engagement (ibid; p. 146). Therefore, the development of a well implemented open data strategy for the city of Vienna is already elaborated.

But beside a number of applied studies and the step by step development of open data, the scholars identify a lack of interest of the private sector in open data (ibid; p. 148). Within the same context, the quite extensive costs of open data implementation are mentioned. Even while Vienna as a OGD provider operates as an active reformer, on the basis of well-rounded political policies and open to international innovations, the final benefits of open data are perceived to be mainly external, especially since external actors put increased pressure of transparency on Viennese officials (ibid.). Thus, both the awareness and interest, especially of economic stakeholders, towards open data, to use not only the full societal but also the full economical potential of OGD. This potential exists not only, but also, and especially, for the public administration.

These statements are especially supported by Kaltenböck (2011), who connects the impact OGD can have on society to the imminent need to use the data. So it may be observed that the issue of a transformation within the field of data management and the resulting decline of the borders between citizens and the public administration (ibid.; p. 66) still are topics that have to be dealt with. Further, privacy and data protection (ibid.) are security measures that gain in relevance with the advancement of technologies and must be addressed in further regulations. Evidence for their consideration by public stakeholders may be the Datenschutzgesetz in Austria or the General Data Protection Regulation of the EU, which comes into force in 2018.

Kaltenböck's deliberations respond to the Austrian efforts to implement an open government data Strategy in 2011. To analyse the requirements for such policies, Kaltenböck (2011) analyses the requirements and introduces workshops with four decisive stakeholder groups. Those workshops with politicians, citizens, representatives of the industry as well as members of the public administration have been initiated to tackle these issues. Topics that have been identified as important for OGD strategies in the course of these examinations are introduced with short descriptions of their most relevant factors. These themes are the need for definitions, transparency and democracy in the course of open government, legal issues – concerning European as

well as Austrian legislation –, the impact the use of open data has on society, the facilitation of the innovation and knowledge society, the impact OGD has on economy and industry, the necessity of licenses, terms of use as well as exploitation models, more detailed aspects concerning the data, data governance, possible applications with hints towards best practices and, finally, technological aspects. The latter includes hints on the data quality, including Sir Berners-Lee's 5 star linked open data approach. This may be a first hint towards the necessity to advance open government data into linked open data (LOD). Kaltenböck (2011) concludes with the recommendation of a two-phase approach. The first step concerns the publication of existing datasets, while in the long term an elaborated digital infrastructure should be implemented (Kaltenböck, 2011; p.69). Chapter 6.2 demonstrates that the past six years already carried out many measures concerning the development of such an infrastructure. Nonetheless, it might still be useful to involve the mentioned issues in the further advancement of Austrian open data policies.

A great part of the literature deals with the evaluation and outcome of recent open data initiatives in Austria and forms recommendations concerning the further development of projects on open data. The elaboration of this concept often leads to the consideration of initiating the use of big data, linked data and linked open government data. A decisive measurement tool for the quality of linked open data is Tim Berners-Lee's "5 Star Open Linked Data" evaluation scheme Kaltenböck (2011) mentions within the context of technological issues concerning OGD. This classifies linked open data according to the availability on the Web under an open license, additional structure, the use of non-proprietary formats, URIs for meaning and links to other data on the fifth level.

Wetz et al. (2013) study open data in Austria in an environmental field and discover that in 2013 most observed datasets are 3-star datasets (ibid.). The authors recommend the advancement of the existing and future published data towards linked open data of 4 or 5-star compliance. The scholars (ibid.) identify the usage of open government data as a possible part of a possible solution to tackle the global problem of climate change. While open data on geographical issues exists, as will be elaborated below, a further step is to create an elaborated network of linked open data. Wetz et al. (2013) introduce related work on the application of Semantic Web Technologies or the use of LOD in Smart Cities.

Wetz et al. (2013) examine eleven Austrian publicly available datasets using eight data principles, general evaluation parameters and, centrally, the question how this data complies with Tim Berners-Lee's 5 star linked open data deployment scheme. But besides the quality and interconnectedness of publicly available datasets, the content and issue of the data is of importance. In Wetz's (2013) study, geographical and territorial datasets are the most frequent datasets that are available. Such open data can improve public services and, in the course of this particular study, environmental protection extensively. This may even be the task of these datasets, since "open data is not useful if the data is not used!" (Kaltenböck, 2011; p. 66). To achieve a higher degree of environmental protection, Wetz (et al., 2013) recommends extending the use of measured real-time datasets with updated frequency of inquiry.

Other scholars also dealt with the issue of "Environmental Infrastructures and Platforms with citizens observatories and linked open data (ENVIP'2013)" (Berre and Schade, 2013) in the course of an editorial to a workshop. The European ENVIP Programme also facilitated the aforementioned notion that "Information and Communication Technologies (ICT) are essential for reaching environmental sustainability" (ibid.; p. 1). Berre and Schade (2013) therefore state that the access to environmental data has to be ensured and advanced into environmental services. In 2013 and in Europe several initiatives already have been implemented. According to

the authors those include the Shared Environmental Information System (SEIS), the INSPIRE Directive and the Global Monitoring for Environment and Security (Copernicus).

Berre and Schade (2013) also introduced the concept of spatial data infrastructure (SDI), which "is a general term for the computerised environment for handling data that relates to a position on or near the surface of the earth" (ibid.; p. 2). An important role in this context plays the project concerning Environmental Infrastructures and Platforms (ENVIP), which "was introduced as a means to identify the European potentials" (ibid.; p. 2). Therefore, the ENVIP 2013 workshop, taking place in Austria, could give an overview of current project results. Part of the project have been workshops and papers on ENVIP requirements, the use for environmental service composition, and for citizens observatories. Additionally, invited talks have been held. Altogether, Berre and Schade (2013) conclude with a reference to projects and activities within the framework of ENVIP, but also hint to the prospect of broader initiatives as well as the further advancement and continuation of current projects. Remarkably, linked open data is an issue that is also mentioned here as a recommendation to facilitate the handling of environmental open data as well as the development of further applications that may help to improve sustainability and tackle problematic environmental issues.

In this context licensing has to be considered for the creation of LOD networks (Danowski et al., 2013). Danowski (et al., 2013) studies especially library linked data in Austria. While open data might be pre-existing in the forms that are introduced in detail in chapter 6.2, linked data is more insufficient and lacks nation-wide consensus (ibid.; p. 580). The improvement of linked data infrastructures and the inclusion of metadata would have positive effects according to the author. Closely linked to that issue is the matter of open access, which has been further elaborated in other papers and is closely related to the concept of Open Science.

Buschmann et al. (2015) provide a paper on the status of open science in Austria and especially focus on open access. While open access does not cover the same concept as open data, but focuses on the public availability of scientific research and corresponding papers. Nonetheless, according to Buschmann et al. (2015; p. 1) identify both open access and open data as vital parts of the open science principle and, moreover, attest Austria the initiation of first successful projects and initiatives within both areas. This includes especially the Open Access Network Austria (OANA), institutional open access policies and the platforms data.gv.at as well as the open data portal Österreich. The scholars further elaborate on important actors in the initiation open access, in addition to the science fund FWF mostly research and higher education facilities, and the growing awareness on the subject that involves the development of strategies. However, Buschmann et al. (2015) also emphasize the growing significance of open data.

As a result of those strategies, a variety of national initiatives and projects emerged. While chapter 6.2 will further elaborate on several of the here examined programmes, they shall be mentioned here. These initiatives concern open access as well as open data. Buschmann et al. (2015) introduce the Open Access Network Austria, which has many institutional members and launched five working groups in 2014, the Austrian Chapter of the Open Knowledge Foundation, which was founded in 2010, the project E-Infrastructures Austria, which elaborates on themes concerning various fields of digitalisation and the Kooperation E-Medien Österreich, a cooperation of academic libraries. Similar to most of the other papers that have been analysed earlier within this chapter, Buschmann's (et al., 2015) paper concludes with emphasizing the neccessity of further advancing, studying and implementing open data, open access and open science policies.

A special focus on open knowledge and the work of the Open Knowledge Foundation can be found within the work of Petrovic-Majer (2015). The Internet is seen as a chance to distribute knowledge rapidly and independently of its place of origin. Open data is seen as a useful tool to facilitate this distribution of knowledge. According to the scholar Open Knowledge Austria follows the vision to share open and transparent knowledge in the society. To meet this objective, a shift of paradigms as well as the transformation of knowledge transmission including new forms of innovation and networking is necessary. But besides the emphasis on the problem-solving characteristics, the importance of open data and new methods of data transfer, the feasibility of this vision and the security for private data have to be considered (ibid.). However, if elaborated policies, which take all these factors into account, are considered and put into practice, open data is an important part of a digitalised development.

Additionally to linked open data, open access and knowledge transfer, one last issue concerns the quality and existence of metadata. The observation of meta-data has been a part of a cluster of the aforementioned project E-Infrastructures Austria. A deliberation that points out the importance of metadata in this context has been published by Blumesberger in 2015. Here it is not only mentioned that the implementation and usage of metadata within repositories is not clear, but also that the importance and the accessibility of this data are significant. Blumesberger (2015) discusses several dimensions of metadata, which can be bibliographic, administrative, legal or technical and can furthermore be observed from a variety of viewpoints. But this complex matter also seems to be discussed recently since within this cluster sessions on policies and expert meetings have been held in 2016.

Before drawing general conclusions from the analysed literature, one last paper on the "Open Government Data Implementation Evaluation" (Parycek et al., 2014) shall be taken into account. This study especially focuses on the significance of open government data. While Vienna identifies simplified access for higher amounts of users, an increase in transparency of the public sector, a decrease in the efforts of the public administration and a simplification of administrative processes as the benefits of the Viennese OGD strategy (ibid.; p. 89), the paper identifies several benefits clusters, including internal, societal and economic advantages. Those have been identified by internal administrational as well as external OGD stakeholders. Altogether, "The main benefits of OGD are seen as improving internal processes, error reporting by users and the community, and an automated data service (instead of individual requests)." (ibid.; p. 90). To materialise and achieve these advantages through the implementation of open government data, recommendations in different dimensions have been stated. These concern, on both, the local and the federal level, strategic, technical and operative measures (ibid.; p. 92). Eventually, open data implementation has to be evaluated in the context of the current development of technology, administrational circumstances and the needs of citizens as well as economical stakeholders.

It is undeniable that European projects and directives have influence on national Austrian OGD policies. On the other hand, the European Open Data Portals also profits from the federally available open datasets. It has been emphasised that open data is an important resource within the development of an advanced and sustainable infrastructure. Since many existing open data resources concern environmental issues, use cases to tackle critical international problematics may be developed with the help of this data. Generally, the use of open data by citizens, businesses and the public administration is essential to generate values and utilise the potential this data has. Applications that are developed on the basis of this information are one method. But as the literature shows, even if it is only shortly mentioned and may be elaborated in further research, other factors also play important roles in the facilitation of open data strategies. This includes the advancement to linked open data as well as the role of metadata and the security

of citizen's private data. But in the course of developing projects and initiatives, several programmes on open data have already been launched in Austria. These will be introduced in the following section.

5.2 Projects and practical examples

While there are theoretical foundations, many of the studies that have been conducted in the area of open data, have led to the implementation of open data initiatives in Austria. Furthermore, basic information on open data in Austria can be found within "The ABC Guide of eGovernment in Austria" [1], which is published on the website that introduces the Austrian digital Agenda. This report introduces the principles of open government data, establishes data.gv.at as the central platform that facilitates access to publicly available OGD in Austria. Further, an abstract concerning the cooperation agreement is included.

It is also mentioned that "The platform is the central point of reference for the European Data Portal" (ABC Guide, 2017; p. 141) for which Austria is an important contributor. [2] The platform includes open data from member states and strives to encourage citizens to create own applications with the published data, for instance in the context of the #EUdatathon2017. [3] This service is funded by the EU and states that it "harvests the metadata of Public Sector Information available on public data portals across European countries. Information regarding the provision of data and the benefits of re-using data is also included." [4]

The "*Cooperation Open Government Data Austria*" (short "Cooperation OGD Austria") is one of the most influential stakeholders within the Austrian open data landscape. Founded in 2011 by the Federal Chancellery, the cooperation would later initiate common standards and agreements for open government data. The Cooperation OGD wants to provide a link between all possible stakeholders and actors who may create OGD platforms. Further, a more intense collaboration between the DACHLI nations (Germany, Austria, Switzerland and Liechtenstein) shall be undertaken. [5]

The platform *data.gv.at* can be qualified as the main OGD portal in Austria, which covers open data regarding all policy fields and the whole country of Austria. It can be called "the Austrian 'One-Stop Open Government Data Metaportal'" (ABC Guide, 2017; p. 140). The portal includes several possibilities to filter data. This includes a search possibility following the policy field, an alphabetical list of all datasets or the use of an integrating search function. Moreover, a list of applications which emerged based on the available data can be found. Part of that are the links to the respective applications. On the 6th of September 2017, 2438 datasets and 414 applications can be found. Based on the platform data.gv.at and the resources the Linked Open Data Pilot Project [6] was created in 2014 and is based on data.gv.at and the open data of Vienna, which will be explained below. While all this shows that there is massive OGD potential on the federal level in Austria, both the data on data.gv.at as well as the information on the LOD pilot is until now merely available in German. To enhance the knowledge of these platforms, the international exchange as well as the use of OGD and LOD a next step may be to publish data in English or other relevant languages.

Since the Linked Open Data Project orients itself on international best practices, including examples from the EU, the UK as well as the US, the observation of successful open data models on an inter- or supranational level may be a helpful tool to develop new or improved data portals.

While data.gv.at publishes open government data, respectively data from the public sector, a new portal is in development which shall supplement Austria's open data landscape with other data, distributed by private as well as public institutions. This platform is called *open data portal* Österreich [7] and the available Beta-version includes 416 datasets as well as 11 applications [8] and is until now only available in the German language. Therefore, the same consideration as for the above mentioned federal portal might be considered in the course of the further development of the open data portal Österreich. This portal is developed as a cooperation of the Cooperation OGD Österreich, Wikimedia Österreich and Open Knowledge Austria and is interconnected to Wikidata [9]. The general approach of cooperation and collaboration not only between different levels but also between the public and the private sector might be an appropriate foundation to foster new and innovative solutions in a digitalised world and deploy the potential of open data in the most suitable manner.

Another data platform is *INSPIRE* Österreich. It was initiated by the creation of an 'Infrastructure for Spatial Information in the European Community' which was the objective of the EU directive 2007/2/EG. From this project several initiatives regarding geospatial data in Austria emerged. [10] As Berre and Schade (2013) as well as Wetz et al. (2013) demonstrate, geographical data is one of the most frequent data that is published within an OGD context. Therefore, its significance for the development of a sustainable and useful digital infrastructure should be considered in further projects. Additionally, it may be concluded that the extent of the existing geodata might be an appropriate starting point to implement OGD and LOD from other sections.

The first of the platforms within the scope of the INSPIRE Österreich initiative is the INSPIRE platform itself, which entails information on the project and contains a catalogue and search tool for geospatial metadata. Access to and navigation within this portal are solely available in German language.

Further open data applications within the range of this project are the AMAP Austria [11] or Austrian Map online by the Federal Office for Metrology and Surveying as well as several GIS applications that are promoted by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management.[12] These contain the following Data:

First is the Altlasten GIS [13], which reveals contaminated sites and polluted areas that may remark a health risk for Austrian citizens.

A second application – eBOD [14] – gives digitalised information in the form of a soil map on the basis of existing Austrian mapping data.

The Hydrographic Service eHYD shows essential components of the natural water resources and related factors. [15]

The water information system Austria (WISA) [16] looks at the resource water from a more economic perspective, particularly on water supply and distribution.

Another relevant application is the EDM GIS, which is described as an assistant to digitally track sites that are relevant for the environment. This service is integrated into the EDM portal that is concerned with the electronic environmental data management. [17]

A more specific application is HORA (Hochwasserrisikozonierung Austria) [18] concerned with the risk of flooding. Besides floods the portal now includes information on other potential natural hazards.

On the website Lärminfo.at [19] information publishes information on environmental and traffic noise, especially if it could be harmful to health. Besides, current news on the topic as well as a mobile app with noise exposure maps are available.

Further applications the Federal Ministry of Agriculture, Forestry, Environment and Water Management mentions are the ISDW (the initiative for protection through forest), which has no working link and AgrarGIS, which provided geospatial information on agriculture until 2015.

The association *Open Knowledge* Österreich [20] is part of the Open Knowledge Foundation and supports open data by creating, using and sharing open knowledge. It plays a decisive role in initiating open data projects as a non-governmental actor. Open data as well as open science are essential parts of the foundation's curriculum. In Austria they participated in and implemented the following projects, that are introduced on the Open Knowledge website, which also seems to be available only in German.

One of the most influential projects Open Knowledge Österreich released recently might be its role in the abovementioned open data portal, which allocates open data from public and private institution as an additional platform to the provision of open government data by data.gv.at.

The site Offene Wahlen [21] (open elections) strives to provide accessible and transparent data on elections. On the point of time of this evaluation, the current data observed concerned a visualisation of the 2017 Austrian elections under the slogan #NRW17.

Another initiative dealt with the general approach to make open data readable and easily accessible and to promote this idea. This project was named Gute Daten or #gutedaten. The approach is to 'free' data, upload it or convert it into readable formats.

Open Data Inside [22] however does not provide open data itself but is similar to a badge that certifies that a certain company, organisation or institution uses open data. This may be an innovative way to further promote the usage of open data within public and private institutions.

Another way to implement a more extensive use of open data can be the involvement of Young Coders, like the Youth Hackathon which Open Knowledge Austria organised in 2014.

While many services on a federal level have been mentioned above, Egger-Peitler and Polzer (2014) identifies the municipalities as the main drivers of opening public data. Therefore, it is essential to include *Open Government Data Wien* [23] as the open data platform on the city of Vienna. Egger-Peitler and Polzer (2014; p. 144) characterise the case of Vienna as exemplary. The first datasets have been uploaded on data.wien.gv.at in March 2011 (ibd.; p. 145). Information on this site is also available in English.[24] As on the federal level, this portal also contains a variety of navigation methods. On the one hand, there is the possibility to search the whole catalogue of available datasets. This catalogue search redirects the request to data.gv.at. On the 6th September of 2017 328 datasets on Vienna can be found. This data is also

accessible on the Vienna OGD portal where it is structure according to policy fields, like work, arts and culture or health. A special feature, which has been highlighted within the literature are the data honeycombs [25] that visualise the OGD in German in a user-friendly manner. In September 2017, alpha versions for further German and Dutch cities are on the verge to follow the Viennese example.

While Vienna as a municipal unit and the Austrian capital occupies an exceptional position within the administrational division of the country. But not only Vienna publishes is data online. Besides the capital, all federal states publish OGD on own portals or interconnect their websites with the catalogue on data.gv.at.

The Burgenland [26] presents applications and datasets on different policy fields on its own website.

The open data presence of Kärnten [27] is directly integrated into the data.gv.at and additionally provides a variety of datasets.

Oberösterreich [28] presents 223 datasets in the form of an alphabetical list.

Salzburg [29] has its own open data platform, containing a list of datasets as well as search function.

The federal state Steiermark [30] contains a portal that introduces news on open data as well as links to national and supranational open data portals and emerging applications.

Tirol [31] follows a similar approach. Here, currently published datasets lead directly to the details of the concerning data on data.gv.at.

Vorarlberg [32] however has an own data portal that contains regional administrational data, geodata and applications based on open data.

The literature also introduces a wide range of other projects that we will be presented in short in the following section.

An influential project is *E-infrastructures Austria*, that has been carried out in between 2014 and 2016 by the Federal Ministry of Science, Research and the Economy. The objective of this project was "to promote coordinated expansion and the further development of repository infrastructures throughout Austria." [33] It involved external stakeholders and think tanks to work on twelve different clusters. From the clusters A to L, cluster F dealt with open access and is referenced in several of the articles mentioned in chapter 6.1.

Another project that might be considered is the *Open City Data Pipeline* [34], which is a Cooperation of the Vienna University of Economics and Business and the company Siemens. This project has been launched with the objective to facilitate the ease of data gathering and connecting city data for future studies and research projects.

Genom Austria [35], however, deals with a completely different issue. This project seeks to initiate an open, publicly accessible database on personal, human genomes.

Above, the innovative potential of Austrian open data projects has been mentioned. A further evidence of this might be that two Austrian initiatives were honoured with the Open Humani-

ties Award. As also has been stated before, geographic data plays an important role in the field of open data. The two awarded initiatives have been Pelagios [36], which matches antique sources with maps of the described location, and Maphub [37], which digitalises and provides historical maps.

Another field that might be related to open data is open access and, in the course of this, open science. While this phenomenon cannot be explicitly observed within this elaboration on open data, a few projects and initiatives shall be mentioned to hint on implications for further observations. The observed literature mentioned the Open Access Network Austria [38], the Austrian Academic Consortium [39] as well as the initiatives Open Science as a Practice [40] and Open Innovation in Science [41].

It can be observed that Austrian open data platforms have a huge potential on the expansion and promotion of open data usage. On the one hand, early adaption in certain fields, like geographical data, has already provided a solid basis of open data sets. The initiation of new projects and platforms, such as the open data portal, can not only create a new basis for interconnected open government data and applications, but may also pave the way for a sustainably linked open data that complies with the 5 star LOD standards and serves as a sustainable basis to support the daily life.

6. Policy Recommendations

In this section, we aim to propose some practical recommendations for open data government implementation. In general, open data is seen to play a significant role in the generation of social capital and creation of value within the economic context. Open data can also contribute to the advancement of good governance, maximizing the benefits of open data in moving towards open governance and provide inputs for evidence-based policy making. These aspects will be discussed in the following subsections.

6.1. Generating Social value through Open data

Innovation in Public Services: Open data can foster innovation in public service provision, through the participation of a range of non-institutional actors who co-create and renew public services alongside the government. However, information availability and accessibility alone are not sufficient conditions to leverage social value from open data. Political and social innovation only arises through the re-use, dissemination and linking up of open government datasets. The provision of tools and value-creation techniques must accompany any public release of data.

Fostering Citizen Empowerment: The release of open data contributes towards the empowerment of individuals within a society by altering the nature and scope of role that they play in the process of governance. Citizen empowerment arises through a combination of access to open government data, and the availability of tools and technologies to combine it creatively. Again, the provision of tools and value-creation techniques alongside open datasets is the key to citizens' better understanding of government and their ability to play an active role in processes of governance.

Promoting Meaningful Citizen Engagement: In providing the public with the data necessary to take well-informed decisions and actively engage with each other and with government, the release of open data has the potential to make citizen collaboration more meaningful. Government can guide these interactions, channelling efforts into priority areas. Active and regular public engagement in the co-creation of public services can also be measured against the achievement of tangible societal and political outcomes.

Implications for Data Protection and Privacy: The opening up of government datasets for use by the general public has particularly significant implications for data protection and individual privacy. A balance needs to be struck between protecting the latter and leveraging the enormous potential benefit afforded by the release of data into the public domain. To prevent privacy breaches, it is necessary to eliminate all privacy-sensitive attributes prior to the opening of data.

6.2. Generating Economic value through Open data

Encouraging Entrepreneurship: For the full business potential of open data to harnessed if governments must encourage and sustain business and regulatory environments that stimulate

its increased accessibility and use. In particular, the ability to mash up different sets of data to gain new insights and knowledge must be catered for. At the same time, the provision of data must be balanced with concerns for privacy.

Promoting Innovation: The key to encouraging people to innovate with open data lies in overcoming well-entrenched risk-averse behaviour with well-targeted incentives and in developing strategies around open data that promote a culture of social entrepreneurship.

Generating Economic Efficiency Gains: The provision of open data and the devising of policies encouraging its use can result in the conversion of data from idle resources into assets that actively generate economic and social value. The maintenance of user-friendly and up-to-date open data portals is particularly important, as such forums play a role in lowering the cost of data and increasing its economic value by bringing together market participants in real-time.

Open Data Business Models: New business models which place open data and associated tools at the heart of strategic decision-making and the development of goods and services are essential for firms wanting to leverage the economic potential of open data.

6.3. Open data promoting good governance

Improving Public Accountability: Open data can be a powerful enabler of public accountability: information on the workings of government is readily-accessible, made easier to analyse, and is available to combine. However, for deeper insight to be gained, the appropriate technical and regulatory framework needs to be put into place. Citizens also need to be able to find answers to questions concerning methods of data collection, and past-current-future data use.

Fostering Transparency and Trust: Merely releasing data into the public domain will not lead to increased government transparency. Citizens need to be provided with adequate procedural and participatory mechanisms to help them make sense of available open datasets; without these necessary conditions, only limited transparency is created. Trust in government will not necessarily follow, therefore, as a consequence of open data provision.

Creating Public Sector Efficiency Gains: Open data has the potential to modernize and streamline government operations, especially when used in combination with technology and appropriate regulatory frameworks. The right data-rich environment within the public to create efficiency and effectiveness gains needs to be developed; wherein a balance is struck between open data sources, data analytics tools and appropriate regulatory mechanisms.

Open Data for Civil Society Organisations: In order to harness the transformative power of open data, civil society organisations need to actively engage with open data resources and convert information into public goods. Governments can support this dynamic by providing civil society with the appropriate technological tools and regulatory environment. The use of open data could also be incentivised; advanced by government as a way for civil society organisations to further their advocacy and policy goals.

6.4. Open data for policy making

The digital transformation is changing the process of policy-making and altering governance models in a disruptive way. Developments on open data, data processing, data mining and visualizations combined with social media, participatory tools and civic engagement are responsible for the changes in the policy-making field (Janssen & Wimmer, 2015).

The pervasiveness of the data concept in these workflows when combined with artificial intelligence and automated decision-making process has significant implications for the transformation of governance structures. Among the emerging digital technologies that has been adopted in government, artificial intelligence, machine learning, and smart things are in the promising trends for 2017 (Gartner, 2017). However, challenges remain in gathering accurate data from the potential connected devices (OECD, 2015). Open data can be a solution if governments have the capacity to establish the related regulatory framework (OECD, 2015) and the competences and infrastructure required for data processing, such as modelling capabilities (Ceri et al., 2012).

In the public sector, new possibilities arise with the emergence of the Internet of Things and data analytics. Due to the variety of data types (primary or secondary, real-time or offline, location-based, reports, maps, satellite photographs, pictures, the genome, medical data, scientific formula, public sector budgeting, and others (Hossain, Dwivedi and Rana, 2016)) open data can be solely or enriched with data from other sources provide inputs for new applications and innovations (Janssen & Wimmer, 2015). Applications in the public sector vary from improving government services with Artificial Intelligence (Chatbots), automated process in non-stop government (sharing databases among government agencies), automated decision-making (optimization of traffic flows) and decision support systems for policy-making (scenario simulation, visualization and mega-modeling).

According to Janssen and Wimmer (2015) the combination of new ICT and models is helping to improve the quality of policy-making, by using a vast amount of data to make predictions and forecasts. Mega-modeling as a comprehensive theory and technology of model construction can be applied to policy-making, providing the required infrastructure to conceive what-if models and scenarios that support decision-makers to anticipate the impacts of different decisions (Ceri et al., 2012). This concept should be built in a world-of-modeling platform, empowering different stakeholders for creating realistic and understandable simulations in a collaborative way (Ceri et al., 2012).

6.5. Towards Open Governance

Open governance is a concept that emerged from the understanding that information belongs to the public, and, alongside with electronic democracy practices, transform electronic government to electronic governance (Klaus, 2016). According to Al Athmay (2015), e-openness is the major theme of electronic governance, supporting people to participate in decision-making processes, being defined as the extent to which the public are able to obtain government information through ICT.

Open government is highly related to the collaborative governance concept, since open data increases the possibilities for knowledge development, decision making and interdisciplinary collaboration (Kamateri et al., 2015). Citizens' willingness to engage is related to both their perception about government openness to integrate public opinion to formulate decisions and the amount of open public sector information they have access (Bonsón, Royo and Ratkaiet, 2015; Mellouli, Luna-Reyes and Zhang, 2014). When analysing collaborative governance, Viale Pereira et al. (2017) identified that information sharing and cooperation are the main elements in framing the use of ICT to enable collaborative governance along with participation and engagement practices in decision making. In this sense, collaboration in government has the main goal of enabling stakeholders to participate in decision making processes that are efficient and effective (Attard et al., 2015).

In order to maximize the benefits of open data towards open governance, data needs to be open, the re-use of data should be facilitated to achieve social and economic value, interdisciplinary collaboration should be legitimized as well as participation and engagement practices in decision making.

Conclusions

The objective of this study was to develop a framework for the release of data through a systematic review of the scholarly literature. This study identified 12 key domains within which the use of open data had the potential to transform and generate social, political, and economic value. These domains were then used as a foundation to develop policy recommendations in the field of open data; most particularly to facilitate government decision-making and policymaking.

The results of the literature survey highlighted several key insights. The first of these is that open data has become a critical input for evidence-based policy-making, which can be achieved through new tools and technologies such as big data analytics and theories like mega-modeling. However, data needs to be not just available but accessible in formats that re-usable to generate social and economic value. Third, the opening up of data increases its re-use as it exposes information to a wider audience. Fourth, open data may be free but data analytics still requires an investment. Fifth, there is a need to invest in technology and skills that will create value out of open data. And finally, there is requirement to open data across the board whilst setting out strategic incentives to channel value generation to where it is needed.

In conclusion, it is vital that not only is data available and easily accessible to the public, but also that the appropriate tools and regulatory frameworks are put in place to ensure that the use and re-use of open data is meaningful.

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Part II:

Monetary added value of open government data

1. Overview about economic impact studies

Open data – any information in machine-readable format that is freely accessible for use, modification or sharing by anyone for any purpose– has in recent times generated a lot of interest amongst governments, businesses, and civil society organisations for its potential to further transparency, drive innovation, and foster economic growth (Carrara et. al., 2015; Manyika et. al. 2013, Vickery, 2011). In this context, governments are especially large producers, collectors, and repositories of a wide range of information and content (Vickery, 2011).

This section takes an initial look at major economic impact studies conducted to measure and estimate the monetary value of open data, open government data, personal data and public sector information. While the benefits afforded by open data, and in particular open government data, have been covered extensively by a number of studies, it is widely recognised that measuring and estimating the value being generated is altogether difficult (OECD, 2015). This is because of the large quantities of data being generated, and the varied use to which it is put. Very few examples exist in the literature that discuss either the different macroeconomic indicators associated with the generation of economic value through open data, or the aggregate figures associated with them (Carrara et.al., 2015).

1.1 Existing studies on economic benefits of Open Data

This section proposes to examine the direction taken by four recent macroeconomic studies to approach the accurate measurement and estimation of the economic value created by open data. In recognizing that arriving at a monetary value of data is the primary challenge to ascribing it an economic value, each study seeks to identify and define the key economic metrics involved in any assessment of the market value of data. For each study, therefore, the central definitions and each associated economic model are discussed in detail below.

I. Organisation for Economic Co-operation and Development (OECD). 2015. Data-Driven Innovation: Big Data for Growth and Well-Being. Paris: OECD Publishing. [Extract: Chapter 2, Chapter 4]

The 2015 OECD study examines the phenomenon of data-driven innovation in the knowledge economy of today. Within the given context, central to the calculation of the economic value created by open data, and its attribution to actors operating within a given data ecosystem, is, according to the OECD (2015), the development of an understanding of the economic characteristics of data and data infrastructure through which a monetary value might be derived. Important too, according to the study, is the identification of key actors operating within the data ecosystem, and an understanding of their interactions [ibid]. The following excerpt taken from the full study on data-driven innovation, therefore, provides us with a conceptual understanding of the key elements involved in the release and monetization of open data.

Key Theoretical Constructs for the Economic Potential of Data [Chapter 4]

The OECD study considers data as an infrastructure or infrastructural resource, owing to its intrinsic economic qualities [pp. 179–183]. The authors follow Frischmann (2012), who defines infrastructure as providing the '*…underlying foundation or basic framework (as of a system or organization)*', and states that infrastructure resources are 'shared means to many ends' that satisfy three criteria: 1) they may be consumed in a non-rivalrous fashion; 2) the resource is required as an input to fulfil social demand; and 3) the resource may be used as an input for general purpose production of goods and services (OECD, 2015; p.179). The OECD study goes on, therefore, to discuss data as an economic resource under these three headings.

1. **Data as a Non Rivalrous Good**: Data may be considered a non-rivalrous commodity, as it can be consumed, in principle, an unlimited number of times [p. 178]. In theory, maximizing access to a non-rivalrous good will lead to social welfare gains, as every additional private benefit comes at no extra cost. These qualities lead to questions about how best to allocate data as a resource.
2. **Data as a Capital Good**: Data is, in most cases, neither a *consumption good* nor an *intermediate good*. It is instead often a capital good; one that generates value through its use and treatment during the production process, and is subject to capital depreciation through its non-use[p. 180].
3. **Data as a General Purpose Input**: Ready access to data makes possible the production and consumption of a wide range of public, private and social goods and service [p.181]. However, the manner in which data is used often depends upon the initial reason for which it was collected.

Key Actors and their Interactions within a Data Ecosystem [Chapter 2]

The OECD study adopts the concept of a *data ecosystem* to explore the dynamics inherent between human and non-human actors involved in the creation, consumption and exchange of data [p.70]. The study uses a data value cycle approach to identify the different types of companies and services operating with a given data-rich environment, and analyses the key factors associated with these entities – technology, business models, coalitions and alliances – that affect their functioning within a data ecosystem.

Five different sets of actors that create economic value within data rich environments are identified by the study; together their roles within a data ecosystem, their technologies, and their business and revenue models: *internet service providers*, *IT infrastructure providers*, *data (service) providers*, *data analytic service providers*, and *data driven entrepreneurs* [pp.71 -91]. **Internet service providers** (ISPs), for instance, form the backbone of the data-rich environment [pp.77–78]. This actor group builds and operates networks over which information is exchanged, grants subscribers access to physical communications infrastructure, and makes available digital channels for subscribers to publish or obtain digitized information and content. ISPs generate revenue by selling products and services to subscribers for fixed terms at market-competitive rates.

The second layer of a data ecosystem comprises of **IT infrastructure providers**, providers of both hardware and software infrastructure [pp. 78–79]. This group of actor offers both data management and analysis tools together with critical computing resources. IT infrastructure providers function using one of two currently trending business models: i) the *freemium*, where a service is offered for free, but money is charged for value-added services; or ii) *cloud computing*, wherein either infrastructure, platforms, or software is provided as a service.

The third actor group identified by the study is that of **data (service) providers**, comprising of *data brokers*, *the public sector*, and *individuals or consumers* [pp.82–85]. Data brokers sell their data, via, data marketplaces across the economy. The public sector contributes to the data ecosystem through the release of public sector information for general consumption. Individuals and consumers create content online, although they often have their personal data exploited by businesses when doing so.

The fourth contributing actor group comprises of **analytics service providers**; start-ups and SMEs that focus on the provision of analytics and visualization services to various sectors of the economy [pp.86–88]. Their primary source of revenue is usually derived from service contracts, although more recently start-ups and SMEs have taken to adopting alternative subscription- and usage-based revenue models.

The final group of actors operating within a data ecosystem are the **data-driven entrepreneurs**, who build innovative businesses and develop goods and services based on the data and analytics available within a given data ecosystem [pp.88–91]. These actors can either act as *data explorers* or their companies can function as *data-generating platforms* within the process of creating economic value out of data.

Key Findings and Policy Recommendations

From the delineation of the key economic qualities of data, and a discussion of the different actors involved in the creation of economic value within a data ecosystem, the following insights relevant to open data might be drawn:

1. The conceptualization of data as a non-rivalrous good supports the principle of open data, as a greater access to data would, in theory, lead to the maximization of social welfare gains [p.187].
2. Data is generally considered a capital good that needs to be used and treated in order to be of economic value. It is rarely immediately consumable or ready for consumption after partial processing. This has implications for linked open data policy, where it is not merely enough to make available data and tools on a website [p.193]. Instead appropriate infrastructure must be put in place to encourage and sustain the creative use of data.
3. As the use to which data is put often reflects the initial purpose for which it was collected, the economic value derived from open data will come to depend on the nature of the datasets involved and the formats in which they are made available [p. 197].
4. Technology has spurred the rise of a global data ecosystem, where data as an economic asset is being increasingly traded across sectors of the economy and across national borders [p.112]. This represents a global multibillion-dollar business opportunity that, at the time of writing, is growing at an average of 40 % a year.
5. The economic impact of the global data ecosystem goes beyond the business prospects of the ICT industry, involving as it does a wide range of actors operating in a wide range of contexts [p. 113].
6. Government and private sector initiatives promoting data portability contribute to the free release and flow of data, and in doing so strengthen individual actor participation in data-driven innovation and the creation of economic value [p.114].

II. Carrara, W., Chan, W.S., Fischer, S., & van Steenbergen, E. 2015. Creating Value through Open Data. Study prepared as part of the European Data Portal.

Another way to accurately estimate the economic contribution of open data policies is to first determine the readiness of a country in terms of its open data policy, and then to put a value on open data based on an assessment of the levels of various economic indicators (Cararra et.al., 2015). In a study conducted by Capgemini Consulting for the European Union in 2015, the economics behind the re-use of public data in 28 European member states was documented to determine how economic value could be created through open data.

Conceptual and Technical Elements of the Study

The Capgemini study was constructed in two parts. In **Phase One**, an *Open Data Maturity Assessment* model was developed to assess the Open Data Maturity of each European member country, and to determine how this maturity had evolved [pp. 43–46]. Open Data Maturity was measured against two key indicators: Open Data Readiness (or the presence of Open Data policies, the use made of available Open Data available, and the political, social and economic impact of Open Data) and Portal Maturity (or the usability of a portal and its functionalities, the overall re-usability of data, together with the spread of data) [p.43].

Based on the scores of these pre-defined indicators, the maturity of open data policies across countries were compared, and a matrix of countries developed. A country could be classified as being either a *Trend Setter*, a *Follower*, an *Advanced Beginner*, or a *Beginner* [pp.45–46]. Summarized results showed that in 2015, only 19 % of countries surveyed could be classified as a *Beginner*, a substantial decrease from 2005 when 63 % of European Member States were only just starting out [p. 70]. In contrast, 31 % of the countries included in the study could be classed as Trend Setters; by 2020 it was forecast that all European Union member states would have a fully functioning data portal [ibid]. Countries will also have introduced improvements to improve their open data maturity.

During **Phase Two**, four key economic indicators were measured, metrics derived directly from the Open Data Maturity model: *direct market size*, *number of jobs created*, *cost savings*, and *efficiency gains* [p. 60]. Initially, the study chose to focus on calculating the **market size** for Open Data to determine its impact [pp. 70–77]. The authors make the distinction between direct market size and indirect market size. They set the direct market size for open data at 75.7 bn. EUR in 2020 [p.72]. The forecast set for the cumulative total market size for Open Data is between 1,138 bn and 1,229 bn EUR in the same year [ibid.]. Examined from a market sector perspective, public administration is predicted to benefit most from the release of open data, by bringing in 22 bn. EUR in 2020 [p.74].

The second indicator made use of by the study – *job creation* – sought to measure and estimate the number of employment opportunities created within the European Union private sector directly linked to the re-use of Open Data [pp.79–83]. In 2014, 79.6 million persons or 36.1 % of employed persons were working in knowledge intensive jobs within Europe [p.79]. The study set the upper bound of forecasted total number of jobs directly related to Open Data at just under 100,000 for 2020, indicating a growth rate of 32 % over a 5 year period [p.81]. With a per year average rate of increase predicted to be at 7.3 %, the number of jobs from 2016–2020 is expected to increase by nearly 25, 000 [ibid.].

The third metric taken up by the Capgemini study was the impact of open data on *cost savings* [p. 84]. For the European Union, this figure was arrived at by taking into account each country's respective government expenditure, and plotting the trend to calculate the cost savings

per country. The study forecast that the accumulated cost savings for the European Union as a whole in 2020 to equal 1.7 bn EUR [ibid.].

The final impact domain, **efficiency gains**, was considered by the study to involve '…*improved resource allocation so that waste is minimized and the outcome value is maximized, given the same amount of resources*'[p. 86]. This metric was assessed using a qualitative framework which made use of three so-called '*exemplar indicators*' [pp.88–97]: *lives saved*, *time saved*, and *environmental benefits*. The study demonstrated that Open Data has the potential of saving 1,425 lives a year (i.e. 5,5 % of the European road fatalities) [p. 92]. The application of Open Data to the problem of traffic congestion, it was found, could save 629 million hours of unnecessary waiting time on the road in the EU (a saving of 27.9 bn EUR per) [p.95]. Open Data can also be helpful in controlling the adverse effects of greenhouse gas emissions, thereby improving both air quality and energy savings [pp.95–96].

Key Findings and Policy Recommendations

In conducting a macroeconomic study on the impact of open data in Europe, Carrara et. al. (2015) have made the following observations and policy recommendations [pp. 100–101]:

1. The costs and benefits associated with the release of open data need to be more deeply analyzed, as open data requires investments in the form of time and money that often go unaccounted for.
2. A marginal or free cost model for Open Data should be constructed to promote innovation, encourage the development of new products and services, and spur data-led economic growth.
3. Governments should more actively monitor site analytics to gain insight into who uses their websites, which datasets are downloaded, and how frequently open access data is used.
4. Feedback mechanisms should be deployed on open data portals to create a multi-stakeholder environment wherein more and diverse actors are involved in the process of opening data.
5. Greater enquiry needs to be made into the re-use of Open Data by the private sector. Accurate estimates need to be obtained regarding the number of companies involved in the open data process, the size of these participating organizations, the level of employment created during the open data process, and the sectoral impact of open data policies.
6. Businesses and government should empower the workforce through active participation open data processes, equipping workers with the skills necessary to comprehend and manipulate large amounts of information and content.

III. Organisation for Economic Cooperation and Development (OECD).2013. Exploring the Economics of Personal Data: A Survey of Methodologies for Measuring Monetary Value. OECD Digital Economy Papers, No. 220, Paris: OECD Publishing.

A landmark report produced by the Organisation for Economic Cooperation and Development (OECD) in 2013 focused on evaluating the economic contribution of personal data by conducting a survey of the methodologies that could be applied to measure and estimate its monetary value. The report is considered of great relevance to this study on the monetary impact of open data as it presents concrete economic methodologies for assigning value to data as an asset class that are not found elsewhere in extant literature.

The study acknowledges that while personal data holds vast potential to create economic and social value, measuring and estimating the contribution being generated is usually difficult

without a concrete notion of the monetary value of the good (OECD, 2013). In such a situation, the authors argue that, while any proposed methodology used to determine market value might be imprecise, it is important to nevertheless to analyse the markets wherein this good is exchanged [p.9].

Conceptual and Methodological Design of the Study

The OECD study is divided into three broad sections. The first section outlines the theoretical and regulatory constructs that define and circumscribe notions of personal data and the importance of personal data as a value-creating asset. The second section delineates and discusses the major methodological tools that could be applied to measure and estimate the monetary market-value of personal data. The final section presents the findings of the study and advances areas for further research.

A. Personal Data: Definition, Scope, and the Personal Data Economy

Personal Data: has been defined in the report as '…*any information relating to an identified or identifiable individual (data subject)*', following the definition of personal data contained within the OECD Privacy Guidelines [p.7]. The study acknowledges that conceptually speaking the notion of personal data is broad [ibid.], encompassing such forms of information as *user generated content*, *activity or behavioural data*, *social data*, *locational data*, *demographic data*, and *identifying data of an official nature* [p.8].

The report also assumes that the concept of personal data also transcends the various categories and distinctions identifiable from a review of existing literature; including categorizations of personal data arising from use, from the blurring of personally identifiable and non-personally identifiable information, and difficulties in distinguishing personal and non-personal data [ibid.].

Personal Data Value Chain: as a concept is also explored within the report, with the data lifecycle traced from capture to usage, together with the business models employed in the creation and realization of monetary value through innovation in products and services, process efficiencies, data analytics, and the creation of economic value-added [pp.10–17]. The report discusses the personal data lifecycle as a four-step value chain: *collection/access*, *storage and aggregation*, *analysis and distribution*, and *usage*.

- *Collection/access*: involves the collection of personal data or the accessing of that information within the given legal context [pp.11–12].
- *Storage and aggregation*: of personal data involves the organization of collected information into datasets, and the holding of organized data in a manner suitable for easy exchange and exploitation [pp.12–13].
- *Analysis and distribution*: involves the merging of held datasets from different sources and the application of analytical tools to derive greater insight [pp. 13–16]. Data sharing often happens across dedicate data platforms – data exchanges or data market places – via specially designated entities known as data brokers.
- *Usage*: at the end of the value chain involves the making available of datasets to end users once the data has been collected, organized, and analyzed [pp.16–17].

It is noted that Personal Data may be gathered in one of three different ways: it may be *volunteered* or *surrendered* by individuals; legally *observed*, *captured*, and *recorded*; or *inferred* and *trended* based on existing datasets – personal and anonymized [p.10]. A wide variety of stakeholders are involved throughout the value chain; ranging from businesses to individuals, public authorities to civil society bodies [p.11].

B. Methodologies for Estimating the Value of Personal Data

The second section of the OECD report evaluates five potential methodologies for determining the monetary value of personal data [pp.18–32]. In a deviation from other major studies focusing on the impact of data as an asset-class, the methodologies outlined in this report attempt to describe value through the capture of the prices that markets assign to data in different contexts [p.18].

N.B.: Most approaches center around the value assigned to an individual user or record. They are not wholly accurate and are difficult to compare as each focuses on a different aspect of monetary value. There is no commonly accepted methodology for assigning a monetary value to personal data [p.18].

Approaches used to determine the monetary value of data either depend on *market valuations of data* or on *individual perceptions of value and privacy* [pp.18–19].

Indicators based on Market Valuation

1. Financial Results per Data Record

This method for estimating the value of personal considers the financial results of a company as a way to capture the market value of recorded data [pp.20–25]. Indicators observed include revenues generated from market capitalization, revenues, and net income on a per-user or per-record basis [p.20].

Benefits: Reporting requirements for public firms means that revenue data pertaining to key indicators is often available, and that these can be combined with personal datasets to gain strategic insight [p.24]. Moreover, financial results are generated in a market environment, and hence this measure reflects the economic value added obtained through the use of personal data in a market context.

Drawbacks: However, this method would work only for firms that either derive a significant proportion of their revenues from personal data or are able to separate out the revenues obtained from personal data-related activities from other components of their financial portfolio [p.25]. Further, financial results are often subject to market trends, random shocks and speculation; meaning that any calculation of the monetary value of personal data might not reflect the real intrinsic value.

2. Market Prices for Data

Another way of estimating and measuring the monetary value of data is to look at the price of the asset in competitive markets [pp. 25–27]. Given the 'non-rivalrous' nature of data as an asset, it is important to consider not just the one-time sale of a data record but instead the average price commanded through its repeat re-sale or multiple use [p.25]. This price would be an expression of the cumulative summation of all the prices paid by all users for the individual record over the course of a year.

Benefits: This methodology has two main benefits [p. 26]. The first is that market prices are generally easy to obtain and interpret when data is available. Second, even when a data broker is involved in transactions, prices at least partially reflect the real market price for an individual data record.

Drawbacks: Often times, especially when data intermediaries are involved in transactions, market prices quoted for data records involve the hidden cost of other value-added services [p 26]. Further, the price at which data is exchanged relates to a specific context and can be used only for one-off calculations [p.27]. Additionally, data quality cannot be guaranteed [ibid.].

3. Illegal Markets

A third method to assign monetary value to personal data consists of observing the price of data in illegal markets operated by cyber-criminals [pp.27–29]. These market are general online platforms where cyber-criminals buy and sell information, software, and services pertaining to the illegal collection and misuse of personal data [p. 27]. Based on continuous observation of the transactions carried out over these markets, the value range assigned to personal data by cyber-criminals can be derived.

Benefits: The central benefit of this approach lies in the fact that the price of a data record listed on an illegal market can provide an accurate reflection of the true value of that record after factoring all market externalities [p.28].

Drawbacks: The efficacy of this method is however limited, as prices from illegal markets are difficult to collect and transactions are never fully transparent [p.28]. Prices quoted are often context specific, and usually factor in externalities such as gaol-time that do not have relevance to ordinary legal buyers and sellers of data [pp.28–29].

Indicators based on Individual (Data Subjects') Valuation

4. Surveys and Economic Experiments

A fourth approach to measuring the economic value of personal data is to extract valuations of the price that firms would have to pay individuals to disclose that information by running economic experiments and conducting surveys [pp.29–32]. The choice between conducting an experiment or commissioning a survey depends largely on the nature of the information required, and the surrounding environmental context of the subjects from whom it is required [p.30].

Benefits: As measures to determine the value placed by individuals on personal data, both experiments and surveys have the advantage of being academically rigorous in their construction and execution [p.31]. Further, data obtained by these methods is generally unbiased and may be used for comparative studies [ibid.].

Drawbacks: Laboratory-based experimentation and traditional survey methods are conducted in settings that are devoid of market verification [p.32]. More precisely, valuations of personal data obtained are generally subjective and reflect personal opinion, rather than being an accurate reflection of market demand-and-supply.

5. Revealed Willingness to Pay to Protect

The final method that can be used to estimate the monetary value of personal data is to get a measure of how much an individual would be willing to pay to protect his or her personal information [pp.32–33]. These values could be obtained from a variety of market sources; amongst others, the market for insurance policies, the market for services pertaining to the anonymization of marketing data, the market for anti-tracking software and related services [p.32].

Benefits: This indicator as a proxy for the economic value of personal data is exceedingly useful as it captures '…*the pure economic value of privacy breach from an individual perspective*', whilst taking into account all possible costs associated with externalities [p.32].

Drawbacks: This approach is prone to bias, as it captures an individual's willingness to pay, and not the real market value of the commodity traded [ibid].Further, it is a valuation made by an individual based on a breach of data security, and not an estimation of the market value of personal data as a commodity [p.33].

C. Conclusions and Areas for Further Research

The final section of the OECD study identifies the following insights that are to be gained from a discussion surrounding the various methodologies that might be employed to assign monetary value to personal data [pp.33–34]:

1. In order to accurately gauge monetary value of personal data, better market-based information and collaboration between various actors along the value chain process is required.
2. More analysis is needed to understand the economic value of data in regional contexts.
3. More case studies need to be documented to build up a picture of the macroeconomic effects of personal data valuations over time.
4. The potential non-linear returns from personal data imply network effects that need to be studied.
5. Efforts need to be made to capture valuations of producer and consumer surplus.
6. Markets where individuals control and sell their own data are evolving and will come to provide better insights.

Key Findings and Policy Recommendations (Open Data)

Different from the conclusions arrived at within the OECD report are the lessons and recommendations for open data policy that can be derived from its central discussion.

N.B. Please note, although these findings and policy recommendations are enumerated below, they are not explicitly mentioned within the text of the report.

1. Understanding the monetary value of open data, is the first step towards quantifying its economic and social impact.
2. The datasets that make up open data releases also have a commercial market price, are subject to the market forces of demand and supply, and can be exchanged over dedicated online forums.
3. The methodologies used to estimate and measure the value of personal data can, therefore, be applied to calculations involving open data. Through their use governments, businesses, and individuals can reach a better understanding of the value of open data as an economic asset.

IV. Vickery, G. 2011. Review of Recent Studies on PSI-Reuse and Related Market Developments. Information Economics, Paris.

A possible fourth approach to the determination of the monetary value of open data involves the definition of key elements and actors involved in the creation of economic value, and an examination of their interplay through the linking back to past open data surveys. This is exemplified by Vickery (2011) in his exploratory paper on studies concerned with the commercial

re-use of Public Sector Information (PSI) and related market trends. In acknowledging that PSI is a difficult area to measure, given its very specific nature and the sheer amount generated, this study attempts to update the potential market value of PSI re-use in Europe from 2006 to the time of writing (Vickery, 2011).

Conceptual and Methodological Design of the Study

This paper is structured into four sections. Section 1 introduces the reader to nature, scope, and direction of the task to be discussed [pp.7–9]. Section 2 delineates key definitions related to information domains, and discusses the nature of value chains created through PSI re-use. Section 3 reviews available reports on the size and development of European markets for PSI. And finally, Section 4 attempts to estimate the EU27 market size from PSI re-use, and to measure current levels of other related economic variables.

A. Section 1: Introduction

This section positions government as one of the largest producers, consumers, and holders of a wide variety of data, information, and content [p.7]. The author argues here that two major recent technological developments have '…*radically changed and re-shaped the role of public sector information and content*': these are i) the digitization of public resources, either in real time or retrospectively; and ii) the deployment of broadband technologies that enable the better access and dissemination of public sector content [ibid.].

The section then locates the concept of PSI within the framework of the European Union Directive 2003/98/EC on the Re-use of Public Sector Information [ibid.]. The author moves on to differentiate between *Public Sector Information* and *Public Sector Information Held By Cultural Establishments*; with each concept comprising an end of a spectrum of uses and applications [p.8].

The final part of the introductory section discusses the objectives, approach, and scope of the study at hand [pp.8–9]. The concluding paragraphs enumerate the types of data and content not included within the purview of the work: scientific information and research data, public sector information held by cultural establishments, public broadcasting content.

B. Section 2: Definitions and Value Chains

This section of the review outlines key definitions related to information and content types, users and applications, and value chains corresponding to PSI re-use [pp.10–15]. Here, the author first defines the bounds of the pool of public information and content, enumerating the diverse information domains that make up the public sector information resource pool [pp.10–11]. These include: geographic information, meteorological and environmental information, economic and business information, social information, traffic and transport information, tourist and leisure information, agricultural and related domains, natural resource information, legal system information, scientific information and research data, educational content, political content, and cultural content [p.11].

The section then discusses the role played by different actors in the re-use of public sector information to leverage its economic value [pp.11–12]. The author focuses particularly on the interaction of public sector, private sector, and individual end-users during the commercial re-use of PSI [p.11]. Public bodies create and supply data, end-users consume processed information, and private companies act as intermediaries between the two who store and process

information. Commercial re-use implies that, unlike during the release of open data, payment occurs in exchange for information.

The value chain associated with the commercial reuse of PSI is then delineated, with the various elements expanded upon in some detail [pp. 13–14]. The key elements comprising this value chain, according to Vickery (2011) are: *data creation* or *collection* (the act of generating or gathering together data); aggregation or organization (the creation of logical datasets for better handling); data *processing* (including the editing, re-packaging, and re-modelling of existing datasets); and *marketing and delivery* (the distribution of information products and services).

C. Section 3: General Market Studies

The third section of the paper explores the aggregate economic dimensions of access to and use of PSI, covering general market studies. Based on available quantitative analysis in the scholarly literature, mostly subsequent to 2006, the author provides broad estimates of the size of markets and the impacts of PSI. It is organized by country and, where possible, by PSI area. Vickery (2011) here argues that improved access to and use of PSI is of major importance for all economies [p.16]. Indeed, he calls for some form of open access to public sector information to underpin and encourage innovation within the economic context [ibid.].

This section also reviews available reports on the size and development of European markets, commencing with the two most important earlier large-scale attempts to collect new information, followed by more partial studies [pp.18–22]. In this context, worth mentioning is the author's review of the PIRA report (2000), which gave very large estimates of the size of the European PSI market by including a wide of non-PSI related activities and emphasizing the importance of geospatial information [pp. 18–19], and the MEPSIR study (2006) of the EU25 PSI, which provided an estimate of around 27bn EUR with upper and lower limit values of 47 bn EUR and 10 bn EUR [pp.19–20]. The author also discusses the market for PSI in the geographical information, meteorological information and legal information sectors up until 2008, which presented a picture of '*generally dynamic growth*' [pp.20–21; p. 22]. Environmental impact assessment studies further showed that the market for PSI was worth EUR 1 billion per year in 2009, with improved access to information saving up to EUR 200 million per year [p.21].

A range of detailed national studies across Denmark, France, Germany, the Netherlands, Norway, Spain, the United Kingdom, and the United States of America shows growing PSI markets and the emergence of new applications based on PSI datasets [pp. 22–30]. Emphasis has also been placed in many countries on the international dimensions public sector information [p.30].

D. Section 4: Estimating EU27 Market Size and Other Economic Variables

The final section of the paper estimates the size of the EU27 PSI market based on extrapolations from existing work [pp.35–40]. Again this section is, by the author's own admission, not exhaustive – it does not cover all of the PSI literature [p. 15]. The section is organized by country and, where possible, by PSI area.

In this section, therefore, the author estimates EU27 PSI market size and aggregate economic impacts from Australian spatial data [p.35], from the Netherlands geo-information sector, from New Zealand spatial information [p.36]; as well as total welfare gains in the EU27 economy from open access to PSI in the United Kingdom [p.37].

Vickery also extrapolates EU27 PSI market size from other estimates: from UK geographic information markets [p.38], from German geo-information data [p.38], from Spanish PSI sector data [p.38], from aggregate time savings in Norway [p.39], from the European environmental impact assessment market [p.39], and as a consequence of improved access to research results across the EU27 [p.39].

Key Findings and Policy Recommendations

In considering improved access to PSI, and its economic impact on markets and value creation, Vickery has made the following observations and recommendations:

1. Open access to public sector information is important, particularly for innovation within an economy. The reason is two-fold: on the one hand, access to knowledge and information underpins creativity and innovation. On the other, the relative scope and scale of PSI makes it a prominent economic resource [p. 16].
2. PSI-related information can be used in a very wide range of direct and indirect applications across an economy. The aggregate direct and indirect economic impacts from PSI applications and their use across the whole EU27 economy are estimated to be of the magnitude of 70–140 bn EURO annually [p.35]
3. Easier access, improved infrastructure, and lower barriers to PSI usage could result in aggregate direct and indirect economic benefits for the whole EU27 economy to amount to 200 bn EUR (1.7 % of GDP) in 2008 [p.37].
4. Direct revenues to governments from PSI are relatively low, based on extrapolations of data obtained from the United Kingdom and the Netherlands, and are much lower than the estimated benefits from access to PSI [p. 25]. This has important consequences for the free release of data by governments, as low returns could act as a disincentive to actively pursue an open data policy.

2. Monetary added value through the publication of OGD in Austria

2.1 Estimated benefits in the European context

The impact of open data, to which the literature attributes the value of 'new oil' (Dapp, 2016; p.7), and its general contributions as well as values for international platforms have been discovered through various studies. Further, the above observed papers identify the creation of new jobs in the field of open data, potential cost savings, an increase in efficiency, especially in the context of decision-making, and an emphasis of environmental benefits as well as advantages concerning the saving of human lives as benefits that may arise from the increased usage of open data. While different approaches exist, these factors play decisive roles, not only in the study by Carrara et al. (2015), but also in the publication of the Konrad-Adenauer-Stiftung (Dapp et al., 2016). The inclusion of open data and the utilisation of all its potential in the government's working programme (Bundesregierung, 2017; p.17) further creates a decisive basis to advance within the field of open data.

To exploit these benefits, as well as possibly still unidentified advantages, the monetary value inherent within these datasets may be seen as a key indicator and incentive for the application of this data as discussed above. Additionally, some factors and external effects, including data infrastructure, innovation, availability, maturity, and others have to be respected in observing the calculations of open data values since they may have considerable ramifications on certain open data policies and frameworks.

While a prediction of these values for any particular market or national approaches will always be more of an estimation or a foreshadow, especially in mostly new and innovative fields that emerge in the context of the digitalisation, such as open data, the aforementioned studies have shown that such an estimation is possible and can be made considering most notably market size, data infrastructure, the influence of different sectors and the maturity of open datasets but also open data policies. Especially the public sector plays an important role in the context of dealing with but also benefitting from open data (Carrara et al., 2015). Therefore, this section shall discover the potential monetary value the implementation of open data and the development of applications based on this data may have for Austria in particular on the basis of the observed studies.

The context of Austria has already been introduced. While there may be the potential of an increase in the general research on Austria's open data policies and implementation, the main challenges for the existing open data portals and applications are the promotion, an increased usage, the development of further applications and the creation of interconnectedness of this data.

Carrara et al. (2015, p. 45) identify Austria as one of the trend setters in the creation of open data portals, attesting even a slightly higher open data readiness than data portal maturity, which confirms that Austria now has to focus in a higher degree on the advancement of open data applications than on the mere provision via open data portals. Since Eurostat provides important data on its member states and in the course of that creates a common basis, this

study may be a helpful basis for a concrete estimation of potential values open data creates for Austria.

The same report also provides concrete values for member states on various areas that are recognised as benefiting from open data. The concerned results are estimations for the values within those areas in 2020. To identify the potential monetary advantages, which may derive for Austria, these numbers shall be considered. The open data market size is one of the least specifically elaborated values, categorising Austria as part of the 'medium' category with a potential market value € 0.5 and € 5 billion (Carrara et al., 2015; p. 77).

According to the Austrian Federal Economic Chamber (WKO, 2017), the country had a nominal gross domestic product of € 353.3 billion in 2016. While there are no estimations of the GDP in 2020 are currently available, the estimations for the next two years show with € 370.08 billion in 2017 and € 387,71 billion in 2018 increasing trends. If Austrian open data would achieve the full exploitation of its estimated market size, its share in proportion to the suggested GDP would only comprise between 0.13 % or 1.29 %. This percentage may appear small, but it has to be considered that this concerns freely available data in an emerging field of digitisation.

Considering data from 2012, Fuchs et al. (2013; p. 13) attest an estimated potential of € 0.5 to € 0.7 billion, or, procentual to the European potential of € 40 billion, € 0.77 to € 1.1 billion per year. In the period considered here, the Austrian GDP accounted for € 318.65 billion. These estimations grant open data for the Austrian market in the observed timescale a potential between 0.16 % and 0.35 % of the gross domestic product. This data shows that within five to six years the potential of open data already passed a considerable increase, from an estimated maximum of 0.35 % of the GDP per year towards 1.29 %.

Another field of, potentially stagnating, growth concerns jobs that are directly related to open data. Austria is considered to have little less than 2 000 working places directly in the field in 2020 (Carrara et al., 2015; p. 78). While this potential does not seem to be very high, for example Germany, a country with about ten times the population, is expected to employ 18 000 persons in the field, consequently the increase seems to be appropriate for the size of the country. These numbers refer to an expectation of 32 % more jobs in open data than in 2015 in the whole European Union. While these employees require wages, maybe even in the field of public administration, they not only create labour in a new and innovative field, but also support the exploitation of cost saving potential and efficiency that are discussed below.

While the number of employees who have to deal with open data is suspected to increase, one inherent benefit of the use of these datasets is the cost saving factor. On the basis of calculations that have been made for Denmark, the study applied a schematic approach to calculate the cost savings for the other EU member states. As a result, Austria is estimated to save € 39 million in government expenditures (ibid., 2015; p. 84). To allow a slight comparison, according to data provided by the OECD, in 2015 the total of Austrian government expenditures accounted for € 175 411.7 million [1].

Additionally, efficiency gains are to be expected. Not only can political decision-making processes may be improved with the resort to publicly available data. But open data can also directly affect citizens and therefore have indirect positive effects on the economic situation. Carrara et al. (2015; p. 95) report an estimation of 629 million hours of unnecessary traffic waiting time in 23 European countries in 2012, which may be saved with the support of open data. While it is hard to track this exact value back to Austria, Carrara et al. (2015) calculate

an average value of commuting time of €44.28 per hour in Europe, resulting in total yearly savings of € 27.9 billion (ibid.).

Another important area where efficiency can be improved concerns saving lives. Not only the health sector itself, including cardiac diseases and diabetes, is concerned, but earlier alerts may improve the response of fire departments as well as increase the numbers of survivors in road fatalities. Based on pioneer applications, Carrara et al. (2015; p. 92) suppose that in Europe in cardiac arrest 7 000 and in road fatalities 1 425 lives may be saved per year.

Finally, not only economic factors and human lives may be improved by using open data, but this might also cause environmental gains. The authors of the study (ibid.) conclude that open data can reduce the costs that are a result of the air pollution as well as support energy savings in private homes and public buildings.

2.2 Extrapolating the added value for Austria

To finally estimate the monetary value open data creates, the aforementioned studies show several differing approaches to obtain these numbers. Generally, Austria's open data potential may be calculated using two basic strategies: extrapolate the potential of the existing datasets and platforms, or applying postulated values from comparable, respectively superordinate entities, such as the European Union. These strategies in conjunction with their more concrete application in the observed studies shall be used in the following section to provide closer information on the potential open (government) data may embody for Austria.

First, the aforementioned segmentation into differing data valuation models has to be taken into consideration. According to the OECD (2013) study on personal data, open data may undergo valuation via the market or the individual's assessment. The report introduces the possibilities of conducting either surveys or experiments or the willingness to pay for the insurance, respectively protection, of the data. Central for this paper however, is the application of open and open government data and therefore, an administrational, governmental perspective shall here be applied, supported by measurable market values.

Further, the cost of data supply has to be considered as a countermeasure to the potential added value. To generate valid numbers for this area however, would require insight into administrational procedures as well as the expenses per dataset. Special insights into the sector-specific supply process might be helpful. An automatic upload of datasets, where it is within the realm of possibility, onto the concerning platform would be the most transparent measure and create the least added expenditures. This transparency might also increase other non-monetary values such as trust into the institutions supplying the data through an increase in transparency (Dapp et al., 2016). Concerning the sole monetary costs, the observed studies (especially Dapp et al., 2016) demonstrate the following steps as cost factors in the process of supplying open data: inquiry, efforts, identification, selection, extraction, conversion, and, finally, publication. Additional cost coordination, communication and additional technical efforts may be critical elements in the process of converting datasets into open data.

To further calculate the potential value of open data, beside the direct costs and gains of open data platforms and applications, other benefits have to be considered. While the calculation of the potential market size as a decisive basis for the economic value of open data includes

taking into account the value, the market share in percent of the GDP as well as the sector, the latter category includes new emerging jobs, cost savings and efficiency gains. More specifically time, lives and energy may be saved through the deployment of open data. To calculate these values, the application of current operating numbers may give an indication for the expected values of the generated improvements.

To provide an insight into the potential of existing open data platforms, a detailed examination of the provided datasets may form a basis. If the sector with the most datasets, in the case of data.gv.at 'Environment' with 485 datasets in front of 'Administration and Politics' with 464 datasets [2], or as Carrara et al. (2016) show, the top downloaded datasets is analysed, inferences on the area of deployment that creates the highest societal welfare may be drawn.

Further, the character of open data shall be borne in mind. As one of the studies (OECD, 2015) showed, open data is a non-rivalrous good, meant to be publicly available and applicable. This accessibility allows the best exploitation of public and social values open data may generate. The pricing of datasets especially shows that in the form of two basic possibilities – supply the data for free or cover the expenses of allocation by pricing it. While the latter option may provide direct income, the free availability could foster the usage of data and therefore decisively increase the impact, social and economic value derived from these datasets.

Within this framework, the role of licensing has to be taken into account as a legal background to provide the data openly. So, considering its inherent characteristics as well as the implementation of the data without consumer costs on the most prominent Austrian portals data.gv.at and open data portal so far, the strategy of providing open data for free should be pursued further.

Altogether, the added value of open data is hard to measure and even harder to calculate in advance. Benefit calculations, such as Fuchs' (et al., 2013; p.15) study of a benefit volume of € 12 215 872.44 in 2009 for all of Austria are still widely based on estimation. To generate concrete numbers on the added value of open data for Austria it would be necessary to consult numbers on the cost of open data provision, the maturity of the open data policies and portals, the market size of open data including valuations from market and personal perspectives, emerging benefits regarding cost savings (in the context of overall government expenditures), efficiency gains as well as the creation of new jobs. Additionally, open data may provide non-monetary and indirect welfare benefits in the sectors where it is downloaded and used. These added values are fostered by applications based on this data and are hard to calculate.

While this assessment provides a complex and estimated overview of the range and added value of open data, it can be observed, that its importance and potential increased over the course of the last years. In relationship to Austria's escalating GDP, the proportion of open data potential also rises, with a tendency to surpass one percent.

2.3 Conclusions: When and how to generate this value?

Remarkably, most of the undertaken studies refer to a rather short-term approach. That may be founded in the necessity to create impactful policies in a relatively short time to adapt to the rapid changes that are an inherent part of the digitalisation process. But while a five year approach as in the European Data Portal study may be reasonable, new inquiries for the advancement of open data applications after 2020 could now be evolved. If a full exploitation

of the added value is targeted by the Austrian Federal Government, a new focus should be the initiation of advanced applications as well as the use of data, which is central for the creation of this value. If a stable open data infrastructure is implemented, grown and used, Dapp et al. (2016, p. 35) suggest a steady increase in benefits for the private sector, indirect benefits as well as tax revenues.

Further, the added value that might be generated is generally dependent on the sector while sectors of application also may be determined by the data available. Currently, the public administration has been identified as one of the main profiteers of open data (Carrara et al., 2015). However, with the promotion and expansion of open data applications, shifts in the subject areas of open data as well as in the applying sectors may emerge. But the public sector plays a decisive role as a driver and innovator of open data as well as the central provider of this data that has the potential to foster social welfare, innovation and efficiency in administrational procedures as well as decision-making processes. The most important factor for the exploitation of open data values after implementing a sufficient infrastructure of accessibility is the use of open data to exploit its full potential.

Additionally, a further generation of added value may ensue by linking this open data. Such an approach may be the objective of further research, since linked data creates complex networks that may be the basis for innovative applications. The resulting added value may comprise sections and new areas of applications that have to be identified and observed within the range of further research.

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