Humanizing Data:

A framework for Open Government Data decision making

By Hannah Chafetz

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Abstract

The objectives of Open Government Data (OGD) are to promote transparency, accountability, and collaboration with the public. Structural issues within Subnational OGD and limited governance of urban data collection technologies have led to public concerns about ethical data collection, privacy, and digital human rights. However, OGD research is often purpose-driven evaluating specific parts of the system from a technical perspective and forgoes what data means to us as humans living in cities. The purpose of this study is to examine OGD use in Canada's cities from a values-based perspective. Using design thinking, strategic foresight, and systems thinking methodology, this research first investigates the current state of the system and uncovers that the metaphor, knowledge is power, is contributing to its insufficiencies. Alternative system metaphors are unpacked using future scenarios that demonstrate areas of critical uncertainty to which we are unprepared. Using the scenarios as the guide, this research submits decision making principles that OGD decision makers and open data advocates can use to humanize data.

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Table of Contents

List of figures

List of tables

Glossary of terms

Absorptive capacity: "The ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen & Levinthal, 1990, para. 1).

Artificial Intelligence (AI): "The ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings" (Copeland, 2020, para. 1).

Augmented Reality (AR): "An experience where designers enhance parts of users' physical world with computer-generated input. Designers create inputs—ranging from sound to video, to graphics to GPS overlays and more—in digital content which responds in real time to changes in the user's environment, typically movement." (Interaction Design Foundation, n.d., para. 1).

Big tech companies: A term used to describe the largest technology companies in the industry.

Bounded rationality: The condition in which people make their best possible decision from the information they are provided, but do not have all of the relevant information about the system as a whole (Meadows, 2008, p. 106).

Cities: An informal term used to describe Municipalities with their own governance structure.

Data: Qualitative or quantitative observations about people, places and things that are used for decision making.

Data collaboratives: A model that combines data from multiple sources within open data portals for secondary uses.

Data paradigm: What is driving the way we think about data.

Data sharing system: The larger system to which OGD is situated. The data sharing system includes the following system levels: OGD pipeline suppliers, urban open data ecosystem, data policy and information governance, the corporate digital economy and lives of city residents.

Data versus information: "Data is raw. It simply exists and has no significance beyond its existence (in and of itself). It can exist in any form, usable or not. It does not have meaning of itself. In computer parlance, a spreadsheet generally starts out by holding data. Information […] is data that has been given meaning by way of relational connection. This 'meaning' can be useful, but does not have to be. In computer parlance, a relational database makes for information from the data stored within it." (Bellinger, et al., 2004, paras. 4-5).

Data visualization: Graphics that "visually display measured quantities by means of the combined use of points, lines, a coordinate system, numbers, symbols, words, shading and color" (Tufte, 2001, p. 9).

Design thinking: "A methodology for innovation that combines creative and analytical approaches and requires collaboration across disciplines." (Chao, 2015, para. 10).

Emerging potentialities: Emerging potentialities or trends are a combination of weak signals that might grow in scope and scale in the future.

Geospatial data: "Information that describes objects, events or other features with a location on or near the surface of the earth. Geospatial data typically combines location information (usually coordinates on the earth) and attribute information (the characteristics of the object, event or phenomena concerned) with temporal information (the time or life span at which the location and attributes exist)." (IBM, 2021, para. 1).

Ground truth data: "Data collected at scale from real-world scenarios to train algorithms on contextual information such as verbal speech, natural language text, human gestures and behaviors, and spatial orientation." (Q Analysts, 2021, para. 1).

Horizon scan: A method used in strategic foresight to gather evidence of possible future developments that could change today's system structures (Cuhls, 2019).

Human values: The personal values we account for when we think about data.

Humanizing data: The process of incorporating the human impact of data in the way it is managed and used.

Indigenous data sovereignty: "The right of Indigenous peoples to govern the collection, ownership, and application of data about Indigenous communities, peoples, lands, and resources." (Rainie, et al., 2019, para. 2).

Infodemic: The condition when there is an abundance of information available about a subject making it difficult to find the truth amongst mis-/dis-information.

Mis-information versus dis-information: Mis-information includes unintentional false information whereas dis-information is a form of mis-information that aims to spread falsehoods (Gebel, 2021, paras. 1-2). The term 'mis-/dis-information' is used to describe incidents where mis-information or dis-information occur.

Open Data: "Open data is data that can be freely used, re-used and redistributed by anyone - subject only, at most, to the requirement to attribute and sharealike" (Open Knowledge Foundation, n.d.).

Open Government Data (OGD): Government data and information made publicly accessible to promote Government "transparency, accountability and value creation" (OECD, 2020b, para. 1).

Open Government Data (OGD) Practice: OGD practice is the act of making Government data and information publicly accessible from data collection to final use.

Orthodoxies: "Deeply held beliefs about 'how things are done' that often go unstated and unquestioned" (Evans, et al., 2017, para. 1).

Portals: Internet repositories where data and information are published.

Principles: The underlying beliefs that guide the design of new policies and strategies.

Scenarios: Possible visions of the future used for strategic decision making (Finch & Casasbuenas, 2020, para. 3).

Sense-making: "A constant process of acquisition, reflection, and action. It is an action oriented cycle that people continually and fairly automatically go through in order to integrate experiences into their understanding of the world around them." (Kolko, 2010).

Smart city: Urbanized regions that integrate data collection technologies in the built environment.

Strategic foresight: "Strategic Foresight is an organizational, social, and personal practice that allows us to create functional and operational views of alternative futures and possibilities" (The Futures School, 2015, para. 1).

Subnational Governments: Levels of Government below the national level - Provincial, Territorial and Municipal levels of Government.

System: "A system is a set of things [...] interconnected in such a way that they procure their own pattern of behaviour over time" (Meadows, 2008, p. 2).

System archetypes: A tool used to describe behaviour within a system that leads to new outcomes and unintended consequences (Braun, 2002).

Systems thinking: "Thinking performed with an appreciation of the broader context, considering dynamic interdependencies within the environment across multiple scales, that deliberately connects potential interventions with their implications for the variety of human values" (Ryan & Hamilton, 2012, p. 1).

The data life cycle: The processes involved in creating value from data from collection to secondary use.

1. **Collection:** The process of gathering and measuring data about a subject area.

2. **Processing:** "The converting of raw data to machine-readable form and its subsequent processing (such as storing, updating, rearranging, or printing out) by a computer" (Merriam-Webster, 2021).

3. **Use:** The manipulation and application of data to "support activities in the organization" (Dataworks, 2019).

4. **Distribution:** The procedure of publishing and sharing data for new use cases.

5. **Analysis:** "The process of collecting and organizing data [that has already been processed and shared] in order to draw helpful conclusions from it." (Import, 2019, para. 4).

6. **Secondary Use:** The act of manipulating and applying data that has already been processed, distributed and analyzed.

The Internet of Things (IoT): Non-standard computer objects that can connect with networks and transmit data (Posey, 2021, para. 1). IoT include devices such as smart city sensors and infrastructure, smart phones, and wearable devices.

Virtual Reality (VR): "Virtual Reality is the technology that provides almost real and/or believable experiences in a synthetic or virtual way" (Furht, 2008).

Weak signal: Evidence within the present of low probability, high impact future changes.

Chapter 1:
Introduction

1.1 Context

Governments produce and commission data to make decisions and solve problems. Due to the breadth of the information collected, Government data can be leveraged for secondary internal and external use cases (Ubaldi, 2013, p. 4). The practice of enabling external public access to Government data and information is known as Open Government Data (OGD) (OECD, 2020b). The Government of Canada (2020d) defines OGD as data that is "machine-readable, freely shared, used and built on without restrictions" (para. 4). OGD includes processed qualitative and quantitative data, visualizations, and insights about various topics, including the environment, culture and public health (Ubaldi, 2013, p. 5; Government of Canada, 2021b). Depending on the department or agency, Canadian OGD is published through Federal, Provincial, and Municipal internet portals. Additionally, individuals can make Access to Information requests to Government departments and agencies for data to be shared with the requester in accordance with the Access to Information Act (Government of Canada, 2020c).

The goals of publishing OGD are to promote Government transparency, accountability and collaboration with the public (Ubaldi, 2013, p. 4), but in many cases OGD has not yet met these goals. Current OGD use cases attempt to minimize silos within Governments and encourage collaboration amongst departments and agencies (The World Bank, 2019). Also, the development of OGD attempts to drive new innovations and citizen-centric business models (Gurin, 2014, p. 9) by distributing the socio-economic value of the data and returning data ownership to the taxpayers. There has been progress towards public servants' understanding the possibilities of Government data (Eaves, 2019). However, research indicates that, "the usage of OGD is lagging behind and there is a lack of evidence of creating value from OGD" (Gao, et al., 2021). Often,

OGD providers emphasize actions that resonate the most with their own mandates and can interpret them in different ways. As a result, the public has had limited involvement in data collection decisions.

One reason OGD practice has not met its objectives is due to the inherent structure of the OGD ecosystem. Structurally, there is unequal emphasis on OGD practice across jurisdictions. Historical efforts to grow the OGD ecosystem have focused on the national level. Data is collected locally to meet national objectives (Gao, et al., 2021). The majority of funding is allocated to the Federal Government, which limits the bandwidth of Municipal and Provincial Governments. However, these Subnational Governments are more likely to collect data to address local needs (Open Government Partnership Steering Committee, 2015). The rapid expansion of OGD during the COVID-19 pandemic exposed National-Subnational structural issues. Problems such as data hoarding, skewed analyses, and barriers to sharing across jurisdictions inhibited Canada's COVID-19 response (OECD & GovLab, 2021; Panetta & Rocha, 2020; Mulligan, et al., 2020; Ling, 2021). Redesigning OGD practice at the Subnational levels of Government is an area of opportunity.

Municipalities are adopting new technologies to solve societal problems and achieve a higher quality of life (Woetzel, et al., 2018), but these initiatives do not account for the human impact of data collection. Cities are collecting data about people and their surrounding environment using cameras, sensors, communication networks, and artificial intelligence (AI) enabled devices. In practice, the widespread use of these technologies has raised concerns about ethical data collection, privacy, and digital human rights (Halais, 2020). Specifically, private sector control over the data sharing system has accelerated fears of surveillance capitalism and anti-empiricism (Cecco, 2019; LaFrance, 2020). OGD research has

historically taken a technical perspective (Gao, et al., 2021) forgoing its impact on human values. Analyzing the human impact of data collection, processing and use in cities is becoming increasingly important in designing new OGD initiatives.

This research explores OGD use in Canada's cities from a values-based perspective. OGD practice is a part of a larger urban data sharing system impacting stakeholders across disciplines. This research aims to look beyond our current ways of working and explore the deeper systemic drivers influencing Canada's urban data sharing system in the future. Analyzing how areas of critical uncertainty could lead to new ways of thinking about data sets the foundation to design principles for humanizing OGD.

Several factors contributed to the design of this research. This research was completed during the COVID-19 pandemic and was designed to align with social distancing requirements. Due to time and budgetary restrictions, the research process explores emerging ways of thinking about data from an expert-led perspective. This research was designed to meet OCAD University's Major Research Project academic requirements and includes events from September 2020 to June 2021.

Purpose

The purpose of this research is to provide OGD decision makers and open data advocates with the underlying principles for designing a data sharing future that supports human values. As part of designing this future, we should understand the guiding principles before we define new strategies and policies. This research uncovers decision making principles that support humanizing or integrating the human impact of OGD within our cities. These decision making principles demonstrate the importance of understanding the 'big picture' of OGD related problems.

Objectives

This research aims to achieve the following objectives:

1. Understand the larger system within which OGD is situated
2. Define the insufficiencies of the current system
3. Explore new ways of thinking about data that are on the horizon
4. Recommend decision making principles for policy and strategy development

▼ *Figure 1. Historical drivers of OGD*
The following figure shows my sense-making of the contextual historical drivers[1] of OGD practice starting from the 1930s. Today's OGD practice was the result of incremental innovation leading to larger system level changes.

WWII: State led propaganda

WWII: Nazis book burning

Knowledge under siege 1930s-1940s

Robert King Merton advocates for open scientific data

The Access to Information Act and the Privacy Act are established

Data journalism is adopted

The rise of personal computers

The right to information movement 1970s-1990s

The rise of the internet

Canadian Institute for Advanced Research was formed

Open information non-profits form

The rise of machine learning

The rise of civic tech

"People's Right to Know" by Harold L. Cross is published

Demands for freedom of the press

International standards for weather data sharing are formed

Peoples' right to know 1940s-1970s

The U.S. Freedom of Information Act

The first internet prototype was invented

Article 19 of the Universal Declaration on Human Rights and the International Covenant on Civil and Political Rights: "Every person shall have the right to seek and impart information"

2011: Government of Canada launches 12 month pilot of national open data program

2007: Sebastopol Open Government meeting - 10 principles for evaluating openness of government data

The OGD movement 2000s-2010s

The rise of big data

Advocacy for knowledge as commons in academia

Canada launches its Directive on Open Government - "open by default"

Canada joins the Open Government Partnership

2009: U.S. Open Government Directive

Wikileaks involvement in 2016 U.S. presidential election campaign

Canada launches the Open Data Charter

Facebook-Cambridge Analytica Data Scandal

Adoption of Crown Jewels strategies

The rise of data equity activism

The data wild west 2010s-2020s

2020 U.S. Presidential Election voting fraud claims

COVID-19 "flatten the curve" public health messaging

Advocacy to publish data with purpose

The COVID-19 Pandemic rapidly accelerated the demand for OGD and exposed gaps in the data sharing system

Uncharted territory 2020s

1

Adam, B. (2013, April 4). Open Data: A History. Data.Gov. https://www.data.gov/blog/open-data-history/

Canada's Plans to the Open Government Partnership. (2020, October 9). Government of Canada. http://open.canada.ca/en/content/canadas-plans-open-government-partnership

Cannariato, N. (2020, December 8). What a History of Book-Burning Can Tell Us About Preserving Knowledge Today. Slate Magazine. https://slate.com/culture/2020/12/burning-books-history-libraries-data-preservation.html

Censky, A. (2021, January 1). How Misinformation Lit The Fire Under A Year Of Political Chaos In Michigan. NPR. https://www.npr.org/2021/01/01/952528193/how-misinformation-lit-the-fire-under-a-year-of-political-chaos-in-michigan

Chignard, S. (2013, March 29). A brief history of Open Data—Paris Innovation Review. Paris Innovation Review. http://parisinnovationreview.com/articles-en/a-brief-history-of-open-data

Eaves, D. (2011, June 23). The next Open Data battle: Advancing Policy & Innovation through Standards. Eaves.Ca. https://eaves.ca/2011/06/23/the-next-open-data-battle-advancing-policy-innovation-through-standards/

Hess, C., & Ostrom, E. (2011). Understanding Knowledge as a Commons: From Theory to Practice. MIT Press. https://mitpress.mit.edu/books/understanding-knowledge-commons

Hosenball, M. (2017, December 7). WikiLeaks faces U.S. probes into its 2016 election role and CIA leaks: Sources. Reuters. https://www.reuters.com/article/us-usa-trump-russia-wikileaks-idUSKBN1E12J2

Houston, B. (2015, November 12). Fifty Years of Journalism and Data: A Brief History. Global Investigative Journalism Network. https://gijn.org/2015/11/12/fifty-years-of-journalism-and-data-a-brief-history/

Jeffreys-Jones, R., & Theoharis, A. G. (1999). A Culture of Secrecy: The Government versus the People's Right to Know. The Journal of American History, 86(1), 303. https://doi.org/10.2307/2567532

Kitch, T. (2015, September 11). Secure the Crown Jewels. Oracle Cloud Security. https://blogs.oracle.com/cloudsecurity/post/secure-the-crown-jewels

Malamud, C. (2007, October 22). Open Government Working Group: Memorandum. https://public.resource.org/open_government_meeting.html

Mittal, P. (2020, April 22). A brief history of hackathon. TechGig. https://content.techgig.com/a-brief-history-of-hackathon/articleshow/75291637.cms

Mokrosinska, D. (2018). The People's Right to Know and State Secrecy. Canadian Journal of Law & Jurisprudence, 31(1), 87–106. https://doi.org/10.1017/cjlj.2018.4

Moreau, N. (2012, December 3). Internet in Canada. The Canadian Encyclopedia. https://www.thecanadianencyclopedia.ca/en/article/internet

Mustonen, J. (2006). The world's first freedom of information act: Anders Chydenius' legacy today. Anders Chydenius Foundation.

O'Flaherty, M. (2012). Freedom of Expression: Article 19 of the International Covenant on Civil and Political Rights and the Human Rights Committee's General Comment No 34. Human Rights Law Review, 12(4), 627–654. https://doi.org/10.1093/hrlr/ngs030

Patterson, D. (2020, July 30). Facebook data privacy scandal: A cheat sheet. TechRepublic. https://www.techrepublic.com/article/facebook-data-privacy-scandal-a-cheat-sheet/

Read, S. (2016, February 16). Track 5: Jane Jacobs and organised complexity. JaneJacobs100. https://janejacobs100.co/track-5/

Shrivastava, K. M. (2009). The right to information: A global perspective. Lancer.

Sieber, J. E. (2015, September 23). Data Sharing in Historical Perspective. Social Science Space. https://www.socialsciencespace.com/2015/09/data-sharing-in-historical-perspective/

Stark, L., & Pylyshyn, Z. W. (2020, December 14). Artificial Intelligence (AI) in Canada. The Canadian Encyclopedia. https://www.thecanadianencyclopedia.ca/en/article/artificial-intelligence

Ten Principles For Opening Up Government Information. (n.d.). Sunlight Foundation. Retrieved February 10, 2021, from https://sunlightfoundation.com/policy/documents/ten-open-data-principles/

Tumilty, R. (2020, May 21). 2016 report warned about public health data reporting problems Canada is facing with COVID-19. National Post. https://nationalpost.com/news/politics/2016-report-warned-about-public-health-data-reporting-problems-canada-is-facing-with-covid-19

1.2 Research question

How might we rethink OGD practice in Canada's cities in support of emerging shifts in human values?

The variables within the research question are deconstructed below:

- **Rethink:** The goal of this research is to rethink or re-evaluate the fundamental principles guiding the system, not the individual parts of the system.
- **OGD practice:** OGD practice is the act of making Government data and information publicly accessible from data collection to final use.
- **Canada's cities:** The term 'cities' is an informal term that describes Municipalities with their own governance structure. While Municipalities hold the majority of data about Canada's cities, city-focused OGD is published though Federal, Provincial, and Municipal OGD portals.
- **Emerging:** The term 'emerging' describes changes that are on the horizon. These changes are currently at their initial stages and it is uncertain how they might grow in the future.
- **Human values:** The term human values or preferences describes what personal values we account for when we think about data. One such example is the public's willingness to provide their personal data to the Government as a part of the Census. This demonstrates the underlying value that supplying personal data is a part of citizenship.

1.3 Report structure

The remainder of the report is divided into five chapters: methodology, the current state, the future, recommendations, and conclusion. First, Chapter 2 lays out the methodology used to answer the research question. This chapter first describes the design thinking phases that guided this research. It then details the information sources and analysis processes used throughout the design thinking process.

Chapter 3, the current state, describes the current system's conditions and inefficiencies. This chapter is divided into three sections: how the current system works, the current system's insufficiencies, and considerations for moving towards change. The first section is a comprehensive systems analysis. This section deconstructs the system levels and stakeholder dynamics to uncover why the current system works. It sets the scope of the larger data sharing system within which OGD is situated and explains the external systems that guide and govern OGD. It then details the stakeholder behaviour that structures the system and uncovers how stakeholder tensions have become a source of complexity within the system. This section concludes by distilling the 'big picture' of why this system works.

The analysis of the current system conditions is followed by its inefficiencies. The second section of Chapter 3 unpacks the problems within the current state of the system. This section identifies the rules at the operational level impacting the current state of OGD before describing the larger patterns within the system that the rules are contributing to. Next, this section critiques the paradigm guiding the system and sets out the barriers to change. Last, this chapter outlines design considerations for moving towards system change. The considerations are the foundation for Chapter 4, the future.

Chapter 4, the future, frames how insufficiencies within the current state might expand in the future. Drawing from the problems described in Chapter 3, this chapter lays out five changes on the horizon that might shift the way we think about data. The changes on the horizon inform areas of critical uncertainty to be explored through scenario development. The second section of this chapter proposes alternative future data paradigms through future scenarios. Three low probability, high impact future scenarios are explored describing data sharing in 2036: the rise of data 'prosumers', what's mine is yours, and behind closed doors. This chapter concludes with insights about areas of critical uncertainty for which we are unprepared. The contents in this chapter are used for decision making in Chapter 5.

Chapter 5, recommendations, sets out a decision making framework to aid the development of OGD strategies and policies. Five decision making principles and the problems that could be addressed are explained followed by the indicators to measure the successful application of the principles. This decision making framework is the starting point to incorporate human values in OGD related problems. The next steps for the implementation process are shown in Chapter 6 which summarizes the report contents and provides jumping off points for future research.

Chapter 2:
Methodology

2.1 Research approach

The research approach of this paper follows the design thinking methodology of Herbert A. Simon (1995) and Kees Dorst (2015). This methodology establishes a broad, multi-disciplinary perspective of the design ecosystem before framing the problems and identifying opportunities for intervention. Initially, a literature review was conducted to identify gaps in the available research. The literature review uncovered that open data research is purpose-driven. Specifically, this type of research tends to examine finite, predefined parts of the system and ignores the broader question of what data means to us as humans living in cities. In contrast to the current literature, this research takes a values-based approach. This research explores how human values are integrated within the collection, use and distribution of data in cities.

The objective of this research is to develop an OGD decision making framework that supports emerging shifts in human values. Using the design thinking methodology, the research process follows three phases: problem finding, problem framing, and problem solving (Simon, 1995; Dorst, 2015). First, problem finding seeks to understand the who and what of the larger system in which OGD is situated. Problem finding identifies the insufficiencies within the current state of the system and provides jumping off points for thinking about the future. Second, problem framing explores how systemic issues identified through problem finding could disrupt the system in the future. The problem framing process envisions possible future system states to understand areas of critical uncertainty within the system. Third, the problem

solving phase bridges the gap between the present and the future by providing actionable insights to humanize data. The methods used within each phase are drawn from design thinking, systems thinking, and strategic foresight. Using the research process explained in the following sections, the intention is to demonstrate the value of design thinking in analyzing data related problems. A summary of the design thinking process is shown in Table 1.

▼ *Table 1. Design thinking process - summary*
The following table summarizes the research objectives, questions,
and methods within each phase of the design thinking process.

Design thinking phase	Phase 1: Problem finding	Phase 2: Problem framing	Phase 3: Problem solving
Timeframe of focus	The current state	The future	Moving from the current state to the future
Objective	Understand the current condition of OGD and its insufficiencies.	Imagine the possible futures of OGD in Canada's cities.	Provide recommendations that support emerging shifts in human values in OGD decision making.
Questions	How does the system work? Why does the system work? What are the insufficiencies of OGD? What are the barriers to change?	What possible changes on the horizon could result in new data paradigms? How might we think about data in 2036?	What if we designed new principles to guide OGD decision making? What would success look like?
Collection methods	Literature review Semi-structured interviews	Horizon scan Semi-structured interviews	Literature review Semi-structured interviews
Analysis methods	Iterative Process of Inquiry System mapping Causal Layered Analysis (CLA) Orthodoxies	Alternative Causal Layered Analysis (Alternative CLA)	Policy stress testing

2.2 Information gathering methods

This section describes how information was gathered for the design thinking process. This research includes both primary and secondary information sources. It draws from three sources of information: literature review, horizon scan, and semi-structured interviews. Figure 2 demonstrates how the information gathered from these sources were used in the design thinking process.

Literature review

A literature review was conducted to explore the state of the art and the drivers influencing the larger system. The literature review included academic papers, journals, books, news articles, and podcasts. The exploration included the following topics: the data economy, data sharing policy making, Municipal policy making, new open data models, data science, data visualization, smart cities, and strategic foresight in the urban technology sector.

Trends from the literature review were compiled within several matrices using spreadsheets that were organized by information source and topic. The themed spreadsheets were evaluated based on their potential impact on OGD in cities. Organizing the information within trends matrices demonstrated the possible connections between different information sources and themes. From there, the interconnections between trends and their positioning within the larger system could be evaluated.

Horizon scan

Horizon scanning is a method used in strategic foresight to gather evidence of possible future developments that could change the current system structures (Cuhls, 2019). Evidence from the present of possible or emergent future change is more commonly known as a weak signal. For this project, the horizon

scan consisted of looking for weak signals in various mediums such as news sources, social media platforms, science fiction, literature, academic research, interviews, and documentaries. Over two hundred weak signals were collected including evidence of future innovations, cultural practices, values, and ways of working that might influence OGD in cities.

The weak signals were organized using the STEEP-V framework, a strategic foresight method ubiquitously used in horizon scanning (Richardson, 2017). The STEEP-V framework categorizes weak signals by their potential social, technological, environmental, economic, political, and values-based impacts. From there, the interconnections between weak signals within the same categories could be analyzed.

Semi-structured interviews

Conducting personal interviews allows us to understand first-hand the stakeholder perspectives of the subject area and design human-centered recommendations that address stakeholder needs. The literature review uncovered that open data research tends to be expert driven focusing on data providers' perspectives. This is because the average citizen tends to experience open data through secondary distillations and is often unaware of the original data source. This research aims to include professionals who provide the data and urban stakeholders who use it in their domains. An initial list of interview participants was identified through online research. Participants were added to the list through snowball sampling as participants recommended additional candidates.

Twenty-four remote semi-structured interviews were conducted with Government officials involved in open data, academics, data and technology specialists, researchers, and urban stakeholders. Each participant was asked a set of predetermined questions. The interview questions were designed according to the

following structure: examining the present, exploring possible futures, and bridging the gap between the present and their preferred future scenario. The audio of each interview was recorded and fully transcribed.

Structural coding was used to find trends within the interview transcripts. Structural coding is a content based method for analyzing interview transcripts that considers the nuances within large quantities of information (Saldaña, 2013). First, each section of text representing a distinct thought in response to an individual interview question was assigned a summary code. Each code represented one section of text that could be summarized in six words or less. The transcription copy and summary codes were combined within trend matrices organized by theme. There were over ninety themes including environmental, data

collection, technology, activism, interoperability, and privacy. Codes of the same theme were analyzed for similarities and consolidated to identify trends (see Appendix B). The themed trends were then placed in new matrices divided into three categories: the current state, changes on the horizon, and the future.

The interviews provided new perspectives that challenged my assumptions about OGD. They helped me navigate the problem finding and framing processes and set the foundation for problem solving. This research was approved by the OCAD University Research Ethics Board (approval number: 2021-01). Interview participants who gave permission to be identified in this document are included in Appendix A. The full list of interview trends used in this report are shown in Appendix B.

▼ **Figure 2. Project roadmap**
This figure demonstrates how the information gathered through the literature review, horizon scan, and interviews were used throughout the design thinking process. The objective of this figure is to show how sections of this project that combine multiple information sources build upon each other.
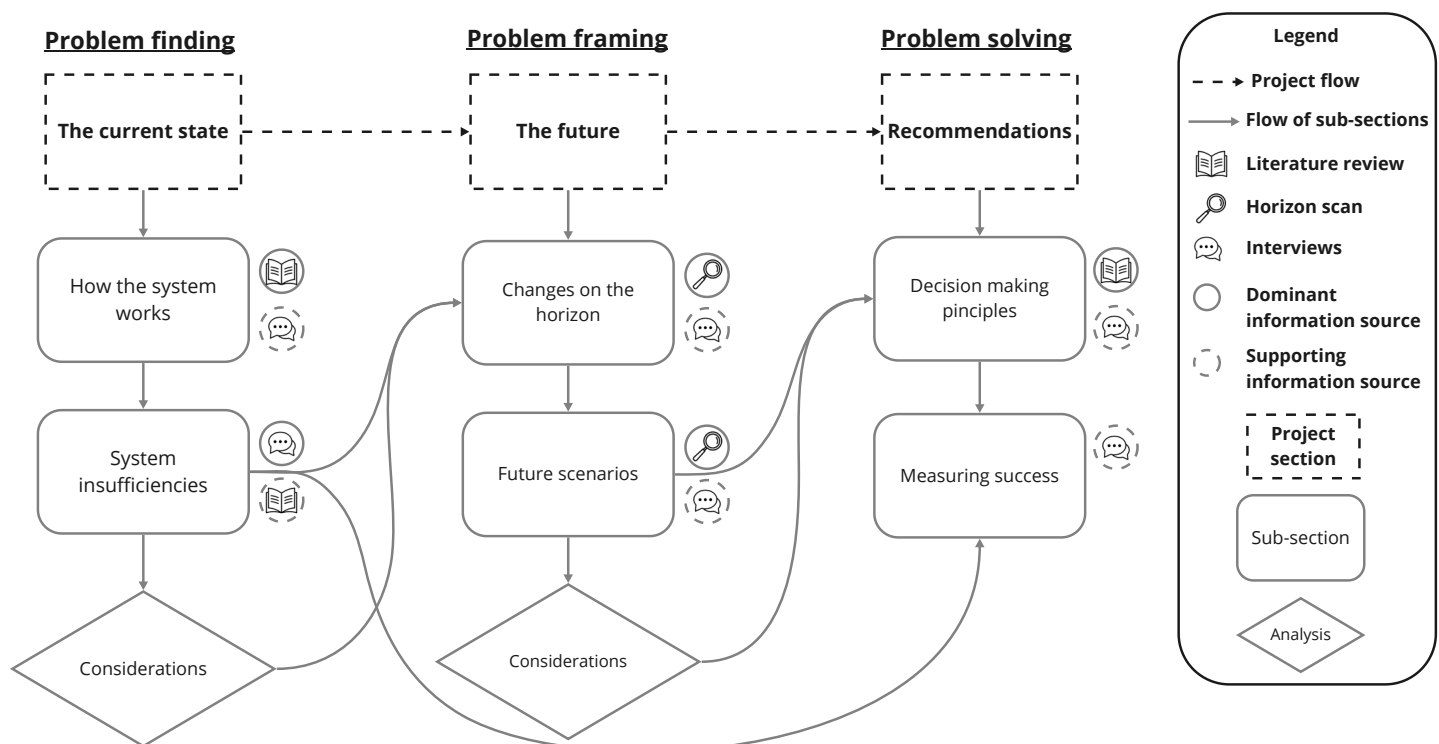
2.3 Analysis methods: design thinking process

This section describes the process used to distill the information gathered and achieve the objectives of the design thinking process.

Phase 1: Problem finding - the current state

The problem finding phase describes the current conditions of OGD and its insufficiencies. This phase seeks to understand how and why the current system works. To formulate a description of the system, the boundaries for this research are set and the situational environment of the present is reviewed. The critique of the system builds upon the system description by identifying the problem area of focus and barriers to change. This research phase provides the foundation to explore how the current insufficiencies might grow in the future. The systems thinking and strategic foresight methods used provide a comprehensive understanding of the system from a human-centered perspective. The research process and methods used in problem finding (Chapter 3) are explained below.

The first part of problem finding is understanding how the current system works. The information used to understand how the system works was impressionistic based on the literature review and supported by interview trends. The process began by setting the boundaries of the system levels included in this research as the background for the systems analysis. Jamid Gharajedaghi's (2011) Iterative Process of Inquiry was the guide to define the system levels and boundaries. The Iterative Process of Inquiry unpacks the purpose, activities, stakeholders, and situational environment of each level of the system. The boundaries of each level were set based on common objectives and activities identified through the literature review. Deconstructing the system levels provided a more complete understanding of the

system as a whole (Gharajedaghi, 2011) and was the foundation to examine the stakeholder behaviour.

Next, influence maps were used to examine the stakeholder behaviour uncovered through the system levels. The influence maps were drawn from Mendelow's (1991) Power Interest Matrix, a framework to compare stakeholders' ability and interest to create change within the system. Mapping the stakeholder interactions distilled the sources of complexity within the system and demonstrated the stakeholder behaviour causing problems. This method allowed us to uncover the most influential stakeholders and the incentives driving the system structure.

The last part of understanding how the current system works investigates the deeper structures driving the system. Sohail Inayatullah's (2008) Causal Layered Analysis (CLA) was used to envision beyond the day-to-day activities and deconstruct the underpinnings not visible from the surface. The CLA is a strategic foresight method used to understand how the structure of the system levels are connected to deeper worldviews and metaphors (Inayatullah, 2008). The CLA distilled the systems analysis and opened a window to understand the 'big picture' of the current state. The current state CLA allowed us to deduce why the system works and was the basis for problem framing. An instrumental description of the current state CLA is shown in Figure 3.

The latter part of problem finding identifies the current system's inefficiencies. This part follows the same structure as the systems analysis starting from the visible activities moving to the deeper systemic structures. The system insufficiencies are drawn from the interview trends and supported by the literature review. The interview trends were first filtered to identify more prominent trends based on the number of participants who indicated the

Figure 3. The current state CLA - structure ▶

Sohail Inayatullah's (2008) CLA is used to describe why the system works in its current state. The analysis starts from the visible layers of the system (litany) and then moves downwards describing the deeper systemic underpinnings. The definitions of each layer are outlined below:

- Litany (continuous): what is visible today within the system boundaries.
- Systemic manifestations (years): historical explanations for the visible activities.
- Worldview (decades): the underlying beliefs guiding the system.
- Myth/Metaphor (societal/civilizational): a headline describing system actors' perceptions of the three layers above.

The current state

Litany

Systemic manifestation

Worldviews

Myth/Metaphor

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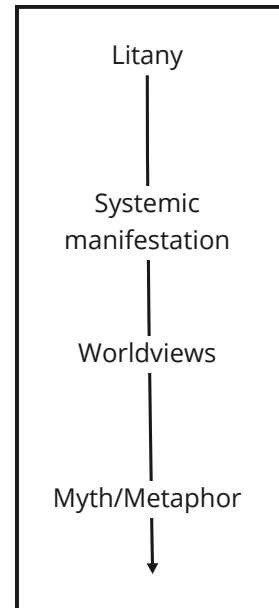
problem. The trends were then narrowed and refined using the following methods. The full list of interview trends used in this report are shown in Appendix B.

System orthodoxies were used as the framework to understand the day-to-day problems within the system. Orthodoxies are "deeply held beliefs about 'how things are done' that often go unstated and unquestioned" (Evans, et al., 2017, para. 1). Oftentimes orthodoxies lead to accepting the status quo and forgoing high impact opportunities. Challenging the existing orthodoxies has the potential to "lead to drastic improvements in practice" (Evans, et al., 2017, para. 1). System orthodoxies allowed us to describe the insufficient rules within each system level before identifying larger patterns.

Defining the system orthodoxies uncovered patterns within multiple system levels that are causing human problems. Causal loops drawn from William Braun's (2002) *The System Archetypes* were used to narrow and refine the patterns and barriers to changing the system as well as deconstruct the unintended consequences of the system's behaviour. The causal loops used to develop the system patterns are set out in Appendix D.

Following the system patterns and barriers to change, this research phase concludes with considerations for problem framing. The considerations were developed by analyzing all content in this phase and narrowing high impact areas for problem framing.

This methodology provides a comprehensive understanding of the system's current conditions and insufficiencies. The analysis of the current state of the system provides jumping off points to frame how today's problems might grow in scope and scale in the future. The problems demonstrated are built upon in the problem framing phase of the research process.

Phase 2: Problem framing - the future

The problem framing process uses strategic foresight methodology to imagine how the current system's inefficiencies could expand in 2036. The objective of this phase is to gain a deeper understanding of the system's problems. The literature review indicated that open data research about the future often takes a linear approach, examining one potential outcome and

different pathways to prepare for it. Strategic foresight methodology opens a window to explore multiple visions of the future and allows us to think beyond the current OGD practice to explore areas of critical uncertainty. This methodology is relevant because developing governance strategies during times of uncertainty, such as the COVID-19 pandemic, requires preparing for unanticipated events (OECD, n.d.).

This research phase explores how the insufficiencies within the current system could lead to new ways of thinking about data. The objective of this phase is to challenge the current state CLA (Inayatullah, 2008), and imagine how shifts in the way we think about data could exacerbate existing problems. This research aims to achieve this provocation by scanning the horizon for evidence of possible future changes and combining evidence of change to design alternative future scenarios. The process and methods used in problem framing (Chapter 4) are described below.

The first step is scanning the horizon or gathering information about the present that might result in future systemic change. The focus of the horizon scan was to gather weak signals about emerging data paradigms. The weak signals were analyzed comparatively within the categories of the STEEP-V framework to find patterns in the information gathered. The patterns were synthesized based on the potential to drive new ways of thinking about data. The emerging potentialities expand our thinking about the system and provide the foundation to imagine future scenarios.

The future scenarios are low likelihood, high impact visions of the future used for decision making (Finch & Casasbuenas, 2020, para. 3). Scenarios challenge our assumptions and unpack how areas of critical uncertainty might impact the system in the future. Scenarios can be normative or exploratory. Normative scenarios describe a population segment's desired outcomes, meanwhile exploratory scenarios envision multiple outcomes that may not be desirable for

the population (Roberts, 2014, p. 1). This research uses exploratory scenarios to demonstrate how the current system's insufficiencies could expand in the future. The scenarios are not intended to predict the future. They are used to frame the system's uncertainties and design recommendations that account for disruptive future changes.

This research phase imagines three future scenarios that describe OGD in Canada's cities in 2036. An alternative CLA (Inayatullah, 2008) was the guide for scenario development because as an unstructured method it expands the breadth of the work and envisions the 'big picture'. The CLAs for each scenario originated from three metaphors that challenge the current state CLA. The underpinnings of each scenario were deduced from the interview trends combined with the emerging potentialities. The underpinnings were synthesized based on their connection to the insufficiencies from the problem finding phase. Next, the visible layers of the system were formed using the emerging potentialities as the guide. Understanding the connections between the layers of the CLA framed uncertainties for problem solving. An instrumental description of how the alternative CLA was used from the present to the future is shown in Figure 4.

Second, back casting was used to consider what events might drive each future scenario. Back casting identifies a timeline of important events leading to 2036 that would bring that future to reality. A fifteen year time horizon was used to examine the future expansively while providing useful insights for the present. The process of back casting started with today's events and then worked forward to describe what could result in each CLA (Inayatullah, 2008). Last, a narrative was written in alignment with the CLA and back casting.

The last part of problem framing provides considerations for problem solving. The considerations were developed by analyzing the scenarios comparatively and finding commonalities amongst all

Figure 4. The future CLA - structure ▶
This figure demonstrates how Inayatullah's (2008) CLA is used in problem framing. The alternative CLA begins with three alternative metaphors that challenge the current state metaphor. Next, the remaining layers are examined from the bottom up. The intention of this process is to differentiate each scenario by its systemic underpinnings before considering the visible parts of the system.

The current state   **The future**
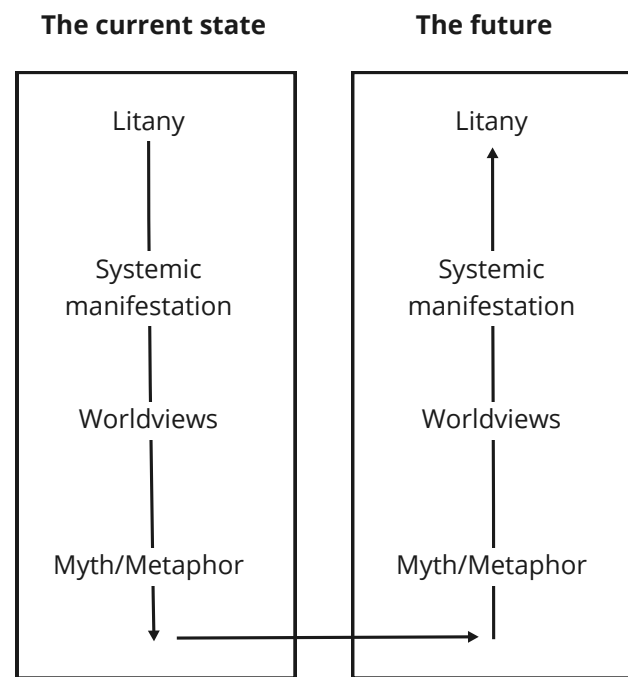
three. From there, the commonalities were narrowed and refined based on the level of uncertainty and preparedness. The considerations included are the ones that have the highest amount of uncertainty and for which we are the least prepared.

This research phase frames how the system's insufficiencies could grow in the future. This methodology allows us to prepare for the changes that might occur in the future and take steps towards achieving a system state desirable for city residents. The final research phase, problem solving, provides recommendations to prepare for these future system states.

Phase 3: Problem solving - recommendations

The problem solving phase provides recommendations that support humanizing the future of data sharing. The objective of this phase is to provide a decision making framework for OGD decision makers and

open data advocates to use in strategy and policy development. Five decision making principles are proposed followed by the indicators of their successful implementation. This research phase is primarily drawn from sense-making through the problem finding and framing results.

The five decision making principles were inspired by systems thinking, design thinking, and intersectional feminist epistemology explored in this research paper. The principles are drawn from the following works: Peter Jones' *Systemic Design Principles for Complex Social Systems* (2014), Catherine D'Ignazio and Lauren F. Klein's *Data Feminism* (2020), and Donella H. Meadows' *Thinking in Systems* (2008). The intention of combining principles from these works is to incorporate the diversity of disciplines involved in this research. Applying the principles to this context could assist decision makers in considering societal values when solving OGD related problems.

Policy stress testing was used to narrow and refine the decision making principles based on their

potential impact. Policy stress testing is "a method for testing the robustness of policy options against a set of scenarios to see how well they stand up against a range of external conditions" (New Zealand Government, 2021, para. 1). Policy stress testing demonstrated how the principles might withstand the future scenarios in problem framing and pinpointed the most important principles to address areas for which we are the least prepared.
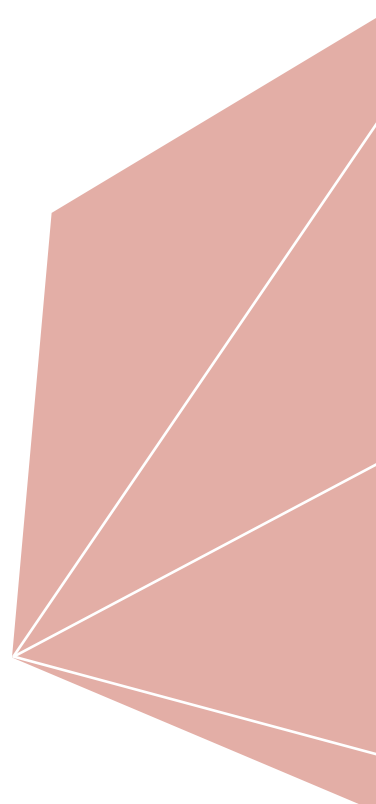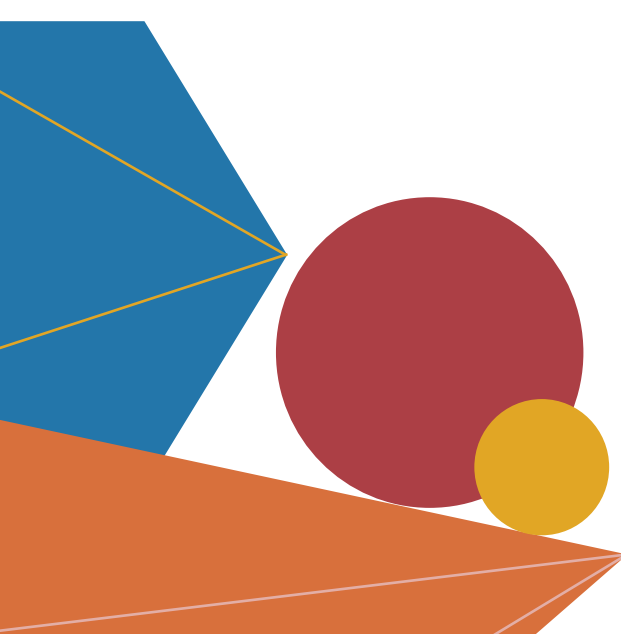
Last, the indicators of successful implementation of the principles were developed from the barriers to change from problem finding in conjunction with the research of this report. This research phase aims to capture the complexity of the problems set out in the previous phases and provide actionable insights for future decision making processes.

Chapter 3:
The current state

The future is rooted in the present. The goal of strategic foresight is to envision possible future system states given perturbations to the system. Envisioning possible futures allows us to better prepare for future conditions and shape the future we want to see. Before we can think about what is changing, we first must make sense of the current system conditions. This chapter describes and analyzes the data sharing system in its current state. It provides the background of how Canada's open data industry perceives the collection, use, and distribution of data in cities and identifies the system's problems. The findings from the systems analysis are expanded upon in Chapter 4, the future.

3.1 How the current system works

The purpose of this section is to provide the background for a comprehensive analysis of OGD. The analysis of the system shows that OGD is situated within the complex data sharing system consisting of competing activities, values, and incentive to initiate change. Understanding the external activities, stakeholder behaviour, and deeper forces that guide this system are necessary to deconstruct why OGD related problems persist.

System levels

OGD is situated within a complex data sharing system divided into levels with common objectives and activities. OGD is an input for open data portals that support socio-economic development, new business models, and social justice. The open data ecosystem is situated within the digital economy which values data as a commodity of trade rather than a tool for knowledge generation.

Technological advancement is rapidly changing data sharing methods and the Government is trying to keep pace. Meanwhile, city residents continue to fuel this system by sharing their personal data in exchange for access to products and services. But, city residents are often unaware of how their data is being used and are primarily engaging with the system externally through sense-making secondary distillations of data. Each of these system levels has different objectives, values, regulations, and ways of working that impact the way OGD is used in cities.

The boundaries of the system levels included in this research are summarized below. These system levels are referenced throughout the report and used to identify areas for intervention. A detailed description of the system levels including Gharajedaghi's (2011) Iterative Process of Inquiry components are shown in Appendix C.

Figure 5. Hierarchy of system levels ▶
This figure shows the hierarchy of the system levels included in this research.

- Micro level: the organization of focus for this research.
- Meso level: the primary sector in which the organization is situated.
- Exo level: the broader environmental forces that allow the industry to operate.
- Macro level: the societal actors.

(Gharajedaghi, 2011)

Macro — Lives of city residents

Exo — Regulatory:
Data policy & information governance
Economic:
Corporate digital economy

Meso — Urban open data ecosystem

Micro — OGD pipeline suppliers
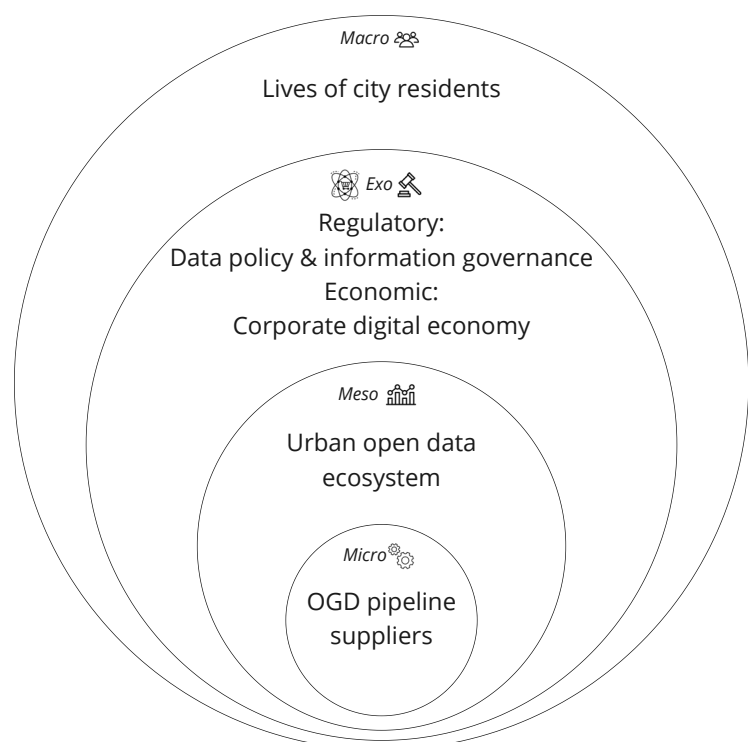
Micro level: OGD pipeline suppliers

The micro level examines the organizational activities required to produce OGD. The OGD pipeline processes and aggregates existing Government data for both Government and public use. Internally, its objective is to foster collaboration amongst Government departments and agencies. Externally, the purpose is to enhance Government transparency and accountability with the public and advance secondary analyses and data informed decision making. This level includes the implicit and explicit assumptions within Government open data programs.

Meso level: Urban open data ecosystem

The meso level describes the industry where OGD is situated. The objective of the open data ecosystem is to support socio-economic development in cities by sharing accessible data and information. It encourages sector-wide collaboration to support the needs of the community. The purpose is to gather together disparate data sources and share user friendly outputs. It supports the growth of public understanding of socio-economic problems by making open data sources accessible to the public.

Exo levels: Data policy and information governance and the corporate digital economy

The exo level examines the broader ecosystem within which the open data industry functions. It includes both the regulatory and economic environment that influence the industry's activities.

Regulatory Environment
This system environment regulates the sharing of data and information in cities. It aims to protect civil liberties and natural biomes impacted by information

ecosystems. This system level aims to maintain public trust in Governments as a regulatory body and credible source of data and information.

Economic Environment
The digital economy facilitates the distribution of resources through the internet (Tattrie, 2019). This system environment measures the use of technologies in production and consumption and the distribution of goods and services. The digital economy is a subset of the economy that is used to generate tax revenue and Government spending. It sets the value of resources available and aims to maximize growth.

Macro level: Lives of city residents

The macro level represents the societal values, norms, and beliefs that shape how city residents, as a population, live in cities. It includes how city residents interact with the prior system levels. This system level represents city residents' interactions with the digital world. It describes how city residents solve problems and satisfy the human curiosity to understand.

System structure

There are several stakeholders within the data sharing system who have the power to change OGD. However, these stakeholders have conflicting priorities with limited resources and benefit from the status quo. Thus, the majority of high power stakeholders are not incentivized to change this system and as a result OGD has remained stagnant. The stakeholders most interested in changing the system have limited power. This section explains the stakeholder behaviour causing these current conditions. Using influence maps adapted from Mendelow's Power Interest Matrix (1991), the stakeholder power dynamics and factors preventing stakeholders from sharing their data are demonstrated (see Figure 6 and 7). The analysis of the stakeholder behaviour is used to identify the consequences of the system's insufficiencies in section 3.2 of this report.

Stakeholder power and interest

The stakeholder analysis shown in Figure 6 uncovers the power dynamics guiding how the system is structured. The key takeaways are summarized in the following sections and organized based on the stakeholder levels of power and interest. Stakeholders with high power may be heavily involved in governance or directly influence other stakeholders' sentiments and activities. In contrast, stakeholders with high interest are concerned for and have a high stake in the system.

Quadrant 1: High power - high interest

High power and interest stakeholders are the most influential stakeholders in the system. They have the most interest in OGD and power to change the system. They play an integral role in the growth of OGD. High power - high interest stakeholders include: OGD Suppliers and Large Corporations.

OGD Suppliers
OGD Suppliers are Government departments and agencies that publish data and information related to cities. OGD Suppliers include entities at all levels of Government (Government of Canada, 2020a). However, the majority of OGD related to cities is held at the Municipal level. OGD Suppliers and Policy Makers are separated on the influence map. One interview trend was the challenge of growing OGD programs with limited resources. OGD Suppliers must adhere to the policies and funding allocation previously set out by Policy Makers. Policy Makers are interested in OGD amongst many other priorities requiring their attention. Thus, OGD Suppliers have a higher interest in growing OGD initiatives, but less influence in the system as a whole. The power to initiate large-scale strategic changes is held by Policy Makers.

Large Corporations
Large Corporations include private sector companies that collect or share data. This includes big tech companies, e-commerce platforms, and multinational enterprises (e.g. Walmart). Large Corporations provide essential services to Canadians from food supply to productivity tools. The majority of data within the system is collected and owned by Large Corporations (Verhulst, et al., 2020). Large Corporations have the right to withhold data from the public unless they are legally mandated to share (Office of the Privacy Commissioner of Canada, 2016). They have high interest in OGD and open data because it directly impacts their ability to conduct business. Changes to data policy and information governance could require new business models.

Quadrant 2: High power - low interest

Stakeholders within the high power - low interest quadrant have high power to create change, but a low stake in the system. Should they be willing to become more involved, they would have the authority to enact transformative change. These stakeholders include Policy Makers, the Media, Research Institutions, and Investors.

31

▼ *Figure 6. Stakeholder power dynamics - how the system is structured*

An influence map drawn from Mendelow's Power Interest Matrix (1991) is used to demonstrate how stakeholders of competing power and interest interact with each other. The text linking the stakeholder groups shows why they interact with each other. This influence map does not show every stakeholder interaction within the system. The focus is the relationships discovered from the available research.
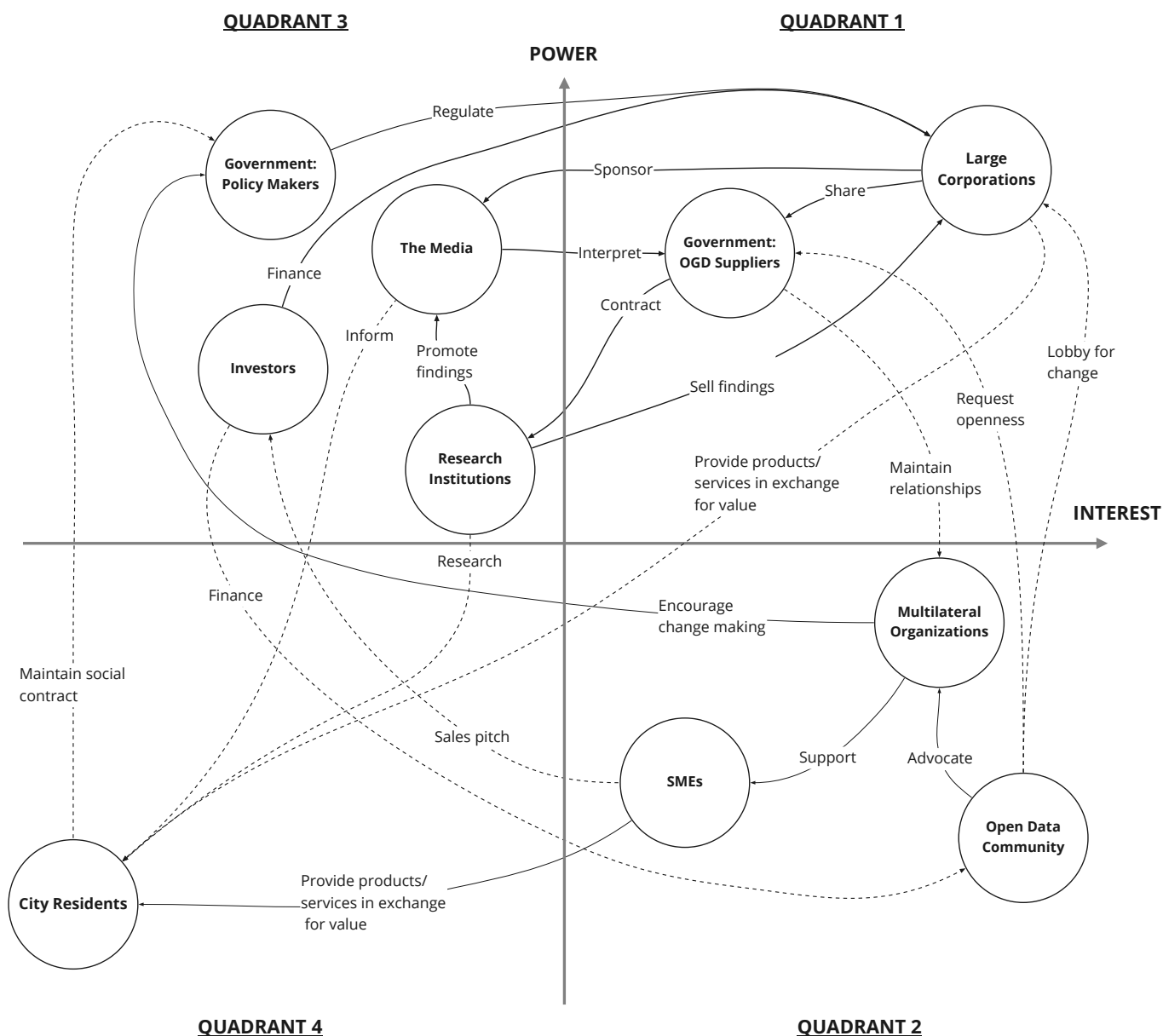
Policy Makers
Policy Makers include politicians and public servants who advance Open Government and data and information sharing policies. Interview participants noted that Policy Makers have the authority to advance open data in cities, but competing interests are often prioritized. Currently, Open Government policies are considered independently from other policy areas. Thus, Policy Makers focused on other subject areas continue to have low interest in the system.

The Media
The Media has a high influence on how open data is viewed by the public. Data journalism has become commonplace in media communications. News organizations and social media users share data driven insights to tell stories and persuade the audience (Bradshaw, 2019). Sub-sections of news organizations monetize the data by using it to tell stories of interest to the public (Darcy, 2020). Interview participants explained that when OGD Suppliers do not process data, media companies will do it themselves. Media companies' distillations of the data remain unregulated. Journalists may have the highest interest within media companies because the use of open data benefits their work (Yankova, 2016). For this reason, the media often wants more explicitly depicted content and visualizations that support their public communications narrative.

Research Institutions
Research Institutions (including universities and private companies) produce research studies as commitment to their mandate. Research Institutions are often contracted by Government departments and agencies for data collection and analysis (Government of Canada, 2021a). Research Institutions aim to secure ample funding to continue their own research. Several interview participants spoke to the trend of Research Institutions creating their own open research repositories. For example, open science networks were used to develop the Moderna COVID-19 vaccine (Gertner, 2020). Research Institutions

have the agency to fill data gaps and advance the open data system. However, their participation is limited by their funding directives and resources.

Investors
Investors are involved in this system in three ways. First, philanthropic Investors and financial institutions fund non-Government open data initiatives. Second, private Investors and financial institutions finance private sector corporations that collect and share data as a part of their business models. Third, private Investors and financial institutions may reference distillations of the data in deciding where to invest (Perini & Jarvis, 2019). Investors have the agency to invest in initiatives that could change the system, but may choose to pursue initiatives with a better financial return on investment. Open data initiatives are often considered a low growth investment because the majority of funding is allocated towards maintaining existing portals (Roberts & Barnes, 2020).

Quadrant 3: Low power - high interest
These are stakeholders who want to be more involved in the system, but do not have the power to create change. Stakeholders such as Multilateral Organizations, Small and Medium Enterprises (SMEs), and the Open Data Community are involved in the system through smaller activities and support larger efforts to advance the system.

Multilateral Organizations
Multilateral Organizations aim to promote sustainable development across countries by financing and connecting stakeholders from the public, private, and non-profit sectors. Multilateral Organizations include development banks and Open Government networks (e.g. the UN, World Bank, Open Government Partnership). Since 2010, several Multilateral Organizations have supported open data initiatives (Hammer, 2019). They develop their own open data portals and encourage multinational collaboration. They provide guidance to Canada's

Open Government decision makers, but the decision making power is held by Policy Makers.

Small and Medium Enterprises (SMEs)
SMEs rely on OGD to build products and services (Card, 2015). They want open data related to their domain and are limited by what is published. Interview participants explained that SMEs operating in smaller cities often have less access to data than larger cities. Even if the data exists, finding the data within portals can be challenging with limited interactivity. SMEs often request additional OGD related to their industry. SMEs benefit from the open data system and have been willing to support its growth as a part of larger efforts to grow the SME ecosystem.

Open Data Community
The Open Data Community are the primary supporters of open data initiatives, but do not have the agency to drive change on their own. The Open Data Community includes civic tech networks, activists, and developers who conduct their own analyses to solve civic problems (e.g. creating data driven Apps and user interfaces). Also, it includes Open Data Institutions that collect, process, and publish their own internet portals using heterogeneous data sources. The impact of the Open Data Community is contingent upon the state of the open data system.

Quadrant 4: Low power - low interest
The final quadrant includes stakeholders who have low interest in the system and do not have the authority to enact change. These stakeholders interact with the system indirectly and are informed of system activities through secondary information sources such as media communications. Low power - low interest stakeholders include City Residents.

City Residents
City Residents are indirect beneficiaries of the system. A trend from the interviews was that City Residents tend to reference open data through secondary

sources such as news articles, info-graphics, and user interfaces (e.g. COVID-19 case count dashboards). City residents supply their personal data to the public, private, and non-profit sectors in exchange for value. For example, they share their data as a part of their citizenship and for access to products and services (e.g. access to Google search functions). Interview participants explained that this system could not function without community participation.

The incentive for data sharing

The stakeholder dynamics demonstrate that data sharing is a central activity throughout the system. However, there are conflicting incentives for sharing data (see Figure 7). The majority of stakeholders share data for one of two reasons: to educate and generate knowledge or to maintain their business model. High interest stakeholders such as Multilateral Organizations, the Open Data Community, and OGD Suppliers share data to generate new knowledge about community issues and drive sustainable development. Low interest stakeholders such as Research Institutions and the Media share data to educate about domains of interest. In contrast, Large Corporations, who hold the highest interest, choose not to share the majority of their data because it is an asset to their business model. The data they do share is either legally mandated or a part of Corporate Social Responsibility (CSR) initiatives. Large Corporations gain more power in this system when they withhold their data and sell it in exchange for value. As a result, the stakeholders who have the most power to build the knowledge capacity are more inclined to withhold their data to maintain their business model.

▼ *Figure 7. Stakeholder power dynamics - the incentive for data sharing*
This influence map demonstrates the incentive for sharing data amongst system stakeholders. The influence map shows that stakeholders share data in support of their mandates and goals. OGD is deeply involved in these relationships and is required for the system to function.
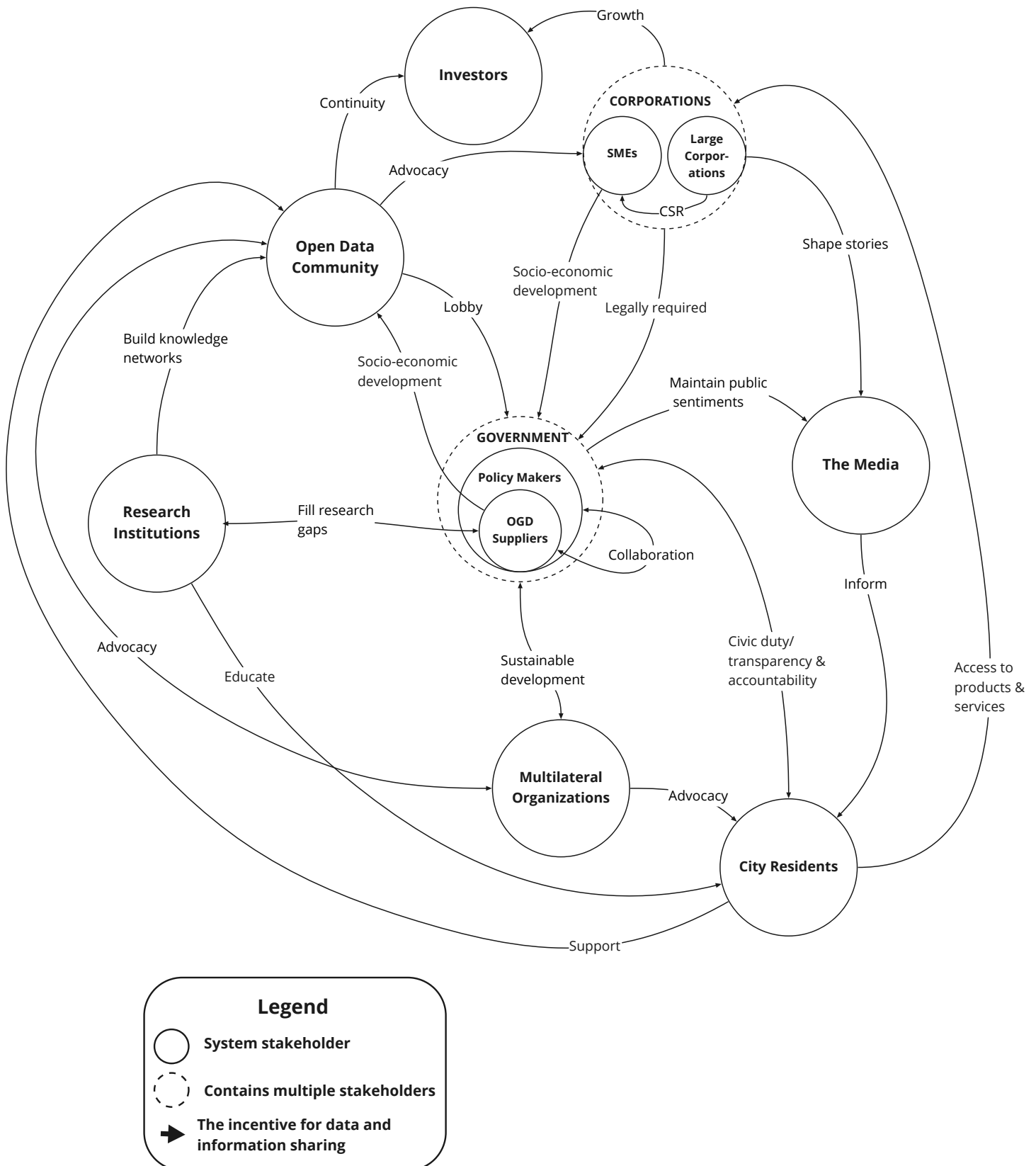
The big picture

Before we can assert the system's insufficiencies, we first must understand the deeper forces driving the system as a whole. The analysis of the 'big picture' of the system uncovers that the system metaphor, knowledge is power, is causing the current system conditions (see table 2). Data is considered both a source of knowledge and an asset in the system. Data is being used as an economic driver as well as a methodology for social innovation and advocacy. Stakeholders gain power when they apply the knowledge generated from their data in support of their mandates and objectives. Thus, data ownership is a source of power in the system. The big picture of the system and the notion of knowledge is power is analyzed in section 3.2 of this report.

Table 2. The current state CLA - ▶
knowledge is power

This figure demonstrates the deeper forces driving the system structure using Inayatullah's (2008) CLA as the guide. The current state CLA discovers that the notion of knowledge is power is driving the system's behaviour.

Legend:
- Litany (continuous): what is visible today within the system boundaries.
- Systemic manifestation (years): historical explanations for the visible activities.
- Worldview (decades): the underlying beliefs guiding the system.
- Metaphor/myth (societal/ civilizational): a headline describing system actors' perceptions of the three layers above.

(Inayatullah, 2008)

Litany (Continuous)	• Micro: The majority of Government data about cities is withheld from the public • Meso: Open data has the potential to support urban innovation • Exo: Data governance is important, but not a priority • Exo: Data monetization business model • Macro: An abundance of information available, the rise of mis-/dis-information
Systemic manifestation (Years)	• Data hoarding • Knowledge economy • Evolving digital human rights • Data education gap
Worldviews (Decades)	• Data can be refined and exchanged for value • Data driven knowledge helps make decisions
Metaphor/Myth (Societal/Civilizational)	• "Knowledge is power"

3.2 The current system's insufficiencies

The analysis of the current state of the system surfaced several insufficiencies requiring change. These insufficiencies exist within all levels of the system and are directly impacting the growth of OGD in cities. Recognizing how the rules at the operational level extend to larger patterns and paradigms is necessary to define an implementation plan to change OGD practice.

System rules

The system rules, otherwise known as orthodoxies, demonstrate that the operational problems influencing OGD extend beyond the OGD pipeline (micro system level). A trend from the interviews was that OGD is deeply rooted within all levels of the system and there are many interconnections between the system levels. Thus, rethinking OGD practice requires challenging the firmly held beliefs within all levels of the system. Each orthodoxy in this section has larger systemic impacts directly influencing OGD that could be challenged. The following section of this report describes the larger problems to which these orthodoxies are contributing.

Orthodoxies

The system orthodoxies included in this section are written from the perspective of the dominant data provider within each system level. Dominant data providers include: Micro - OGD Suppliers, Meso - Open Data Community, Exo - Policy Makers, Exo - Large Corporations, and Macro - City Residents.

Micro: OGD pipeline suppliers

- We set our own portal standards.
- We produce OGD to be transparent about decisions that have already been made.
- We publish what we can.
- Our growth is driven by internal Government data stewards advocating for openness.

- We process data for Government projects, then publish it for public use.
- We publish data in response to requests and public consultations.

Meso: Urban open data ecosystem

- We collect data to help minimize information asymmetries.
- Government privacy analyses are extensive and guarantee citizen privacy.
- OGD is an input for our products and services.
- We support data driven initiatives in our city.

Exo: Data policy and information governance

- We can only explore problems within our jurisdictional boundaries.
- Subnational OGD initiatives can be maintained by short-term portal solutions.
- We create Open Government policies in response to negative events.
- We govern data and information sharing, not land sharing.

Exo: Corporate digital economy

- The value of data is attained when it is withheld from others.
- Consumers provide their personal data in exchange for access to our products and services.
- The Government defines the rules and ethical parameters in which we can operate.

Macro: Lives of city residents

- We have the right to share our own data analyses without substantiation.
- We are responsible for our own digital safety.
- We supply our personal data to Governments for the Census.
- We rely on our own connectivity to access basic services.

System patterns

The analysis of the system orthodoxies uncovered five patterns that are causing human problems within the current state of the system. These patterns are large in scale and extend beyond individual stakeholder groups and levels of the system. Fixing these patterns cannot be done with a linear solution. These patterns are "wicked" in nature and as per Rittel & Webber (1973), addressing them requires multiple solutions targeting several stakeholders and system levels. The five system patterns causing the system to lose its fit for purpose are described in the following sections.

System pattern 1: The infodemic

An 'infodemic' describes when there is an abundance of information available about a subject making it difficult to find the truth amongst mis-/dis-information. Mis-information includes unintentional false information whereas dis-information is a form of mis-information that aims to spread falsehoods (Gebel, 2021, paras. 1-2). The term 'infodemic' became widely used in 2020 after it was used by the WHO and UN to describe the excessive volume of false COVID-19 related data and information (Department of Global Communications, 2020; World Health Organization, 2020). The public recognition of the infodemic exposed the influence of sense-making in analyzing data.

The sense-making process has a major impact on how we understand and utilize OGD. The lens that people use to process and comprehend data is shaped by the culmination of their life experiences (Kolko, 2010). Often people assume that data analysis and use involves data-based sense-making. However, people may turn to cultural, emotional, ecological, or political based reasoning to shape new perspectives and solve problems. The abundance of information available challenges conventional assumptions about the public's data comprehension methods.

The abundance of information available has also made it increasingly difficult to find the truth online. The public is spending more time on digital platforms and is turning to internet voices of authority for information (Disinformation Research Group, 2020). In many cases, online discussion spaces are not moderated and allow the spreading of mis-/dis-information (Townsend, 2021). People are not legally required to share the results of their analyses and have the right to withhold the discovery of problems of which a city may be unaware. The sense-making process is personal and therefore difficult to track. The challenge of understanding how people make sense of data will continue as more data becomes available to a wider audience.

Participants voiced that the rapid acceleration of online mis-/dis-information is diminishing trust in OGD. The rise of mis-/dis-information is a part of a larger trend of distrust of public institutions. The public often cannot differentiate between Government actions and politics. When the public is dissatisfied with Government policies, that distrust is aimed beyond the political leaders. The distrust of the system and lowered barriers to create and share data analyses has allowed mis-/dis-information to flourish, diminishing the purpose of the open data system.

Example: Data visualization

Data visualizations diversify the breadth of people who can engage with data by simplifying datasets to focus on specific subsections. For example, the COVID-19 pandemic has driven "dashboard thinking" (Schott, 2020) across sectors. These digital dashboards are online visual interfaces offering "immediacy, interactivity, flexibility and unified focus" (Schott, 2020). While the viewers may assume that the dashboard creator is a subject matter expert, these visualizations are often produced by data communications artists with limited knowledge of the subject matter. Edward R. Tufte (2001) explains that having data communications artists put together

visualizations is equivalent to having typographers edit copy (p. 87). More plainly, the dashboard represents the lens through which the data communications artist views the data (D'Ignazio & Klein, 2020). The widespread distribution of digital productivity tools has decreased the resources required to produce these visualizations. The lowered cost has allowed new internet voices of authority to spread their own visualizations that contain mis-/dis-information.

System pattern 2: The innovation myth

When open data was first launched, one of the primary benefits discussed was its potential to drive socio-economic innovation. Open data was often considered in terms of its potential impact for entrepreneurs looking to build new products and services (Gurin, 2014, p. 1). In 2012, Deloitte published a study outlining how open data can help design business models to address citizen needs. Since its launch, there have been many studies about the potential for open data to drive innovation across sectors. However, open data driven innovation has not yet met the expectations for value set out when it started (Eckartz, et al., 2016).

Publishing open data is only the starting point in harnessing the innovative capacity of data. There are several steps required after the data is published to support the development of innovation ecosystems (Gurin, 2014, p. 24). A trend from the interviews was the commonly held belief that data and creativity are countervailing forces. Urban stakeholders often consider creativity a process about understanding complexity and combining the unexpected. Data simplifies complexity and puts elements together in a methodical way limiting the potential for exploratory thinking. Participants expressed that they believe open data can lead to innovative business models. However, current data literacy problems limit the potential for data driven creativity. Governments first must build data literacy skills amongst urban stakeholders and provide guidance of how open data can fit within innovation processes.

System pattern 3: Citizen privacy

The OGD publishing process has several steps and requirements. Government data must be reviewed and meet internal standards as a precondition for publishing. If there are risks in publishing the data, it will not be published. For example, data about the private sector is often analyzed with respect to its impact on the economy and the possibility of crowding out existing markets. Governments have extensive processes to anonymize data before it is published. Participants explained that privacy processes are robust and it is rare for Governments to publish data hindering user privacy. Many OGD portals have become flooded with administrative data because it is considered a lower risk.

The focus on making Government data privacy compliant is one of many preconditions for citizen privacy. However, if someone wants de-anonymized personal data, they can simply purchase it from a data brokerage. Participants explained that it takes significantly less resources to purchase the data from a brokerage than combine Government datasets to identify citizens. Technology platforms are collecting a massive volume of personal data that continues to be unregulated. Even if Governments publish citizen data to be privacy compliant, citizen personal data privacy may still be jeopardized.

Advancements in robotics and AI have created new sources of data causing privacy challenges. The proliferation of the Internet of Things (IoT) has exponentially increased the volume of data collected and requires new measures to manage it that have not yet been determined. The recent surge of cyberthreats on physical infrastructure has demonstrated that Government privacy departments are not equipped to keep pace with the rising volume and ubiquity of data sources (The Canadian Press, 2021; Schlesinger, 2020).

Personal data privacy is a part of a larger digital human rights problem that has not yet been

addressed. Human rights are often not enforced online. The United Nations (2021) contends that "data protection and privacy issues, digital identity, the use of surveillance technologies, online violence and harassment" (para. 1) are all issues of concern. Personal data privacy problems at the local level will continue and grow until global digital human rights are defined and enforced.

Example: Sidewalk Labs - Toronto Quayside Project

In 2017 Sidewalk Labs, Alphabet Inc.'s urban innovation firm, released a plan to develop smart city infrastructure along Toronto's harbourfront. The plan included using sensors to provide customized citizen experiences in the area (Hawkins, 2019). It involved collecting a massive amount of personal data and was met with criticism by local residents. The plan was cancelled in 2019 as a result (Wakefield, 2019). Although the Sidewalk Labs Toronto project was cancelled, big tech companies' investment in data driven smart cities has persisted (Scammell, 2021). Cities have implemented smart city infrastructure such as sensors and 5G networks that are collecting personal data. Policies are now being developed to regulate the use of AI and surveillance technologies. Until there are clear regulations, privacy issues will persist.

System pattern 4: Data gaps

Bounded rationality describes the condition in which people make their best possible decision from their information, but do not have all of the relevant information related to the larger system (Meadows, 2008, p. 106). Data providers are bounded by their own rationality and may not realize there are gaps in the systems collecting and processing data. This design flaw is often unintentional, but can have a detrimental impact on a population's health, safety, and wellbeing. For example, the COVID-19 pandemic revealed several gaps in Canada's health surveillance system disproportionately impacting vulnerable

populations (Robertson, 2021). Due to the tendency for data gaps to be magnified following a crisis (Criado-Perez, 2019), it is imperative that a strategy is designed to deal with data gaps post-COVID 19.

Participants spoke to the growing awareness of the correlation between data inequality and social justice. Initiatives to close data gaps are integrated in efforts to combat systemic inequalities. Governments and the open data community have started several initiatives focused on collecting data about vulnerable populations. Collecting data to fill gaps can lead to more diversity in decision making (MacArthur, 2020). However, research to close data gaps is primarily quantitative and often disregards what happens after the data is collected.

Participants explained that efforts to close data gaps often reinforce existing power asymmetries. In many cases, closing data gaps means collecting more data about vulnerable populations and giving the same actors more influence over the populations' rights (Eubanks, 2018). This means that the affected population has no control over how the data is used. In turn, the decision makers have more power. Governments have pursued several initiatives to collect gender and race disaggregated data to close data gaps. But, generally, by the time the public sees the data, all decisions have already been made.

Example: The gender data gap in city planning

Datasets used to design gender-neutral products and services are often not gender balanced. These datasets prioritize male needs. This gender-based discrepancy is known as the gender data gap. There is a prevalent gender data gap in Canada's city planning system. From public transportation to urban development, city planning is predominantly androcentric – designed for men. The majority of cities built after WWII were constructed for the average white male worker and ignore all other gender identities (Criado-Perez, 2019). Some cities have pursued efforts to minimize the gender data

gap. For example, Vienna distributed mass surveys to understand which areas cause anxiety for women and collected data about female participation in sports to redesign city parks (Hunt, 2019). However, most cities deprioritize gender based design because it is competing against conflicting concerns with limited resources. In Canada, more robust change is required to achieve a gender inclusive urban planning system.

System pattern 5: The value of data

OGD was developed to challenge traditional data ownership. It aimed to change traditional Crown Copyright by acknowledging that Government data belongs to all citizens and distributing the power that data owners retain. It was designed based on the three principles of the open source software movement: "openness, participation and collaboration" (Chignard, 2013, para. 13). The intention was to create a collaborative ecosystem where everyone has access to data. However, conflicting perspectives of the value of data has hindered the growth of the open data movement.

The rise of the digital economy has demonstrated the economic potential of data. Historically, companies have managed land, equipment, and other fixed assets (Opher, et al., 2016). Today, data has become a fourth asset category. But, the economic value of data remains unclear. Participants explained that there have been attempts to quantify the economic value of data but these attempts have not settled the value because much depends upon its usage. Setting the price of data depends upon understanding its applications and the usage is not fully recognized until the data is understood (Deloitte, 2020). As such, companies set the price of their data in an unregulated market (European Parliament, 2020). People treat data as a tangible asset and when the value is unclear their instinct is to keep it to retain its value. In order to transform to a shared ownership model, we need to be clear of the value we are sharing.

System metaphor

The current state system metaphor, knowledge is power (see section 3.1), has a profound impact on the ability to achieve the objectives of OGD practice. The objectives of OGD are to distribute the value of data and minimize data hoarding. Internal Government objectives include providing access to information across Government departments, minimizing silos, increasing collaboration, and streamlining operations. External objectives focus on enabling the public to make data informed decisions. Instead of distributing value and minimizing hoarding, current OGD initiatives reinforce existing power dynamics. Current data governance strategies allow data owners to decide what data is collected, sold, and published. Thus, the data sharing system provides data owners and producers more power.

What if knowledge is power no longer guides this system in the future? Chapter 4, the future, proposes alternative system metaphors that challenge the notion of knowledge is power and demonstrates how shifts in human values could change the problems we are looking to solve. But, before we can frame possible future problems, we first must understand what prevents the current system from changing. The barriers to change are explained in the following section of this report.

▼ Figure 8. Connecting system patterns and rules

This figure demonstrates the possible connections between the system rules and patterns. The intention of this figure is to show how problems at the operational level could be contributing to larger scale system patterns.

System patterns

We publish what we can.

1. The infodemic

We have the right to share our own data analyses without substantiation.

We are responsible for our own digital safety.

We publish data in response to requests and public consultations.

We support data driven initiatives in our city.

2. The innovation myth

We supply our personal data to Governments in the Census.

Sub-National OGD initiatives can be maintained by short-term portal solutions.

OGD is an input for our products and services.

Government privacy analyses are extensive and guarantee citizen privacy.

3. Citizen privacy

We rely on connectivity to access basic services.

We create Open Government policies in response to negative events.

We collect data to help minimize information asymmetries.

Consumers provide their personal data in exchange for access to products and services.

We set our own portal standards.

4. Data gaps

The government defines the rules and ethical parameters in which we can operate.

We produce OGD to be transparent about decisions that have already been made.

We govern data and information sharing, not land sharing.

We process data for government projects, then publish it for public use.

We can only explore problems within our jurisdictional boundaries.

5. The value of data

Our growth is driven by internal Government data stewards advocating for openness.

The value of data is attained when it is withheld from others.

Legend

OGD pipeline suppliers	Urban open data ecosystem	Corporate digital economy	Data policy & information governance	Lives of city residents

Barriers to change

As demonstrated by the previous sections, there are several problems within the system requiring change. However, efforts to change the system have been undermined by stakeholders who benefit the most from the status quo. Identifying the factors stifling change allows us to assess the feasibility of possible future system changes. Six technical, institutional, and human barriers we must overcome to address the system's problems are explained in the following sections. These barriers are used to assess the decision making principles proposed in Chapter 5, recommendations.

Barrier 1: Governance structure

The current governance structure limits the growth of the data sharing system. There are many steps and rules in publishing OGD. The process impedes sharing data beyond jurisdictional boundaries. Canada's OGD system is decentralized where each jurisdiction creates its own portal and sets its own standards. This results in conflicting local regulations and licensing agreements (Attard, et al., 2015). The lack of interoperability amongst OGD portals has caused delays from the process of collection to publishing. It is common that by the time OGD is published the results are dated. Participants highlighted that the bureaucracy is a primary reason OGD has not yet met the objectives when the process started.

The governance framework encourages short-term thinking that discourages long-term system wide changes. The focus is improving the data itself rather than improving the systems governing it. The improvements to the data are mostly short-term solutions. For example, OGD does not have a formal archival system so it can track learnings longitudinally. Large scale data governance efforts are rare. Access to Information laws were established in the 1970s

and 1980s (Government of Canada, 2020b) and those laws did not account for digital technologies. Also, our systems of governance were designed before the majority of the population were urban dwellers. Without contemporary system-wide data governance efforts, today's system wide inadequacies will persist.

Barrier 2: Municipal resources

Municipalities have the lowest funding pool amongst all levels of Government. The data Municipalities collect is typically more targeted to local needs than the other levels of Government (Verhulst, et al., 2020). Often, there is only one data governance professional within a Municipality. Only the largest Municipalities have data governance offices that we can turn to for advice. Municipalities decide where the OGD team is placed within the organization and how much they use it in their decision making processes. However, new technologies and growing populations have expanded the range of their responsibilities. Municipalities are at the forefront of smart city technology integration but with limited financial resources. Municipalities do not have the funds to analyze the system conceptually.

Barrier 3: Measuring success

Tracking the open data system over time allows us to evaluate its impact and identify leverage points for future changes. The open data system does not have a uniform measure for success and failure. Measurement tools are numeric indicators that track elements of the system over time (Lämmerhirt, et al., 2019). Individual organizations have designed their own measurement tools, but these designs are often proprietary. In response, we have observed the development of several open data measurement initiatives such as the Open Data Institute and World Wide Web Foundation's Open Data Barometer (Lämmerhirt, et al., 2019; Davies,

2013). However, these techniques tend to focus on the volume and 'openness' of the datasets rather than the use and outcomes. As a result, it remains unclear which open data initiatives are the most impactful. Until we have consistent ways of measuring success, we cannot commonly assess the system's value and progression.

Barrier 4: Proprietary data systems

Hoarding data by the private sector has accelerated information asymmetries. The majority of data is held by the private sector and is not accessible by the public (Verhulst, et al., 2020). We know of stories about the misappropriation of personal data by big tech companies. Our ability to regulate the monetization of personal data is limited because we do not fully know how big tech companies are using the data they collect (Tisne, 2021). Governments need access to proprietary data systems to identify what are the issues (Engler, 2020). Currently, Governments do not have the knowledge base or capacity to evaluate data systems. The information asymmetries will persist until regulators have access to proprietary data systems.

Barrier 5: Skill development

Skill development is required to maintain this system. However, Canada has an in-country data literacy divide. Participants explained that understanding data is not just numeric literacy. It requires an understanding of all of the systems where the dataset originated. For example, understanding a dataset about incarcerations could require understanding the OGD portal language, the governance system, mathematics, the history of systemic racism, and the judicial system. Only subsets of the population have such skills. Participants indicated that few public servants outside of the data teams are data literate. As a result, the majority of decisions are data

expert driven rather than subject expert driven. Skill development is not accomplished only by educational training. Our ability to create new knowledge from data is heavily influenced by our previous knowledge (Kolko, 2010). More people are aware of the mis-use of data and reluctant to engage with it. Data-phobia, the fear of data, is a substantial barrier to skill development (Redman, 2015). Also, data literacy requires digital literacy. A Brookfield Institute study points out that digital literacy is dependent upon infrastructure and internet access, literacy and mathematical skills, economic status, location, educational programs, and a sense of belonging within digital offerings (Huynh & Malli, 2018).

Skill development relies on system boundary judgments. In Werner Ulrich's (2000) *Reflective Practice in the Civil Society: The Contribution of Critically Systemic Thinking*, Ulrich discusses the importance of civic competence in industry growth. In order to build civic competence, we must critique and expand our individual system boundary judgments. This includes evaluating our sources of "motivation, power, knowledge and legitimization" (p. 10). This is achieved by asking questions that challenge our existing mental models (p. 9). Expanding our system boundaries will allow us to analyze data and the systems involved in the process.

Barrier 6: Absorptive capacity

Wesley M. Cohen and Daniel A. Levinthal (1990) define absorptive capacity as "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends" (para. 1). The ability to leverage external information impacts organizations' innovative capacity. There is a prevalent absorptive capacity gap between the private and public sector. Large corporations have a high absorptive capacity because they often have R&D departments equipped to use external

information. In contrast, SMEs are often unable to leverage information outside of their core mandate because of financial constraints and insufficient digital competency. Government leadership must justify their funding allocation and other functions may be assigned greater priority. Publishing data is the first of many steps in developing data driven innovations. In order to develop an integrated open data system, the absorptive capacity must increase amongst the stakeholder groups.

3.3 Considerations for moving towards change

Chapter 3 provides a summary of today's data sharing system. It explains why the system works, the problems within the system, and the challenges we must overcome to change the system. The key takeaways from this chapter are summarized below:

- The underlying incentive for data sharing is generating new knowledge.
- Data is a source of power in the system.
- OGD practice is reinforcing existing power asymmetries and decision making structures.
- OGD practice aims to publish data, rather than support innovation systems.
- The value of open data is unclear. OGD is a 'nice to have' but not a priority.
- Data represents the systems it originated from and these systems have their own gaps.
- Canada has a prevalent data education gap.
- The speed in which the system operates encourages short-term thinking deterring from long-term data governance efforts.
- OGD privacy concerns are a part of a larger digital human rights problem.

From problem finding to framing

The systems analysis demonstrated that OGD practice is situated within the larger data sharing system impacting several stakeholders and industries. The OGD pipeline system level currently has a decentralized structure. OGD portals are managed by individual departments and agencies and there is limited interoperability amongst OGD portals. As a result, OGD published within jurisdictional portals often does not take into account data from other levels of Government or the system as a whole. The fragmented system has led to problems such as data gaps and the spreading of mis-/dis-information. There is an opportunity to explore how the complexity within the system can be represented within OGD portals.

This chapter points to a disconnect between the objectives of OGD and the data sharing system. Section 3.2 discusses the institutional barriers to publishing OGD at the Subnational levels of Government. The analysis demonstrated that the barriers to publishing data within the Government have changed the objective of OGD practice. The objective of OGD has become publishing data rather than building Canada's capacity for data driven knowledge. The speed in which the data sharing system operates is leading to short-term OGD objectives. More effort is required to understand the larger purpose of OGD practice and the value it brings to the data sharing system. This includes how OGD privacy concerns are a part of larger digital human rights problems. Rethinking the objective of OGD practice as a component of a larger system is an area of opportunity.

A trend from the interviews was how OGD language is causing confusion within the system. The term 'open' often has binary connotations where data is either fully open or withheld from the public. Data users do not consider the nuances of the term 'open'. In OGD practice, openness refers to publishing decisions that have already been made. Canada's OGD practice does not include open decision making processes that encourage stakeholder collaboration. Instead, the implementation of openness is further dividing the Government and its citizens. Rethinking how openness can improve collaboration amongst system stakeholders is an opportunity for further exploration.

What if problems resulting from the stakeholder power dynamics continue and grow in the future? The problems demonstrated by this chapter are expanded upon in the context of future scenarios. Chapter 4 moves beyond the current ways of working and explores possible future perturbations to the system that might impact the way we live in cities. The analysis of possible future system states is the guide to design a new decision making framework for OGD related problems.
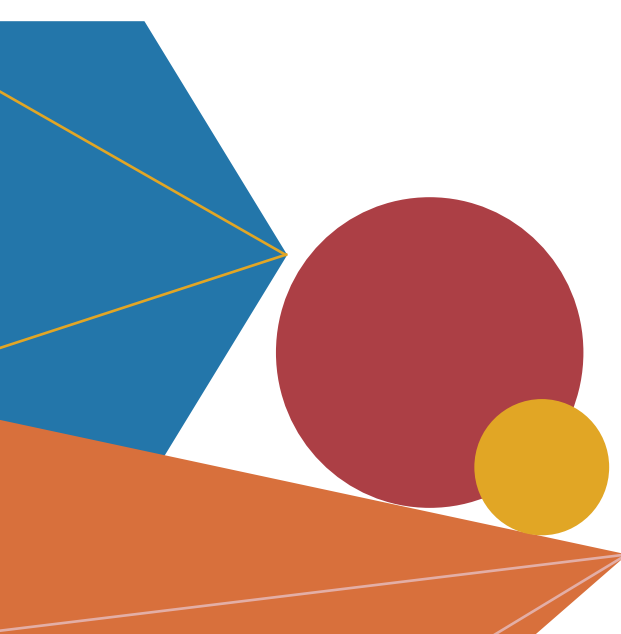
Chapter 4:
The future

Strategic foresight methodology opens a window to think beyond the current ways of working and imagine how the system's insufficiencies might expand in the future. Using strategic foresight for problem framing, the objective is to identify high impact areas of critical uncertainty to be considered for moving towards change. This chapter aims to achieve this provocation by challenging the current state system metaphor, knowledge is power, and proposing alternative metaphors that might guide the system in 2036 using future scenarios.

The scenarios do not aim to predict the future. They aim to expand the breadth of this research and provoke new thinking about possible future data paradigms. The scenarios are drawn from the emerging potentialities and supported by interview trends. The analysis of the scenario commonalities frames areas of critical uncertainty used in problem solving.

4.1 Changes on the horizon

Thinking about the future first requires understanding how events from the present might expand in different directions. Through the horizon scan and interviews, five emerging potentialities surfaced that might change the way we think about data in 2036 (see Table 3). The emerging potentialities were evaluated independently and provide alternative future directions. The breadth of emerging potentialities demonstrates the importance of exploring how the external systems that guide and govern data could drive future change. Possible outcomes of the emerging potentialities are shown in section 4.2 of this report.

▼ **Table 3. Emerging potentialities - summary**
The following table provides a summary of the emerging potentialities included in this section.

Title	Summary
1. The democratization of the internet	Growing public awareness of big tech companies' control of the internet have led citizens and Governments to pursue efforts to reform the internet as a force for good.
2. Questioning the data life cycle	A looming climate crisis and growing public recognition of systemic inequalities is leading the public to rethink how urban systems causing harm are reflected in the way we manage data.
3. Real-time data collection technologies	Advancements in AI and robotics are creating new technologies that continuously capture data in cities.
4. Centralizing data governance	Prevalent gaps within the Government's data sharing systems are leading to more interest in centralizing data governance.
5. Cohabitating virtual environments	The public is transitioning more aspects of their lives to the virtual world creating new public commons and challenging existing notions of reality.

Emerging potentiality 1: The democratization of the internet

Growing public awareness of big tech companies' control of the internet have led citizens and Governments to pursue efforts to reform the internet as a force for good.

The COVID-19 pandemic has rapidly accelerated the spreading of online mis-/dis-information. The pandemic cast a spotlight on the many different realities people experience online and the impact on public health and democracy. Big tech companies' influence on politics has led the public to realize that the internet has shifted from the democratic values set out when it started. Centralized private sector control of the internet is now considered a threat to democracy. Governments and citizens are taking action to reclaim the internet. Tech workers are organizing against the practices of their employers. Citizens are boycotting big tech companies and advocating for personal data autonomy. Governments are exploring new models to curb big tech companies' influence on politics. However, it is unclear whether these efforts will make an impact or if they have come too late.

Possible outcomes

- A new internet structure could form centered around enforcing digital human rights.
- Big tech companies may be required to disclose their business practices to the public.

Implications

- Community services currently managed by the private sector could shift to public sector control. This could provide Municipalities more autonomy over urban economic activity.
- National Governments could set policies allowing the surveillance of citizen internet activity. A fragmented internet structure, or 'Splinternet', could emerge. This could result in data and information sharing challenges across borders. In the long-term, citizens may have less exposure to foreign information. Online information bubbles or 'echo-chambers' could intensify contributing to growing political polarization and distrust of other countries.
- Internet consortiums that distribute data for the value of society could dominate. Data collaboratives, a model that combines open data from multiple sources could replace the open data system.
- Governments could create new taxation models treating the harvesting of personal data by the private sector as labour. This new model would likely be unsustainable for big tech companies leading them to stop selling user data or declare bankruptcy.
- New encryption methods such as homomorphic encryption could change how data is processed, analyzed, and used. This may increase the reliance on synthetic datasets.
- The Government of Canada could declare internet access a social determinant of health. This declaration could lead to widespread free internet and subsidized internet infrastructure. It is unclear how this might impact urban versus rural connectivity disparities.

Counter trends

- Big tech companies are taking initiative to control the spreading of online mis-/dis-information. Increased content validation and verification is becoming a part of existing business models as well as user settings controlling how personal data is shared.

Weak signals

Anderson, J., & Rainie, L. (2020, February 21). Concerns about democracy in the digital age. Pew Research Center: Internet, Science & Tech. https://www.pewresearch.org/internet/2020/02/21/concerns-about-democracy-in-the-digital-age/

Benda, N. C., Veinot, T. C., Sieck, C. J., & Ancker, J. S. (2020). Broadband Internet Access Is a Social Determinant of Health! American Journal of Public Health, 110(8), 1123–1125. https://doi.org/10.2105/AJPH.2020.305784

Germain, T. (2021, April 26). What The New iPhone Tracking Setting Means, and What to Do When You See It. Consumer Reports. https://www.consumerreports.org/privacy/what-the-new-iphone-tracking-setting-means-and-what-to-do-when-you-see-it/

How the internet turned from a tool for democracy to a threat against it. (2019, July 19). CBC Radio. https://www.cbc.ca/radio/sunday/the-sunday-edition-for-july-21-2019-1.5214940/how-the-internet-turned-from-a-tool-for-democracy-to-a-threat-against-it-1.5214959

Kall, J. (2020). The Materiality of Data as Property. Harvard International Law Journal, 61. https://harvardilj.org/2020/04/the-materiality-of-data-as-property/

Kishimoto, S. (2018, April 23). The unstoppable rise of remunicipalisation. Transnational Institute. https://www.tni.org/en/article/the-unstoppable-rise-of-remunicipalisation

Labratory for Information and Decision Systems. (2020, October 16). The real promise of synthetic data. MIT News. https://news.mit.edu/2020/real-promise-synthetic-data-1016

Leskin, P. (2020, June 8). "We would walk out with you—If Facebook would allow it": Content moderators join Facebook employees in revolt over how the company handles Trump posts. Business Insider. https://www.businessinsider.com/facebook-content-moderators-protest-virtual-walkout-donald-trump-posts-2020-6

Lohr, S. (2021, January 10). He Created the Web. Now He's Out to Remake the Digital World. The New York Times. https://www.nytimes.com/2021/01/10/technology/tim-berners-lee-privacy-internet.html

Marr, B. (2019, November 15). What Is Homomorphic Encryption? And Why Is It So Transformative? Forbes. https://www.forbes.com/sites/bernardmarr/2019/11/15/what-is-homomorphic-encryption-and-why-is-it-so-transformative/

Nguyen, C. T. (2019, September 11). The problem of living inside echo chambers. The Conversation. http://theconversation.com/the-problem-of-living-inside-echo-chambers-110486

Wright, K. (2019, March 13). The 'splinternet' is already here. TechCrunch. https://social.techcrunch.com/2019/03/13/the-splinternet-is-already-here/

Emerging potentiality 2: Questioning the data life cycle

A looming climate crisis and growing public recognition of systemic inequalities is leading the public to rethink how urban systems are reflected in the way we manage data.

The public is coming to terms with the meaning behind their city's street names, statues, public spaces, and buildings. The sharing of violent acts of systemic racism online has increased public recognition that our built environments represent deeply rooted inequality. The COVID-19 pandemic cast a spotlight on the connection between our social constructs and the patriarchal systems they originated from. Publicized incidents of failing to collect race disaggregated COVID-19 data and algorithms of oppression have led to questions about our social systems' influence on the data value chain. The public is rethinking the effectiveness of our social, economic, and environmental systems and how we can build an equitable and sustainable data life cycle. Intersectional feminist epistemology is increasingly integrated in data science, Indigenous Data Sovereignty is becoming more widely appreciated as a method for data governance, and new policies are being implemented to regulate ethical AI use. Can the data life cycle incorporate evolving social systems or will the next crisis divert from meaningful change?

Possible outcomes

- More marginalized voices could be included in urban decision making processes.
- Alternative forms of knowledge could become commonplace within the data life cycle.
- The data life cycle could become fully autonomous.

Implications

- There could be increased emphasis on data not involving people such as environmental and

ground truth data that is directly measured from a location. Geospatial data could become more widely integrated in combating the climate crisis. Delays in Government data processing could result in more private sector involvement in collecting geospatial data. New consortiums combining geospatial data and climate change strategies could emerge.

- There could be increased appreciation of Indigenous forms of knowledge. Progress could be made towards Truth and Reconciliation and the United Nations Declaration of the Rights of Indigenous Peoples (UNDRIP). Indigenous Data Sovereignty could become commonplace within Canada's data sharing system. Also, 'low-tech' urban interventions based on Indigenous knowledge could be used to solve environmental problems.

- There could be new efforts to quantify information not previously counted. There could be increased emphasis on collecting data disaggregated by race, gender and economic status. Progress could be made towards equity and transparency of AI algorithms. This new data may lead Government decision makers to rethink how we measure and assign value to unpaid care work. New decision making models could form assigning value to what is currently invisible.

- Ecological economic models could become a measurement tool for the data sharing system. This could include Kate Raworth's "doughnut economics", an economic theory that describes economic success when all of society can meet their needs within the capacity of the planet. Data providers may adopt new data storage mechanisms to minimize the environmental impact of data centers. Data processing centers could be built in space. Cybersecurity threats might emerge due to the possibility of hacking space infrastructure.

- The education system could mandate teaching digital and data literacy. Public recognition of data ethics could increase leading to less mis-/dis-information.

- The data life cycle and Government decision making could become fully integrated. Open source and direct democracy could become a part of urban decision making processes. The use of participatory democracy platforms could raise questions about white labelling private sector technology in the Government.

Counter trends

- The technology industry could alter the purpose of bias, equity, diversity, and inclusion problems in their own interest.
- Efforts towards redesigning the data life cycle could be deprioritized due to lack of resources.

Weak signals

Boyle, A. (2021, May 1). How commercial space stations could become the final frontier for data and cybersecurity. GeekWire. https://www. geekwire.com/2021/commercial-space-stations-become-final-frontier-data-cybersecurity/

Data2X I Partnering for Better Gender Data. (2021). Data2X. https://data2x.org/

D'Ignazio, C., & Klein, L. F. (2020). Data feminism. The MIT Press.

Fleming, A. (2020, January 15). The case for ... Making low-tech "dumb" cities instead of "smart" ones. The Guardian. http://www.theguardian.com/ cities/2020/jan/15/the-case-for-making-low-tech-dumb-cities-instead-of-smart-ones

Fry, H. (2019). Hello world: Being human in the age of algorithms.

Hawai'i State Commission on the Status of Women. (2020). Building Bridges, Not Walking on Backs: A Feminist Economic Recovery Plan for COVID-19.

How Statues Are Falling Around the World. (2020, June 24). The New York Times. https://www.nytimes. com/2020/06/24/us/confederate-statues-photos.html

Kern, L. (2020, July 6). "Upward-thrusting buildings ejaculating into the sky" – do cities have to be so sexist? The Guardian. http://www.theguardian. com/artanddesign/2020/jul/06/upward-thrusting-buildings-ejaculating-cities-sexist-leslie-kern-phallic-feminist-city-toxic-masculinity

Kilawna, K. (2020, May 13). First Nations seek data sovereignty amid COVID-19. The Discourse. https://thediscourse.ca/okanagan/first-nations-seek-data-sovereignty-amid-covid-19

Noble, S. U. (2018). Algorithms of Oppression. http://www.vlebooks.com/vleweb/product/openreader?id=none&isbn=9781479866762

Nugent, C. (2021, January 22). Amsterdam Is Embracing a New Economic Theory to Help Save the Environment. Could It Replace Capitalism? Time. https://time.com/5930093/amsterdam-doughnut-economics/

O'Brien, C. (2020, February 17). EU's new AI rules will focus on ethics and transparency. VentureBeat. https://venturebeat.com/2020/02/17/eus-new-ai-rules-will-focus-on-ethics-and-transparency/

Uanikhehi, I. (2018, March 26). How ancient knowledge inspires African tech to flourish. CNN. https://www.cnn.com/2018/03/26/africa/ubuntu---the-african-concept-of-community-/index.html

Emerging potentiality 3: Real-time data collection technologies

Advancements in AI and robotics are creating new technologies that continuously capture data in cities.

The COVID-19 pandemic rapidly accelerated the adoption of surveillance technologies such as the COVID alert app for contact tracing and controlling the spread of the virus. We are beginning to experience a fluid relationship between urban environments and data collection. We are surrounded by a growing number of cameras, sensors, smartphones, wearable devices, speakers, and various other technologies in cities. These devices are continuously capturing data about us that can be used in real-time and autonomously. Even if you turn off your phone's data sharing settings, another device nearby may be able to capture data about you. New scoring systems to manage the volume of data are making urban environments increasingly quantifiable. The use of these technologies with patchwork regulations raises questions about the boundaries of data collection and surveillance capitalism.

Possible outcomes

- There could be increased societal acceptance of intrusive technologies as a mechanism for social control during crises.
- Data collection technologies could be used to monitor societal lawfulness.
- 'Smart city' technologies could become universally adopted across Canada's cities if there is an economic incentive for its implementation. Data could be governed using a data trusts model where an independent third party governs the collection, analysis and use of the data collected by smart city technology.

Implications

- Data black markets could emerge consisting of personal data attained in unlawful ways. These databases could diminish trust in OGD practice and the Government's ability to control the data sharing system.
- Smart city infrastructure could lead to increased private sector control of public spaces. The public's willingness to provide their data could become an entrance requirement for urban environments.
- Biometric screening technologies that collect data about the human body could become commonplace. New open databases with aggregated heart rates, breathing patterns, body temperatures and even DNA could emerge.
- The frequency and intensity of cyber threats is rapidly accelerating. Cyberattacks disrupting infrastructure and critical assets in cities could increase diminishing trust in data systems.
- Counter-surveillance technologies, devices that allow you to be undetected, could become commonplace. A counter culture might emerge of urban residents moving to remote self-sustaining communities without technology. This could create new complications for the Census in tracking population movements.
- Real-time data collection technologies might be able to track societal lawfulness in real time. This could reduce criminal activity within urbanized areas. However, it could reinforce biased algorithms negatively impacting marginalized populations.

Counter trends

- Governments are starting to regulate the technology sector. We are seeing new regulations for ethical AI and the banning of facial recognition technology.
- New technologies may not be able to collect data representative of all instances. We may still need to generate simulated datasets to maintain services diminishing the need for real-time data capture.

Weak signals

Bogel-Burroughs, N., & Fazio, M. (2021, April 20). Darnella Frazier captured George Floyd's death on her cellphone. The teenager's video shaped the Chauvin trial. The New York Times. https://www.nytimes.com/2021/04/20/us/darnella-frazier-video.html

Carver, L. F. (2020, March 19). Robopets: Using technology to monitor older adults raises privacy concerns. The Conversation. http://theconversation.com/robopets-using-technology-to-monitor-older-adults-raises-privacy-concerns-132326

Fowler, G. A. (2021, June 8). Amazon may be sharing your Internet connection with neighbors. Here's how to turn it off. Washington Post. https://www.washingtonpost.com/technology/2021/06/07/amazon-sidewalk-network/

Halliday, M. (2020, July 28). What exactly is a data trust? MaRS Discovery District. https://marsdd.com/news/what-exactly-is-a-data-trust/

Martin, A. (2021, March 19). Sci-Hub: Police warn students and universities against using "the Pirate Bay of science." Sky News. https://news.sky.com/story/police-warn-students-and-universities-against-using-the-pirate-bay-of-science-12250407

Microsoft halts listening in to Xbox gamers. (2019, August 22). BBC News. https://www.bbc.com/news/technology-49435837

The Canadian Press. (2021, May 12). Cyberattacks on Canadian businesses up since remote work increased: Report. Global News. https://globalnews.ca/news/7854432/cyberattacks-canada-business-remote-work/

Thomas, E. (2019, September 16). New surveillance tech means you'll never be anonymous again. Wired UK. https://www.wired.co.uk/article/surveillance-technology-biometrics

Turnbull, S. (2021, May 27). Was Canada's COVID Alert app a hit or a miss? CTV News. https://www.ctvnews.ca/health/coronavirus/was-canada-s-covid-alert-app-a-hit-or-a-miss-1.5445730

Wilks, J., & Davies, P. (2021, March 30). How a smart thermometer saw COVID-19 coming before the experts. Euronews. https://www.euronews.com/next/2021/03/30/how-a-smart-thermometer-saw-covid-19-coming-before-the-experts

Wilson, M. (2021, February 19). This privacy ring is like an Incognito Mode for real life. Fast Company. https://www.fastcompany.com/90606006/this-privacy-ring-is-like-an-incognito-mode-for-real-life

Emerging potentiality 4: Centralizing data governance

Prevalent gaps within Government data sharing systems and increased societal willingness to relinquish control during crises are leading to more interest in centralizing data governance.

The COVID-19 pandemic exposed the gaps within the Government's data sharing systems. One such example is how the fragmented healthcare system lowered our ability to track the spread of the virus and distribution of vaccines. These incidents demonstrated the importance of data sharing during a crisis. It is raising questions from within and outside of the Government about enabling seamless data sharing across jurisdictions. Gaps within the Government's data sharing ecosystem and openness to relinquishing control for a unified crisis response has led to efforts to centralize data governance and create interoperable data sharing. This includes having preset keywords, metadata, language, and file formats that would apply across all Government databases. The private sector, multilateral organizations, and nonprofits are also working towards making data sharing standardized and interoperable. However, interoperability requires significant investment. It is unclear if these efforts will persist or if other Government functions will be prioritized.

Possible outcomes

- All OGD could be held within a singular portal diminishing regional licensing and copyright agreements.
- Fragmented Government systems could be consolidated providing increased control to the Federal Government.
- All OGD portals within each province could be consolidated.

Implications

- Centralizing data governance could be an opportunity for international collaboration. Canada could consult with Open Government multilateral organizations to align strategies with other countries and facilitate data sharing beyond national borders.
- There could be increased investment in digital Government services. This could include AI assistants to guide user experiences through OGD portals.
- There may be increased collaboration amongst cities to solve problems beyond jurisdictional boundaries.
- The expansion of OGD initiatives at the local levels is currently driven by Government data stewards advocating for openness. The Government does not offer incentives to grow OGD programs and data stewards may intrinsically be motivated by the value they bring to the system. If OGD becomes standardized, it may limit the value they can bring to the system and in turn decrease growth.
- New initiatives could emerge for the interoperability of private and public sector databases. The connections between databases could become integrated in efforts to govern the technology sector.
- More regimented OGD standards may result in increased incidents of public servants sharing Government data that otherwise would have been withheld from the public.

Counter trends

- A centralized system has previously been avoided due to security concerns and maintenance costs. Policy makers may not consider it worth the investment.

Weak signals

Chappell, B., & Treisman, R. (2021, January 18). Data Scientist Rebekah Jones, Facing Arrest, Turns Herself In To Florida Authorities. NPR. https://www.npr.org/sections/coronavirus-live-updates/2021/01/18/957914495/data-scientist-rebekah-jones-facing-arrest-turns-herself-in-to-florida-authoriti

Doctorow, C. (2021, June 15). Inside the Clock Tower: An Interoperability Story. Digital Lab at Consumer Reports. https://digital-lab.consumerreports.org/2021/06/15/inside-the-clock-tower/

Petz, S. (2021, June 25). Some Manitobans having trouble proving they're fully vaccinated against COVID-19 due to data errors. CBC. https://www.cbc.ca/news/canada/manitoba/vaccination-record-issues-manitoba-1.6079281

Principles. (n.d.). International Open Data Charter. Retrieved August 15, 2021, from https://opendatacharter.net/principles/

Robertson, G. (2021, June 17). Canada's data gaps hampered COVID-19 pandemic response, hurting vaccination tracking: Report. The Globe and Mail. https://www.theglobeandmail.com/canada/article-canadas-data-gaps-hampered-pandemic-response-hurting-vaccination/

Robinson, J. (2021, March 23). The Future of Data Storage is Decentralized. Coruzant Technologies. https://coruzant.com/blockchain/the-future-of-data-storage-is-decentralized/

The territorial impact of COVID-19: Managing the crisis and recovery across levels of government. (2021, May 10). OECD. https://www.oecd.org/coronavirus/policy-responses/the-territorial-impact-of-covid-19-managing-the-crisis-and-recovery-across-levels-of-government-a2c6abaf/

Waddell, K. (2021, June 15). An Interview With Tech Activist and Author Cory Doctorow. Consumer Reports. https://www.consumerreports.org/digital-rights/an-interview-with-tech-activist-and-author-cory-doctorow-a1943952645/

Emerging potentiality 5: Cohabitating virtual environments

The public is transitioning more aspects of their lives to the virtual world creating new public commons and challenging existing notions of reality.

The COVID-19 pandemic rapidly accelerated the use of digital products and services to maintain social distancing requirements. The pandemic demonstrated that many of our societal needs can now be met online. We can now work, socialize, immigrate, invest, and even purchase land in the digital world. Advancements in AR and VR technologies are allowing the merging of digital worlds into metaverses, shared virtual spaces offering a variety of experiences. The public is investing in metaverses through non-fungible tokens (NFTs), unique data representing value stored on the blockchain or ledger system. Metaverses are built upon a set of beliefs allowing new notions of reality to flourish. The blending of virtual worlds is at its preliminary stage and it is uncertain how it might impact the offline world.

Possible outcomes

- Digital economic activity could expand as we transition more of our lives online.
- Metaverses could streamline data sharing across systems.
- There could be a paradigm shift where the digital world cannot be trusted leading more people to disengage.

Implications

- Virtual migration allowing working visas for remote workers could become commonplace. Digital nomad visas for teleworkers could become widespread allowing increased international participation in domestic economies. Knowledge

economy workers could migrate away from mega cities to smaller cities with a lower cost of living. This may raise new policy grey areas such as the regulation of data sharing across borders.

- There could be increased Government surveillance of citizen online activity.
- Metaverses could become a new avenue for the spreading of online mis-/dis-information. There could be increased adoption of AI generated databases and research. These research portals could be programmed to spread mis-/dis-information. Deepfakes could become commonplace on digital spaces and become increasingly difficult to track.
- The acceleration of digital economic activity could require new measurement strategies to define the value of national economic activity. More online spending may result in less support for offline urban economies.
- Art and culture are increasingly displayed virtually through digital art galleries and museums. The blending of digital spaces could raise new challenges of how we preserve learnings for future generations.
- As more products and services transition online, it might exacerbate inequalities and the in-country digital literacy divide.
- Increased digital economic activity could raise new questions about the environmental impact of technologies. Increasing the adoption of cryptocurrencies and game worlds using an immense volume of energy may contribute to the climate crisis. However, it is unclear how widespread use of metaverses compares to the energy consumed through offline activities.

Counter trends

- There are deeply rooted fears in giving the private sector more power over the digital world associated with fears of surveillance capitalism.

Weak signals

Carmiel, O. (2021, March 19). Virtual Land Prices are Booming, and Now There's a Fund for That. Bloomberg. https://www.bloomberg.com/news/articles/2021-03-19/virtual-land-prices-are-booming-and-now-there-s-a-fund-for-that

Estonia is launching a new Digital Nomad Visa for remote workers. (n.d.). Republic of Estonia: E-Residency. Retrieved August 15, 2021, from https://e-resident.gov.ee/nomadvisa/

Hackl, C. (2021, June 24). More Than A Trend: Entering The Metaverse Will Become A Necessity For Brands. Forbes. https://www.forbes.com/sites/cathyhackl/2021/06/24/more-than-a-trend-entering-the-metaverse-will-become-a-necessity-for-brands/?sh=6696d68555ab

Haselton, T. (2021, March 24). How to make, buy and sell NFTs. CNBC. https://www.cnbc.com/2021/03/23/how-to-create-buy-sell-nfts.html

Herrman, J., & Browning, K. (2021, July 10). Are We in the Metaverse Yet? The New York Times. https://www.nytimes.com/2021/07/10/style/metaverse-virtual-worlds.html

Mehdi, T., & Morissette, R. (2021, April 1). Working from home: Productivity and preferences. Statistics Canada. https://www150.statcan.gc.ca/n1/pub/45-28-0001/2021001/article/00012-eng.htm

Perez, S. (2021, July 6). Roblox partners with Sony Music to connect artists with money-making activities in the metaverse. TechCrunch. https://social.techcrunch.com/2021/07/06/roblox-partners-with-sony-music-to-connect-artists-with-money-making-activities-in-the-metaverse/

Considerations for scenario development

Several insights emerged through the process of developing the emerging potentialities. The insights from this section are summarized below:

- Governments are recognizing that human rights are not being enforced in the digital world. Governments are pursuing new efforts to define and enforce digital human rights at an international scale. The data sharing system is complex and multidisciplinary. Changing this system requires stakeholder collaboration. Stakeholders outside of the Government are becoming more willing to enact change when there is an economic incentive.

- The COVID-19 pandemic demonstrated how a public health crisis could change this system. The rise of new technologies and the looming climate crisis is creating further uncertainty within the system.

- The climate crisis could increase the demand for environmental data. Growing private sector involvement in the collection and distribution of geospatial data could pose governance challenges in managing the sharing of environmental data.

- Governments and multilateral organizations are pursuing efforts to regulate AI and facial recognition technologies. However, it is uncertain whether these technologies can be controlled given the speed of technological innovation and ubiquity of data collection technologies.

- The state of interoperability remains an area of uncertainty and debate. Arguments for interoperable data systems continue to be met with privacy and cost concerns. It is uncertain how a centralized OGD pipeline might impact cities in the long-term.

- Virtual worlds are becoming increasingly complex. It is uncertain how citizen privacy can be managed as the internet becomes more engrained in our lives.

The analysis of the emerging potentialities demonstrates that there are several areas of critical uncertainty that could change in different directions. These uncertainties will be explored in the future scenarios (section 4.2). The scenarios will demonstrate the possible future perturbations to the system and guide the recommendations for humanizing data.

4.2 Future scenarios

What if the notion of knowledge is power no longer drives the data sharing system in the future?

This section imagines how possible shifts in human values might change OGD in 2036. Using alternative future scenarios, this section frames how the current system's insufficiencies might expand in the context of the emerging potentialities. The scenarios uncover areas of critical uncertainty to which we are unprepared that require further exploration. A high-level summary of the systemic differences in each future scenario are shown in Table 4. The content in Table 4 is expanded upon within the scenario components. The scenarios are used to guide and test the decision making framework in Chapter 5, recommendations.

▼ *Table 4. Three alternative future scenarios - summary*
This table provides a summary of the three alternative future scenarios included in this section:
the rise of data 'prosumers', what's mine is yours, and behind closed doors. The scenarios are
differentiated by the ways in which data is governed, the cultural conditions, and technological
paradigms. The content in this table is explained in detail within the scenario components.

Scenario Title	Scenario 1: The rise of data 'prosumers'	Scenario 2: What's mine is yours	Scenario 3: Behind closed doors
System metaphor	The power is in the people	Knowledge defends us	Our knowledge is private
Type of data emphasized	Personal data	Biometrics	Environmental and AI data simulations
Data governance strategy	The Government of Canada regulates the data sharing system	All data within a jurisdiction is open to the Subnational Government	Cities restrict data collection and use within jurisdictional boundaries
Governance epistemology	Hyper-democracy	Evidence-based decision making	Restoring digital human rights
Government structure	Decentralized liberal Government	Centralized conservative Government	Centralized liberal Government
Human relationship with cities	Urban data prosumers (producers and consumers)	Surveillance is a requirement of citizenship	Living within the environment's constraints
Societal attitude	Equity over equality	Privacy is a myth	Technology is not necessary
Cultural conditions	Every opinion matters	Hold your neighbours accountable	The Government cares for its citizens
Technological integration	Regional	Immersive	Limited
Economic activity	Economic gardening - the growth of local businesses	Digital economy dominates	Ecologically driven

Scenario 1: The rise of data 'prosumers'

What if citizens are provided the legal status of data producers and consumers?

What if citizens decide what data should be collected and used in their city?

What if open source democracy becomes commonplace?

Description

Following a K shaped[2] COVID-19 economic recovery, Canadians are aiming to build a more equitable society. Some progress is made towards regulating digital human rights from an international perspective but many issues surrounding data ownership at the local level persist. The Federal Government's policies continue to allow big tech companies to hoard and manipulate personal data. The Government's failure to act has led citizens to pursue efforts to democratize the data ecosystem. Citizens are protesting the Government's handling of data manipulation by walking away from big tech companies and refusing to participate in the Census. Networks of urban data collaboratives where citizens control how their data is produced and used become commonplace.

As an attempt to re-establish citizen trust and gain control over the data ecosystem, the Government of Canada pursues efforts to regulate data sharing. The Federal Government formally declares data a public good that should be locally managed like

Photo of a student at the University of Toronto logging in to vote on the city of Toronto's immigration policies.

Photo by Sergey Zolkin on Unsplash

water or energy. It identifies citizens engaging with technologies as data 'prosumers' who are data producers and consumers, and establishes new data rights. The Federal Government sets national goals for democratizing data sharing and hires top data experts to work in the public service. The Federal Government increases funding for Subnational Governments to support democratizing data and closing data gaps. Cities facilitate 'circular data ecosystems' encouraging sharing the value of data amongst urban stakeholders and increasing equity. To regain citizen trust, the re-municipalization movement expands and several public services run by the private sector return to public ownership. Progress is made towards regulating personal data manipulation, but some citizens are disappointed by lack of new voices involved in the process.

Several cities re-evaluate the social contract and develop participatory decision making models. Some cities leverage platform-mediated open source democracy in all decision making processes. Larger cities invest in closing the digital divide amongst its citizens to ensure there are increased opportunities for citizen participation. Some Municipal functions adopt direct democracy to eliminate political bias and provide citizens more agency in decision making. Urban economies include more small businesses addressing citizen needs and voter turnout is at

2   A K shaped recovery is where parts of the population recover quickly from an economic downtown, while others stagnate or continue to decline. In a K shaped recovery, the population is often differentiated by geography, industry, economic status and race (Aldrich, 2020).

an all time high. However, rapid technological innovation is becoming increasingly difficult to manage and it is unclear whether this system will withstand new technological innovations.

▼ *Table 5. CLA - The rise of data 'prosumers'*
See the rise of data 'prosumers' CLA (Inayatullah, 2008) below.

Litany (Continuous)	• Global data governance collaboration • Open source participatory democracy in cities • Investment in growing local businesses • Federal directive for personal data sharing • Data science ethics is emphasized
Systemic manifestation (Years)	• Data sovereignty • Re-municipalization • Hyper-democracy
Worldviews (Decades)	• Data is a public good; personal data autonomy, egalitarian[3] perspective
Metaphor/Myth (Societal/Civilizational)	• The power is in the people

Back casting: How might we get here?

- 2021: The COVID-19 pandemic demonstrates the importance of the internet in maintaining our social constructs.
- 2024: The Government of Canada declares internet access a social determinant of health.
- 2025: Facebook, Google and TikTok are charged for manipulating user data.
- 2027: The UN develops a global data treaty providing the public increased agency over their data rights.
- 2030: Canadians protest the manipulation of their data and refuse to participate in OGD initiatives until the technology sector is regulated.
- 2032: Citizens develop networks of data collaboratives and cooperatives.
- 2034: The Government formally acknowledges urban residents as data 'prosumers', producers and consumers of data.
- 2036: Open source participatory democracy and direct democracy are used for urban decision making.

Emerging potentialities
- The democratization of the internet
- Questioning the data life cycle

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3   "Egalitarianism is a trend of thought in political philosophy. An egalitarian favors equality of some sort: People should get the same, or be treated the same, or be treated as equals, in some respect." (Arneson, 2013).

Scenario 2:
What's mine is yours

What if all data within a city is open to the Government?

What if Government surveillance becomes a part of citizenship?

What if open data becomes the primary method to implement the law?

Description

In 2036, technology is integrated in all aspects of our lives. Rapid technological innovation following a U shaped[4] COVID-19 economic recovery has made personal AI devices cheap and fast to produce. AR and VR technologies including emotional and facial recognition are widely adopted. Deep learning algorithms are allowing devices to talk to each other and share data in real-time. These devices are collecting data about personal behaviour of everyone and everything within its periphery. This includes biometrics about the human body and emotions. Cities across Canada are implementing smart infrastructure to streamline data sharing in public spaces. Governments and citizens can now detect when people are lying, anxious, and in danger in real time. Living in a city no longer guarantees the right to privacy.

The volume of data collected by the private sector has made it nearly impossible to regulate data processing. The Federal Government pursues new efforts to moderate data use. New regulations require all data to be shared with the Government. Data within jurisdictions must first be filtered through Subnational Governments and then shared nationally. The public can access data through Access to

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4   A U shaped economic recovery occurs when there is a gradual recovery period following

Photo of a raccoon in Vancouver, B.C. collecting data about recycling compliance using a smart wristband.

Photo by Overture Creations on Unsplash

Information requests to the Federal Open Government department. Advancements in interoperability allow some private sector data to be automatically processed and uploaded to OGD portals. Big tech companies invest in rigorous content moderation to minimize unlawful societal outcomes leading to Government audits. The Government implements a Splinternet or fragmented internet structure and now knows more about its population than ever before. The Federal Government pursues targeted evidence based decision making to protect its citizens.

As the proliferation of data collection technologies continues to accelerate, questions are raised about when it is ethical for data to be private. The Government has been able to track several high profile crimes through this new data sharing system. Politicians can no longer make false claims which has led to high turnover rates within the Government. Citizens' distrust in the Governments' ability to protect their human rights has resulted in migration away from cities. A counter culture forms of Canadians migrating away from cities to forests and living 'off the grid' to avoid being surveilled. As more people migrate away from cities and advocate for data privacy, questions are raised if a new data governance strategy is required.

▼ *Table 6. CLA - What's mine is yours*

See the what's mine is yours CLA (Inayatullah, 2008) below.

Litany (Continuous)	• Smart city infrastructure is incentivized • Rigorous digital content moderation • Private sector interfaces on OGD portals • Open data to protect citizens from rule breaking • Cheap and fast supply chains for technologies
Systemic manifestation (Years)	• All data is open • Proliferation of data collection technologies • Government has the freedom to surveil • Fragmented internet structure
Worldviews (Decades)	• Data is the law; it is the Government's responsibility to make logical decisions, deontological ethics [5]
Metaphor/Myth (Societal/Civilizational)	• Knowledge defends us

Back casting: How might we get here?

- 2021: Darnella Frazier captured the murder of George Floyd on her cell phone camera and uploaded it to Facebook leading to four police officers being criminally charged.
- 2023: Big tech companies voluntarily share their data with regional Governments to inform who broke social distancing rules during the COVID-19 pandemic.
- 2025: Big tech companies pursue rigorous content moderation to minimize the sharing of mis-/dis-information.
- 2027: The UN develops a global strategy to address the proliferation of data collection technologies and ethical surveillance practices.
- 2030: The Government of Canada hires data experts to advance a new internet structure for Canadian citizens.
- 2033: The Government of Canada declares all data is open. Subnational Governments become responsible for data management for their jurisdiction.
- 2035: Subnational Governments make private sector data accessible to the public through Access to Information requests.
- 2036: Anonymized and aggregated data from technology companies are seamlessly integrated in OGD portals.

Emerging potentialities
- Cohabitating virtual environments
- Real-time data collection technologies
- Centralizing data governance

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5   Deontological or "duty-based ethics teaches that some acts are right or wrong because of the sorts of things they are, and people have a duty to act accordingly, regardless of the good or bad consequences that may be produced." (BBC, 2014).

Scenario 3: Behind closed doors

What if the Government of Canada experiences a massive cyberattack on citizen data by foreign cyberterrorists?

What if the Government restricts what data can be collected and used?

What if ecological forms of knowledge guide decision making processes?

Description

Following a V shaped[6] COVID-19 recovery, the Government of Canada centralizes OGD along with other Government functions and creates a singular national OGD portal to fix data interoperability issues. But, the Government cannot keep up with technological advancements opening up cybersecurity concerns. In 2030, the Government of Canada experiences a record breaking cyber breach by foreign cyberterrorists jeopardizing the personal data of over half the population. Perceived loss of control over personal safety leads the public to advocate for Government efforts to establish digital human rights.

The Government of Canada recognizes that centralized control over data collection and processing violates privacy rights and the next foreign cyberattack is inevitable. The solution is to implement rigorous regulation to protect the citizens of Canada and restore trust in the Federal Government. The solution is for the Government to become heavily involved in data governance. The Government of Canada sets a Federal directive for digital human rights to minimize what data can be collected and processed in Canada. The Federal directive prohibits

Photo of Facebook's abandoned research facility in Waterloo, ON.

Photo by dogherine Creations on Unsplash

the collection, processing, and use of non-essential personal data. Under this directive, the only data about people that can be collected is to maintain essential services and population health. OGD is reduced to only include high impact environmental data.

Subnational Governments become responsible for enforcing the Federal directive. Following Federal guidelines, local Governments enact community initiatives involving new voices and forms of knowledge. Cities implement grass-roots initiatives limiting quantitative data collection and emphasizing ethnography. These initiatives appreciate Indigenous knowledge and promote the need to live within the constraints of the environment. The Government offers incentivization strategies through grants and tax breaks to encourage new business models that do not involve quantitative data. Progress is made towards inclusive decision making in both the public and private sector. Cities pursue efforts to reduce their carbon footprint. As a part of this process, cities invest in new infrastructure and resources that minimize technology use. The Federal Government forms international alliances with other nations prioritizing climate impact over technological innovation. Despite this progress, many citizens are not ready to let go of data. Data black markets emerge where organizations secretly collect prohibited data raising questions if this model will be sustainable in the long-term.

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6   A V shaped recovery refers to a quick and sharp economic recovery following a sharp decline (Warner, 2020).

65

▼ *Table 7. CLA - Behind closed doors*

See the behind closed doors CLA (Inayatullah, 2008) below.

Litany (Continuous)	• Data breach • Restricting data collection and processing • OGD is the only source of open data • Appreciation of alternative forms of knowledge • Ecological economics is commonplace
Systemic manifestation (Years)	• Inclusive decision making • Data causes harm • Restoring human rights
Worldviews (Decades)	• Data is personal property; technologies do more harm than good, utilitarian perspective[7]
Metaphor/Myth (Societal/Civilizational)	• Our knowledge is private

Back casting: How might we get here?

- 2021: Lack of interoperability within Canada's health data sharing system leads to difficulty tracking vaccine distribution.
- 2023: The Federal Government sets a new fully interoperable OGD portal combining the data of all Government departments and agencies.
- 2024: There is a massive cyber attack on the Government of Canada's databases by foreign cyberterrorists jeopardizing the personal information of over half the population.
- 2025: The Government of Canada establishes a new directive for digital human rights restricting what data can be collected and used within Canada's borders.
- 2027: All non-essential personal data is banned in Canada.
- 2030: Canada joins the Global Data Equity Alliance focused on minimizing technological harm.
- 2032: All data about people is removed from OGD portals and replaced with environmental data.
- 2034: Subnational Governments implement initiatives to encourage ethnography and alternative forms of knowledge in decision making processes.
- 2036: Cities implement community incentives to limit technology use.

Emerging potentialities
- Questioning the data life cycle
- Centralizing data governance

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7   "Utilitarianism, in normative ethics, [...] [is when] an action (or type of action) is right if it tends to promote happiness or pleasure and wrong if it tends to produce unhappiness or pain—not just for the performer of the action but also for everyone else affected by it." (Duignan, 2021).

4.3 Considerations for moving towards change

This section submits three alternative future scenarios that were deduced from the emerging potentialities: the rise of data 'prosumers', what's mine is yours, and behind closed doors. The scenarios were analyzed comparatively and the key takeaways are summarized below:

- Centralized efforts to change this system could reinforce existing power asymmetries. Stakeholder collaboration is required to curb negative outcomes of data use.
- Improving the data will not change the data sharing system. The system is driven by how society perceives and derives new knowledge. Changing the system requires reconsidering the relationship between data and knowledge in the way we live and work.
- The problems within the current data sharing system will become increasingly difficult to manage as the internet becomes integrated within more aspects of our lives.
- Canada's data policy and information governance system level (see figure 5) will continue to be influenced by the data governance strategies of national allies and Multilateral Organizations. New directives at an international level could change Canada's data sharing system.
- Opening more data without having nuanced conversations about what data should be open and why could exacerbate today's problems.
- It is uncertain how the next crisis will impact the demand for OGD, but it is important to prepare for it.
- The state of the data sharing system is contingent upon the state of digital human rights. Until digital human rights are defined and enforced at an international level, data governance issues will persist.

From problem framing to solving

The analysis of the scenarios uncovered several common themes to which there is a high level of uncertainty and low level of preparedness. This section summarizes considerations about three common scenario themes to be used for problem solving: data governance, system structure, and technological innovation.

First, the scenarios demonstrate that centralizing control over parts of the data life cycle could result in more data benefiting stakeholders who own the data. Centralizing control could lead to large players dominating the system and higher entry barriers for new market entrants. This could become problematic as digital economic activity continues to expand. Further research is required to understand how centralizing control over the data sharing system could impact system stakeholders. There is an opportunity for stakeholder collaboration to understand the implications of data governance strategies and how they might withstand the next crisis.

Second, the analysis of the scenarios raised questions about the system structure and interoperability. A trend from the interviews and literature review was the many benefits of interoperable data sharing. An interoperable OGD pipeline could streamline data communications across jurisdictions, decrease data hoarding, and increase sector wide collaboration. What if interoperability negatively impacts cities? A fully interoperable OGD pipeline could provide cities less autonomy in managing their data. Government data stewards currently driving the Subnational programs could become less motivated to enact

change. Without data stewards advocating for openness, disparities in data governance across cities could increase. There is an opportunity to explore interoperability from a local perspective. This includes discussing what data should be managed at the Federal and local levels.

Third, the analysis of the scenarios raised the following question: how might we prepare for and govern technologies that have not yet been invented? We are living in a time of rapid technological innovation. 20th Century science fiction envisioned 2020 to have video calling, flying cars, time travel, and the human brain attached to the internet (Ghimire, 2019). The divergence between what we envision for the future and the reality is difficult to predict. Currently, the speed of technological innovation is encouraging short-term thinking, diverting from long-term system change. The speed of technological innovation will continue to challenge data governance strategies and policies in the future. There is an opportunity to explore how continuous learning and agility can be incorporated in data governance strategies.
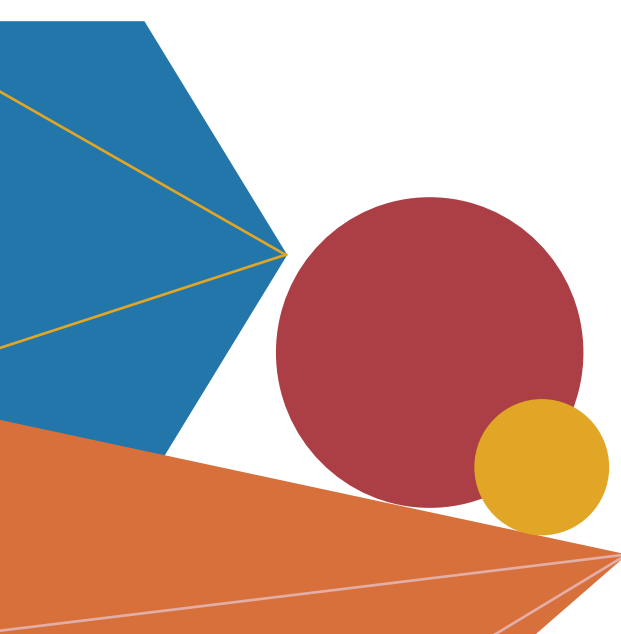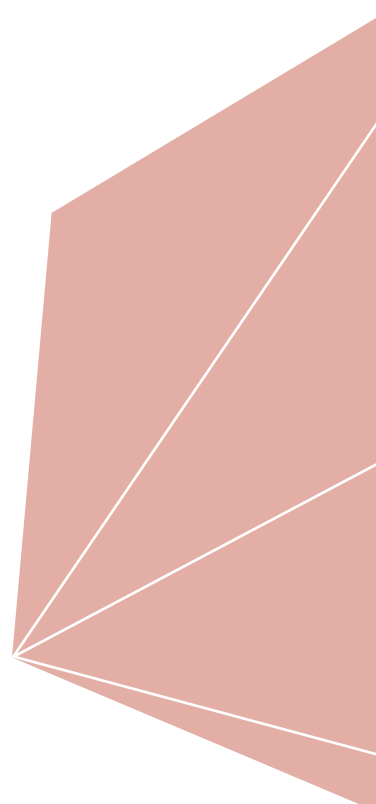
Changing OGD involves several steps and processes. Before we can develop tactics, strategies, and policies, we first must define the underlying principles to guide decision making. The areas of critical uncertainty from the scenarios are the guide to develop a decision making framework for humanizing data.

Chapter 5:
Recommendations

Given the scope of this research, it is appropriate to provide recommendations that could be applied across Municipal and Provincial Governments and support the objectives of the system. Before we develop new strategies and policies, we first must identify the underlying principles that guide decision making. The intention of this chapter is to provide the framework to incorporate human values in OGD decision making processes and address the research question set out at the start of this report.

5.1 Decision making principles

This section submits five principles to underpin the development of Subnational OGD policies and strategies. The application of Jones' (2014), D'Ignazio and Klein's (2020), and Meadows' (2008) works is intended both as a guide for decision making and a methodology for changing the system in support of emerging shifts in human values.

Decision making principles - summary:

1. *Embrace complexity within all levels of the system*
2. *Consider the larger purpose of OGD*
3. *Dismantle power asymmetries*
4. *Rethink openness*
5. *Prioritize continuous learning*

Principle 1: Embrace complexity within all levels of the system

Description

Meadows describes our systems as a combination of "diversity and uniformity" (Meadows, 2008, p. 181). Her work explains that "there's something within the human mind that is attracted to straight lines and not curves, to whole numbers and not fractions, [...] and to certainties and not mystery" (2008, p. 181). The purpose of data is to create uniformity within complexity and provide certainty. However, data represents the complex systems it originated from and ignoring the "wickedness" (Jones, 2014) or complexity of the system leads to outputs targeting specific parts or stakeholders within the system. This principle encourages embracing all parts of the system. It considers all forms of knowledge and recognizes when complexity cannot be simplified within a dataset (D'Ignazio & Klein, 2020, p. 131).

This principle includes setting boundaries on data as an appropriate measure of the system. Also, it involves understanding when system actors have the expertise to evaluate the system.

What: Systemic problems that could be addressed

- Data gaps
- The infodemic

Where: System levels of focus

- Exo: Data policy and information governance
- Macro: Lives of city residents

When: Operational applications

- Scoping and setting project boundaries
- Analyzing data that has been collected
- Communicating data to the public
- Analyzing processed data for secondary uses

Why: Design theories and methods supporting this principle

- Ashby's Law of Requisite Variety: Ashby contends that the variety of the system inputs should represent the variety of the system's outputs (Jones, 2014).
- System mapping: The process of mapping system components, actors and interactions to find sources of complexity within the system (Jones, 2014).
- Wicked problems theory of design: Design problems are 'wicked' or complex in nature and cannot be solved through linear approaches (Rittel & Webber, 1973).

Principle 2: Consider the larger purpose of OGD

Description

Jones (2013) submits that the purpose of a system is the outcome or "function that defines the whole system" (Jones, 2014). Currently, publishing data is a part of the data sharing system. There are barriers to publishing data and as a result publishing is often considered the objective of OGD. This predefined purpose excludes the impact of the data. This goal does not consider the data sharing system's role in the innovation process and how it impacts our lives once it is published. This principle aims to consider OGD as part of a broader knowledge generation system working to make positive change in Canada's cities. Jones (2014) explains: "while defining purposes can lead to a more precise definition of a problem, the combination of clear purpose and creative framing resists fixation on the wrong problem or level of the problem system".

What: Systemic problems that could be addressed

- The innovation myth
- The value of data

Where: System levels of focus

- Micro: OGD pipeline suppliers
- Exo: Corporate digital economy
- Exo: Data policy and information governance

When: Operational applications

- Defining project objectives
- Brainstorming new directives
- UX design of OGD portals
- Funding allocation

Why: Design theories and methods supporting this principle

- Designing for emergence: Design and the higher order purpose or emergence should both be harnessed for innovation (Van Alstyne & Logan, 2006).
- Value Sensitive Design: A value-driven approach to technology design (Davis & Nathan, 2015).
- Envisioning cards: A method for envisioning how systemic problems are integrated in technology design (Friedman, et al., n.d.).
- Iterative Process of Inquiry: Framing the function, structure, process and context at each level of the system to rethink the larger purpose of each level (Gharajedaghi, 2011).
- Five whys method: Asking 'why' to reveal the underlying purpose of decisions (Young, 2021).

Principle 3: Dismantle power asymmetries

Description

Meadows submits that we should be working towards optimal results for the entire system, not just certain actors or activities within it. We should "aim to enhance total systems properties, such as growth, stability, diversity, resilience and sustainability - whether they are easily measured or not" (2008, p. 178). To restore equity within the system, we first must understand the power structures within it (D'Ignazio & Klein, 2020, p. 21). This involves framing and evaluating the sources of power within the system. The data sharing system has a power bias favouring those who own the data. This power structure disproportionately impacts vulnerable populations. Data informed decisions often reinforce such power asymmetries and disregard the needs of stakeholders who provide their data (D'Ignazio & Klein, 2020, p.

52). This principle involves restoring equity for those disproportionately impacted by the system. D'Ignazio & Klein contend that "shifting the frame from concepts that secure power, like fairness and accountability, to those that challenge power, like equity and co-liberation" (2020, p. 72) can help design solutions benefiting those disadvantaged by the system.

What: Systemic problems that could be addressed

- The infodemic
- Data gaps

Where: System levels of focus

- Micro: OGD pipeline suppliers
- Macro: Urban open data ecosystem
- Exo: Data policy and information governance
- Exo: Corporate digital economy

When: Operational applications

- All processes within the data pipeline from data collection to final use
- Public consultations and stakeholder engagement initiatives
- Education curriculum development
- Funding allocation

Why: Design theories and methods supporting this principle

- Design justice principles: A set of design principles aimed to restore equity for vulnerable populations disproportionately impacted by design (Design Justice Network, n.d.).
- Designing for liberation: Fostering diversity within the design process to combat oppression (Van Amstel, 2021).
- Intersectionality in design: A methodology for dismantling the designer's power to understand the needs of system actors marginalized by design (Shaw, 2019).

Principle 4: Rethink openness

Description

Meadows (2008) explains that we can improve a system's functions by providing it "more timely, more accurate, [and] more complete information" (p. 173). The level of stakeholder involvement in decision making impacts the completeness of the system's information. D'Ignazio and Klein (2020) advocate that "the most complete knowledge comes from synthesizing multiple perspectives, with priority given to local, Indigenous and experiential ways of knowing" (p. 125). The authors explain the importance of involving multiple perspectives throughout data related processes (p. 125). Currently, OGD practice includes publishing decisions that have already been made. The intention of this principle is to integrate 'openness' as a process and service. This principle includes facilitating collaboration amongst system stakeholders and co-creating with subject experts and vulnerable voices. This principle aims to rethink the limitations of expert-led decisions and integrate open decision making processes.

What: Systemic problems that could be addressed

- Citizen privacy
- Data gaps

Where: System levels of focus

- Micro: OGD pipeline suppliers
- Exo: Data policy and information governance
- Exo: Corporate digital economy

When: Operational applications

- Designing future scenarios
- Policy development

- Data collection and analysis decision making processes
- Creating OGD portal standards

Why: Design theories and methods supporting this principle

- Participatory mindset: A design research approach where the users are co-creators of the design (Sanders, 2008).
- Henry Chesbrough's open innovation and business models: The act of involving external perspectives within research processes (Osterwalder & Pigneur, 2010, p. 110).
- Co-design: The users of the design act as "experts of their experience" in the design process (Sanders & Stappers, 2012, p. 23-24).

Principle 5: Prioritize continuous learning

Description

Meadows (2008) emphasizes the importance of continuous learning when working within complex systems. Implementing rigid policies and strategies does not benefit the system. Meadows explains that "what's appropriate when you're learning is small steps, constant monitoring, and willingness to change course as you find out more about where it's leading." (2008, p. 180). The learning process involves learning from failure and enacting incremental changes based on previous errors (p. 181). Currently, the data sharing system does not have a common mechanism to track its successes and failures. In many cases, learning achievements are not archived or shared amongst system stakeholders. This principle encourages a culture of humility and willingness to learn. Learning involves listening to stakeholders' needs and finding new ways to engage with the system. It includes facilitating a culture of experimentation and embracing failures. It places learning at the forefront and of equal importance to publishing initiatives.

What: Systemic problems that could be addressed

- The value of data
- The innovation myth

Where: System levels of focus

- Micro: OGD pipeline suppliers
- Meso: Urban open data ecosystem
- Exo: Data policy and information governance
- Macro: Lives of city residents

When: Operational applications

- Scoping and setting project boundaries
- Measurement strategy development (key performance indicators)
- Consultations and stakeholder engagement initiatives
- Tracking OGD secondary uses

Why: Design theories and methods supporting this principle

- Prototyping: The modeling and iterating of products and services as a part of the research process (Sanders & Stappers, 2012, p. 62-63).
- Scenario development: The process of developing low probability high impact futures to test strategies and policies (Inayatullah, 2008).
- Stakeholder personas and empathy mapping: Tools used to test the efficacy of designs and business models based on customer behaviour and characteristics (Osterwalder & Pigneur, 2010, p. 131).

5.2 Measuring success

The data sharing system does not have a uniform mechanism to measure its success or failure and as a result the value of OGD remains ambiguous. Universal indicators of success are necessary to define the direction for the system to grow. Before we can define what success looks like, we first must identify the broader categories that measurement tools can be based upon. Such categories or indicators are the first step in measuring the effectiveness of the decision making principles.

It is noteworthy that the openness or volume of published data is not an indicator of a successful implementation. The decision making principles attempt to humanize the data we have and increase the capacity for new knowledge that benefits local communities.

Indicators of success

Four indicators of success are explained in the following sections:

1. *Urban data informed initiatives*
2. *Symbiotic stakeholder relationships*
3. *Long-term data and information governance*
4. *Knowledge capacity building initiatives*

Indicator 1:

Urban data informed initiatives

The first indicator of success is the secondary uses of open data for the benefit of the community. This indicator demonstrates that stakeholders are harnessing open data to define and solve urban problems. This indicator includes digital and physical products and services from ideation to implementation that were developed from open data. These initiatives are intended to solve urban problems and reduce

inequality. As shown in Figure 1, the growth of OGD was the result of small-scale incremental initiatives taken over time. As per Mariana Mazzucato's moonshot guide, the objective of this indicator is to encourage risk taking and the pursuit of several innovation initiatives (Ghosh, 2021). Failed initiatives still lead to new knowledge development and future initiatives. Measuring this indicator could include setting licensing agreements that require stakeholders to disclose data use to the Government and open data providers.

Related barriers to change:
- Measuring success
- Proprietary data systems

Indicator 2:

Symbiotic stakeholder relationships

Drawing from Mazzucato's *The Entrepreneurial State* (2015), this indicator describes symbiotic relationships between high and low power stakeholders from the private and public sector (see Figure 6). This indicator is a shift where stakeholders at different levels of power both benefit from the relationship. The objective is to have more voices declaring what problems we should solve and pursue those efforts with the aim of increasing equity. As demonstrated by section 3.1, there are power asymmetries guiding the data sharing system. This indicator challenges existing relationships and aims to more equally distribute power within the system. Implementation could involve a network analysis that examines the size and nature of the system's network.

Related barriers to change:
- Proprietary data systems
- Absorptive capacity

Indicator 3:

Long-term data and information governance

This indicator includes data and information governance initiatives that extend beyond short-term solutions. This indicator involves exploring what might disrupt or transform the system in the long-term. Historically, efforts to govern OGD have mostly focused on the short-term. The ambiguous value of OGD resulted in limited funding and capacity for long-term data governance. There is now an opportunity to explore long-term data governance strategies given the demand for OGD associated with the COVID-19 pandemic. Measuring the success of this indicator could involve tracking the volume of new research and policy discussions about open data theory and practice.

Related barriers to change:
- Governance structure
- Municipal resources

Indicator 4:

Knowledge capacity building initiatives

The final indicator is building the capacity for new knowledge generation. This indicator involves harnessing educational initiatives to increase digital and data literacy. This indicator includes understanding how Canadians prefer to receive information and providing Government services that cater to citizen needs. Section 3.2 discusses how Canada's digital literacy divide has contributed to the spreading of online mis-/dis-information. OGD
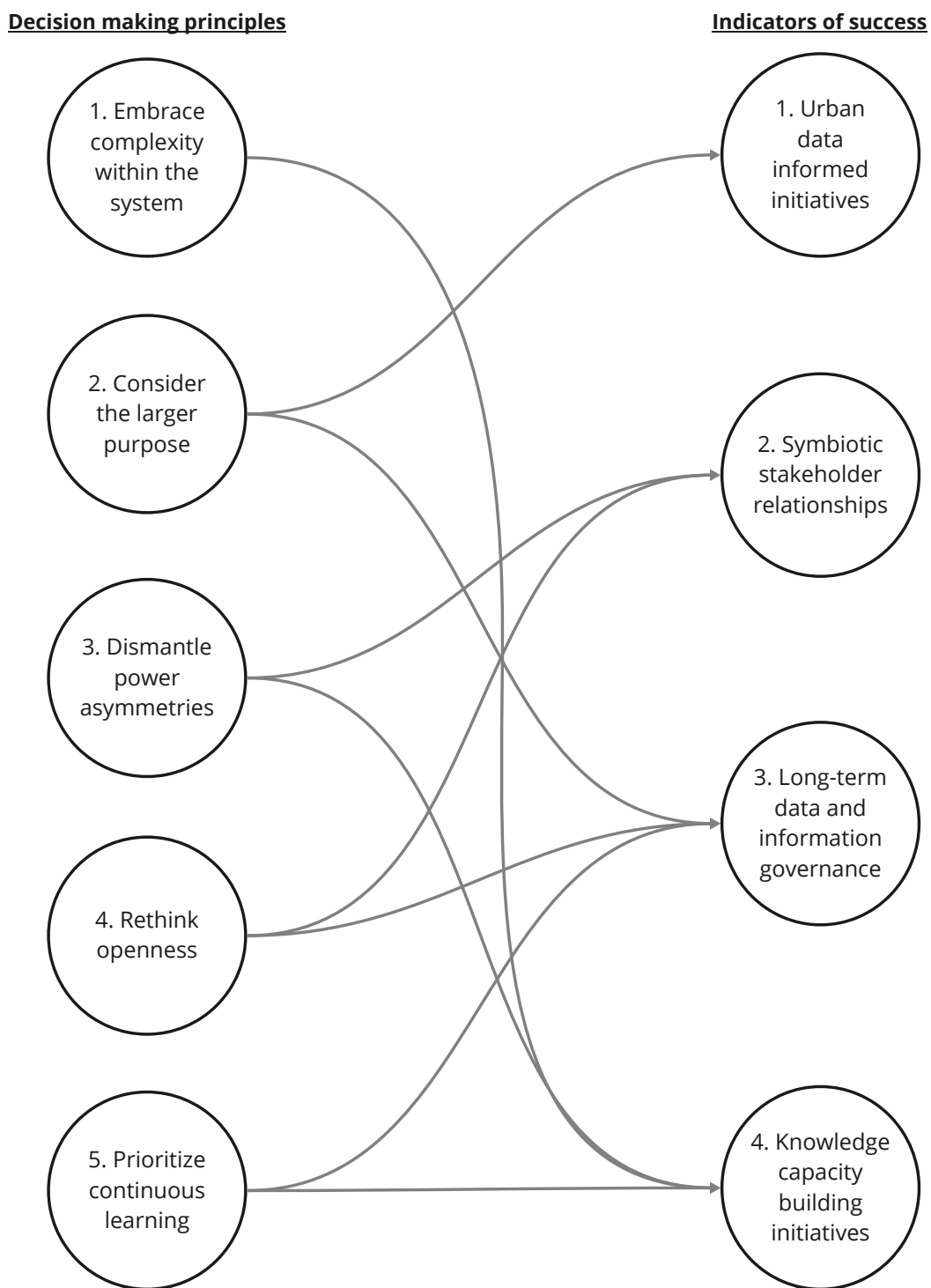
portals and the format of datasets are limiting user engagement. This indicator includes new ways to use and understand data. Measuring this indicator could include tracking data education initiatives, archival systems, OGD portal user engagement, and the depth of context within datasets.

Related barriers to change:
- Skill development
- Absorptive capacity

▼ *Figure 9. Connecting the indicators of success and decision making principles*
The following figure demonstrates the connection between the
decision making principles and indicators of success.

Decision making principles

Indicators of success

1. Embrace complexity within the system

2. Consider the larger purpose

3. Dismantle power asymmetries

4. Rethink openness

5. Prioritize continuous learning

1. Urban data informed initiatives

2. Symbiotic stakeholder relationships

3. Long-term data and information governance

4. Knowledge capacity building initiatives

Chapter 6:
Conclusion

The objective of this research is to answer the following question: *How might we rethink OGD practice in Canada's cities in support of emerging shifts in human values?* The project framework follows Herbert A. Simon (1995) and Kees Dorst's (2015) design thinking methodology and includes three phases: problem finding, problem framing, and problem solving. Using this framework, this research describes the current system's conditions and insufficiencies before exploring possible future perturbations to the system. Alternative future scenarios are used to frame areas of critical uncertainty and test decision making principles to underpin OGD policy and strategy development.

The analysis of the current state of the system in Chapter 3 uncovers problems causing OGD practice to lose its fit for purpose: the infodemic, innovation myth, citizen privacy, data gaps, and the ambiguous value of data. The analysis of these problems provides four insights. First, OGD is situated within a complex system involving several stakeholders. OGD often does not take into account the complexity of the system in decision making processes. Second, there is a disconnect between the objectives of OGD and the data sharing system. The goal of OGD practice is to publish data, meanwhile the data sharing system aims to generate new knowledge. Third, OGD privacy concerns are a part of a larger digital human rights problem. Until digital human rights are defined and enforced, privacy concerns will persist. Last, OGD practice is reinforcing existing decision making structures. OGD is about opening decisions that have already been made rather than opening the decision making process.

Chapter 3 concludes by explaining how the metaphor driving the data sharing system, knowledge is power, is contributing to the current system's problems. OGD was developed to challenge traditional data ownership and distribute the value of data. In practice, this system reinforces existing power asymmetries and provides more power to those who own the data. The underlying incentive for data sharing is to generate new knowledge. As a result, the potential for data to generate new knowledge provides power to data owners.

Chapter 4, the future, challenges the notion of knowledge is power and proposes alternative ways of thinking about data in 2036. Chapter 4 explores changes on the horizon pointing to new ways of thinking about data. The changes on the horizon uncover low probability, high impact future data paradigms that are used to design three alternative future scenarios: the rise of data 'prosumers', what's mine is yours, and behind closed doors.

The future scenarios demonstrate considerations about three areas of critical uncertainty: data governance, system structure, and technological innovation. First, centralizing data governance could reinforce existing power dynamics and create higher entry barriers for new market entrants. Second, an interoperable system has many benefits in streamlining data sharing and minimizing data gaps, but it is uncertain how interoperability might impact motivation within the Subnational levels of Government. Third, the speed of technological innovation is becoming increasingly difficult to regulate. It is uncertain how Governments can regulate technologies that have not been invented yet. These considerations are used to develop a new decision making framework that considers human values in the way we manage OGD.

Five decision making principles drawn from Meadows' (2008), Jones' (2014), and D'Ignazio and Klein's (2020) previous works are proposed that could be used to develop new OGD strategies or policies. The first principle is to embrace complexity within all levels of the system. This involves evaluating the interactions between systemic components and appreciating alternative forms of knowledge. The second principle, consider the larger purpose of OGD, is about refining the underlying systemic drivers and thinking about the objectives beyond the scope of individual system components. Third, dismantling power asymmetries encourages challenging power imbalances and

restoring equity within the system. Fourth, the principle of rethinking openness aims to incorporate stakeholder collaboration across the system. This principle includes open decision making processes. Last, prioritizing continuous learning fosters a culture of humility and willingness to learn. The research concludes by providing broad indicators to evaluate the success of the principles. These principles aim to provide a new decision making framework that could be used to evaluate emerging shifts in human values.

My objective of the decision making framework is to foster the development of urban data ecosystems that benefit the community first. Data has become a central pillar in decision making processes. But, gaps and bias in our systems for managing and governing data have resulted in harm. Rapid technological innovation will continue to complicate data sharing and has the potential to create further harm if it is not properly managed. Considering human values at the beginning of the OGD pipeline is the starting point to minimizing data driven problems and developing a data sharing system that benefits communities. These principles could result in more urban initiatives targeting local needs, citizen participation in policy making, and inclusive products and services. These principles have the potential to support local governance initiatives that reflect how we live in cities today and as a result benefit Canadians' health, safety, and wellbeing.

Limitations and next steps

This research is limited by several factors. First, the research ontology is influenced by the COVID-19 pandemic. The research topic was examined during a time of heightened interest and scrutiny of Governments' data sharing systems. Second, the drivers influencing OGD practice are fast evolving. This research provides a snapshot of a particular point in time with the intention of understanding the necessity for change. Third, this research only includes expert perspectives and does not include

the general population's views of data. Last, the project scope and depth was limited by time and budgetary restrictions. This research was designed to fulfill the Major Research Project academic requirements for the degree of Master of Design in Strategic Foresight and Innovation at OCAD University. These restrictions influenced the research methods and participant sample size selected.

There are several possible avenues to advance the depth and breadth of this research. Given the scope of this project, more research could be done to understand the broader forces impacting the system and the interconnections between data sharing system stakeholders and components. This research presents three exploratory scenarios and does not define which scenario would be the most desirable for citizens living in cities. Future research could aim to define the preferred future scenario. The next steps would be to understand how the decision making principles could be used to build a preferred future system state. This would involve human centered design, defining the measurement tactics for each indicator of success, and surveying the populous to understand citizen perspectives of data.

Through this research, my objective is to provide open data advocates and OGD decision makers a new way of thinking about OGD related problems. I hope it encourages new conversations about supporting human values through data and demonstrates the value of combining designing thinking, systems thinking, and strategic foresight methodology for future research in this field of study.

References
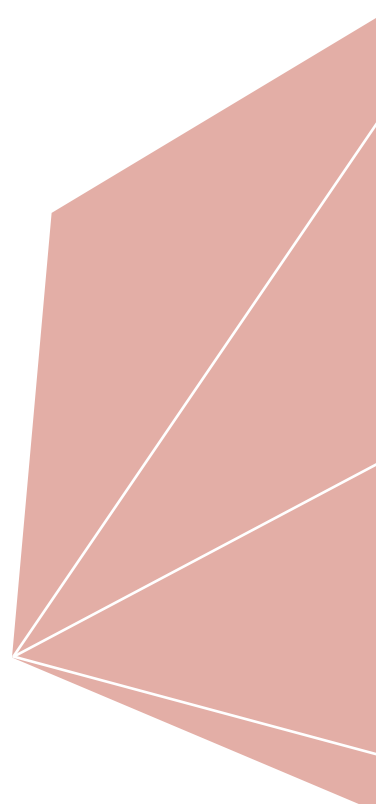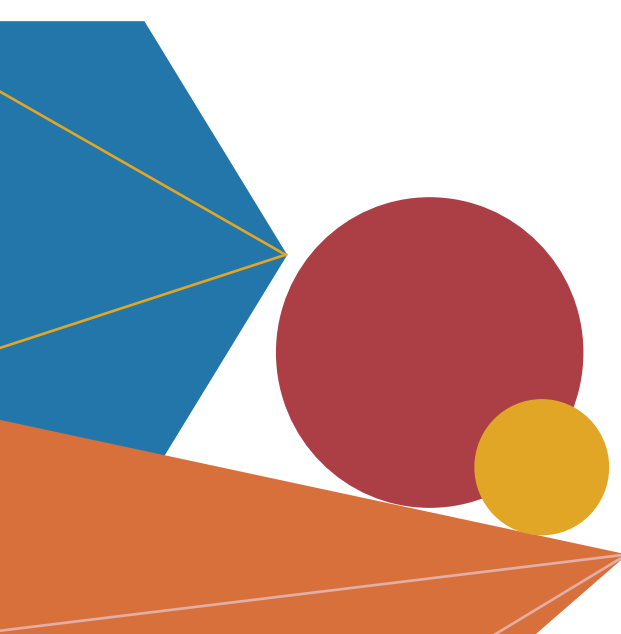
Aldrich, E. (2020, December 17). What a K-shaped recovery means, and how it highlights a nation's economic inequalities. Business Insider. https://www.businessinsider.com/k-shaped-recovery-definition

Alice Design. (n.d.). Data [Image]. Retrieved September 3, 2021, from https://thenounproject.com/term/data/2500462/

An overview of Ground Truth Data Collection. (2020, March 9). Q Analysts. https://qanalysts.com/an-overview-of-ground-truth-data-collection/

Arneson, R. (2013). Egalitarianism. In E. N. Zalta (Ed.), The Stanford Encyclopedia of Philosophy (Summer 2013). Metaphysics Research Lab, Stanford University. https://plato.stanford.edu/archives/sum2013/entries/egalitarianism/

Attard, J., Orlandi, F., Scerri, S., & Auer, S. (2015). A systematic review of open government data initiatives. Government Information Quarterly, 32(4), 399–418. https://doi.org/10.1016/j.giq.2015.07.006

Bellinger, G., Castro, D., & Mills, A. (2004). Data, Information, Knowledge, & Wisdom. Systems Thinking. https://www.systems-thinking.org/dikw/dikw.htm

Bradshaw, P. (n.d.). What Is Data Journalism? Data Journalism. Retrieved July 31, 2021, from https://datajournalism.com/read/handbook/one/introduction/what-is-data-journalism

Braun, W. (2002). The System Archetypes.

Businesses and your personal information. (2016, September 12). Office of the Privacy Commissioner of Canada. https://www.priv.gc.ca/en/privacy-topics/information-and-advice-for-individuals/your-privacy-rights/businesses-and-your-personal-information/

Card, J. (2015, August 26). All the data you need to power your business is free online. The Guardian. http://www.theguardian.com/media-network/2015/aug/26/open-data-guide-tips-business

Chao, G. (2015, May 15). What is Design Thinking? The Stanford Daily. https://www.stanforddaily.com/2015/05/15/what-is-design-thinking/

Chignard, S. (2013, March 29). A brief history of Open Data—Paris Innovation Review. Paris Innovation Review. http://parisinnovationreview.com/articles-en/a-brief-history-of-open-data

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive Capacity: A New Perspective on Learning and Innovation. Administrative Science Quarterly, 35(1), 128. https://doi.org/10.2307/2393553

Copeland, B. J. (2020). Artificial Intelligence. Encyclopedia Britannica. https://www.britannica.com/technology/artificial-intelligence

Criado-Perez, C. (2019). Invisible women: Data bias in a world designed for men. Abrams Press.

Cuhls, K. E. (2019). Horizon Scanning in Foresight – Why Horizon Scanning is only a part of the game. FUTURES & FORESIGHT SCIENCE, 2(1), e23. https://doi.org/10.1002/ffo2.23

Darcy, O. (2020, March 12). How Fox News misled viewers about the coronavirus. CNN. https://www.cnn.com/2020/03/12/media/fox-news-coronavirus/index.html

Davies, T. (2013). Open Data Barometer—2013 Global Report. Open Data Institute & World Wide Web Foundation. http://opendatabarometer.org/doc/1stEdition/Open-Data-Barometer-2013-Global-Report.pdf

Davis, J., & Nathan, L. P. (2015). Value Sensitive Design: Applications, Adaptations, and Critiques. In J. van den Hoven, P. E. Vermaas, & I. van de Poel (Eds.), Handbook of Ethics, Values, and Technological Design: Sources, Theory, Values and Application Domains (pp. 11–40). Springer Netherlands. https://doi.org/10.1007/978-94-007-6970-0_3

Definition of DATA PROCESSING. (2021). Merriam-Webster. https://www.merriam-webster.com/dictionary/data+processing

Deloitte. (2012). Open Data—Driving growth, ingenuity and innovation. https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/deloitte-analytics/open-data-driving-growth-ingenuity-and-innovation.pdf

Deloitte. (2020). Data valuation: Understanding the value of your data assets. https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Finance/Valuation-Data-Digital.pdf

Department of Global Communications. (2020, March 31). UN tackles 'infodemic' of misinformation and cybercrime in COVID-19 crisis. United Nations; United Nations. https://www.un.org/en/un-coronavirus-communications-team/un-tackling-%E2%80%98infodemic%E2%80%99-misinformation-and-cybercrime-covid-19

Design Justice. (n.d.). Design Justice Network. Retrieved August 11, 2021, from https://designjustice.org

D'Ignazio, C., & Klein, L. F. (2020). Data Feminism. The MIT Press.

Disinformation Research Group. (2020, October 21). Most Covid Related Disinformation on Social Media Likely Emanating from Known Influencers and Traditional Media Sources. Federation Of American Scientists. https://fas.org/blogs/fas/2020/10/most-covid-related-disinformation-on-social-media-likely-emanating-from-known-influencers-and-traditional-media-sources/

Dogherine. (2021). Unsplash collection [Photograph]. https://unsplash.com/photos/D2hrRh7E-fg

Dorst, K. (2015). Frame Creation and Design in the Expanded Field. She Ji: The Journal of Design, Economics, and Innovation, 1(1), 22–33. https://doi.org/10.1016/j.sheji.2015.07.003

Duignan, B. (2021). Utilitarianism. Encyclopedia Britannica. https://www.britannica.com/topic/utilitarianism-philosophy

Duty-based ethics. (2014). BBC. https://www.bbc.
co.uk/ethics/introduction/duty_1.shtml

Eaves, D. (2019, January 4). The first decade of open
data has been a win—But not for the reasons you
think. Apolitical. https://apolitical.co/solution-
articles/en/the-first-decade-of-open-data-has-
been-a-win-but-not-for-the-reasons-you-think

Eckartz, S., van den Broek, T., & Ooms, M. (2016). Open
Data Innovation Capabilities: Towards a Framework
of How to Innovate with Open Data. 47–60.
https://doi.org/10.1007/978-3-319-44421-5_4

Engler, A. (2020, September 10). Tech cannot be governed
without access to its data. Brookings. https://www.
brookings.edu/blog/techtank/2020/09/10/tech-
cannot-be-governed-without-access-to-its-data/

Eubanks, V. (2018, June 14). High-Tech Homelessness.
American Scientist. https://www.americanscientist.
org/article/high-tech-homelessness

European Parliament. (2020, January 8). Is data the new
oil? Competition issues in the digital economy.
https://www.europarl.europa.eu/thinktank/en/
document.html?reference=EPRS_BRI(2020)646117

Evans, R., Siesfeld, T., & Gabriel, K. (2017). Redefining
standards: Decision making, diversity, and open
data | Deloitte US. Deloitte United States. https://
www2.deloitte.com/us/en/pages/monitor-
institute/articles/re-imagining-measurement-
redefining-standard-practices.html

Fae Frey. (n.d.). Community [Image]. Retrieved
September 3, 2021, from https://thenounproject.
com/term/community/2522271/

Finch, M., & Casasbuenas, J. (2020, July 29). Using
scenarios to reimagine our strategic decisions.
Nesta. https://www.nesta.org.uk/project-updates/
using-scenarios-reimagine-our-strategic-decisions/

Friedman, B., Nathan, L., Kane, S., & Lin, J. (n.d.).
The Envisioning Criteria. Envisioning Cards.
Retrieved August 22, 2021, from https://
www.envisioningcards.com/?page_id=2

Furht, B. (Ed.). (2008). Encyclopedia of Multimedia. Springer
US. https://doi.org/10.1007/978-0-387-78414-4

Gao, Y., Janssen, M., & Zhang, C. (2021). Understanding
the evolution of open government data research:
Towards open data sustainability and smartness.
International Review of Administrative Sciences.
https://doi.org/10.1177/00208523211009955

Gebel, M. (2021, January 15). Misinformation vs.
disinformation: What to know about each form of
false information, and how to spot them online.
Business Insider. https://www.businessinsider.
com/misinformation-vs-disinformation

Gertner, J. (2021, March 25). A DNA Sequencing
Revolution Helped Us Fight Covid. What Else
Can It Do? The New York Times. https://www.
nytimes.com/interactive/2021/03/25/magazine/
genome-sequencing-covid-variants.html

Gharajedaghi, J. (2011). Holistic Thinking. In Systems thinking: Managing chaos and complexity: A platform for designing business architecture (3rd ed, pp. 89–108). Morgan Kaufmann.

Ghimire, S. (2019, November 26). 2020 Imagined by Science Fiction. Medium. https://medium.datadriveninvestor. com/2020-imagined-by-science-fiction-467e8721cdf5

Ghosh, J. (2021). Lessons from the Moonshot for fixing global problems. Nature, 589(7842), 349–350. https://doi.org/10.1038/d41586-021-00076-1

Government of Canada. (2020a, May 4). Open Government Across Canada. http://open. canada.ca/en/maps/open-data-canada

Government of Canada. (2020b, June 21). Consolidated federal laws of Canada, Access to Information Act. Justice Laws Website. https:// laws-lois.justice.gc.ca/eng/acts/a-1/

Government of Canada. (2020c, August 19). Access to Information. http://open. canada.ca/en/access-to-information

Government of Canada. (2020d, November 5). Open Data 101. http://open.canada.ca/en/open-data-principles

Government of Canada. (2021a). Contract History— Open Government Portal. Open Canada. https:// open.canada.ca/data/en/dataset/53753f06- 8b28-42d7-89f7-04cd014323b0

Government of Canada. (2021b, May 7). Open Data. http://open.canada.ca/en/open-data

Gurin, J. (2014). Open data now: The secret to hot startups, smart investing, savvy marketing, and fast innovation. McGraw-Hill Education.

Halais, F. (2020, March 4). Is Your Data Being Collected? These Signs Will Tell You Where. Wired. https://www. wired.com/story/data-collected-signs-will-tell-where/

Hammer, C. (2019). Open Data Stakeholders— Multilateral Organisations. In The State of Open Data: Histories and Horizons. African Minds and the International Development Research Centre (IDRC). https://www.stateofopendata.od4d.net/ chapters/stakeholders/multilateral-orgs.html

Hawkins, A. J. (2019, June 24). Alphabet's Sidewalk Labs unveils its high-tech 'city-within-a-city' plan for Toronto. The Verge. https://www.theverge. com/2019/6/24/18715486/alphabet-sidewalk- labs-toronto-high-tech-city-within-a-city-plan

Hunt, E. (2019, May 14). City with a female face: How modern Vienna was shaped by women. The Guardian. https://www.theguardian.com/ cities/2019/may/14/city-with-a-female-face- how-modern-vienna-was-shaped-by-women

Huynh, A., & Malli, N. (2018, June). Levelling Up: The quest for digital literacy. Brookfield Institute for Innovation + Entrepreneurship. https:// brookfieldinstitute.ca/levelling-up

Import.io. (2019, October 1). Data Analysis: What, How, and Why to Do Data Analysis for Your Organization. https://www.import.io/post/ business-data-analysis-what-how-why/

Inayatullah, S. (2008). Six pillars: Futures thinking for transforming. Foresight, 10(1), 4–21. https://doi.org/10.1108/14636680810855991

Jones, P. (2014). Systemic Design Principles for Complex Social Systems. In G. S. Metcalf (Ed.), Social Systems and Design (pp. 91–128). Springer Japan. https://doi.org/10.1007/978-4-431-54478-4_4

Kolko, J. (2010). Sensemaking and Framing: A Theoretical Reflection on Perspective in Design Synthesis. 9.

LaFrance, A. (2020, December 15). Facebook Is a Doomsday Machine. The Atlantic. https://www.theatlantic.com/technology/archive/2020/12/facebook-doomsday-machine/617384/

Lämmerhirt, D., & Brandusescu, A. (2019). Issues in Open Data—Measurement. In The State of Open Data: Histories and Horizons. African Minds and the International Development Research Centre (IDRC). https://www.stateofopendata.od4d.net/chapters/issues/measurement.html

Leyland, C. (2019, June 6). "Surveillance capitalism": Critic urges Toronto to abandon smart city project. The Guardian. http://www.theguardian.com/cities/2019/jun/06/toronto-smart-city-google-project-privacy-concerns

Ling, J. (2021, April 7). Canada's public health data meltdown. Macleans. https://www.macleans.ca/news/canada/canadas-public-health-data-meltdown/

MacArthur, H. V. (2020, August 27). Data And Diversity: How Numbers Could Ensure There's A Genuine Change For The Better. Forbes. https://www.forbes.com/sites/hvmacarthur/2020/08/27/data-and-diversity-how-numbers-could-ensure-theres-a-genuine-change-for-the-better/

Made x Made. (n.d.). Production [Image]. Retrieved September 3, 2021, from https://thenounproject.com

Mazzucato, M. (2015). The entrepreneurial state: Debunking public vs. private sector myths. PublicAffairs.

Meadows, D. H. (2008). Thinking in systems: A primer (D. Wright, Ed.). Chelsea Green Pub.

Mendelow, A. (1991). Stakeholder Mapping. Proceedings of the 2nd International Conference on Information Systems.

Mulligan, K., Rayner, J., & Nnorom, O. (2020, April 30). Race-based health data urgently needed during the coronavirus pandemic. The Conversation. http://theconversation.com/race-based-health-data-urgently-needed-during-the-coronavirus-pandemic-136822

New Zealand Government. (2019). Wind Tunnelling (also known as policy stress-testing). Department of the Prime Minister and Cabinet. https://dpmc.govt.nz/our-programmes/policy-project/policy-methods-toolbox/futures-thinking/wind-tunnelling

OECD. (n.d.). What is Foresight? Retrieved July 31, 2021, from https://www.oecd.org/strategic-foresight/whatisforesight/

OECD. (2020a). OECD Open, Useful and Re-
usable data (OURdata) Index: 2019. https://
www.oecd.org/gov/digital-government/
ourdata-index-policy-paper-2020.pdf

OECD. (2020b). Open Government Data. https://
www.oecd.org/gov/digital-government/
open-government-data.htm

OECD. (2021, May 10). The territorial impact of
COVID-19: Managing the crisis and recovery
across levels of government. https://www.oecd.
org/coronavirus/policy-responses/the-territorial-
impact-of-covid-19-managing-the-crisis-and-
recovery-across-levels-of-government-a2c6abaf/

OECD, & GovLab. (2021, March). Open data in action:
Initiatives during the initial stage of the COVID-19
pandemic - OECD. https://www.oecd.org/gov/
digital-government/use-of-open-government-
data-to-address-covid19-outbreak.htm

Open Government Partnership Steering Committee.
(2015). Subnational Governments and the Open
Government Partnership: Issues and Options
Paper. Open Government Partnership. https://
www.opengovpartnership.org/wp-content/
uploads/2019/10/Subnational-Governments-
and-the-Open-Government-Partnership_0.pdf

Open Knowledge Foundation. (n.d.). What is Open
Data? Open Data Handbook. Retrieved August
2, 2021, from http://opendatahandbook.
org/guide/en/what-is-open-data/

Opher, A., Chou, A., & Onda, A. (n.d.). The Rise of the
Data Economy: Driving Value through Internet
of Things Data Monetization. IBM, 16.

Osterwalder, A., & Pigneur, Y. (2010). Business model
generation: A handbook for visionaries, game
changers, and challengers (T. Clark, Ed.). Wiley.

Overture Creations. (2019). A Trash Panda in
his natural habitat. [Photograph]. https://
unsplash.com/photos/mOXLzrzBorg

Panetta, A., & Rocha, R. (2020, April 4). Is Canada bad
at sharing public data? COVID-19 rekindles an
old debate. CBC News. https://www.cbc.ca/
news/politics/canada-data-sharing-1.5521574

Perini, F., & Jarvis, M. (2019). Open Data Stakeholders—
Donors and Investors. In The State of Open
Data: Histories and Horizons. African Minds and
the International Development Research Centre
(IDRC). https://www.stateofopendata.od4d.net/
chapters/stakeholders/donors-investors.html

Petzka, P. (n.d.). Interview [Image]. Retrieved
September 3, 2021, from https://thenounproject.
com/search/?q=interviews&i=2554565

Posey, B. (2021, March). What are IoT Devices? IoT
Agenda. https://internetofthingsagenda.
techtarget.com/definition/IoT-device

ProSymbols. (n.d.). Shopping Center [Image]. Retrieved
September 3, 2021, from https://thenounproject.
com/term/shopping-center/2260440/

Rainie, S. C., Kukutai, T., Walter, M., Figueroa-Rodriguez, O. L., Walker, J., & Axelsson, P. (2019). Issues in Open Data—Indigenous Data Sovereignty. In The State of Open Data: Histories and Horizons. African Minds and the International Development Research Centre (IDRC). https://www.stateofopendata. od4d.net/chapters/issues/indigenous-data.html

Redman, T. C. (2015, July 16). Dispel Your Team's Fear of Data. Harvard Business Review. https://hbr. org/2015/07/dispel-your-teams-fear-of-data

Richardson, J. V. (2016, March 22). STEPE—Social, Technical, Economic, Political and Ecological Factor Model. UCLA. https://pages.gseis. ucla.edu/faculty/richardson/STEPE.htm

Rifai. (n.d.). Magnifying Glass [Image]. Retrieved September 3, 2021, from https://thenounproject. com/search/?q=magnifying+glass&i=4205553

Rittel, H. W. J., & Webber, M. M. (1973). Dilemmas in a general theory of planning. Policy Sciences, 4(2), 155–169. https://doi.org/10.1007/BF01405730

Roberts, B., & Barnes, D. (2020, April 17). Why people aren't taking advantage of government data [Podcast]. https://open.spotify.com/show/

Roberts, E. J. (2014). Exploratory Scenario Planning: Lessons Learned in the Field. 22.

Robertson, G. (2021, June 17). Canada's data gaps hampered COVID-19 pandemic response, hurting vaccination tracking: Report. The Globe and Mail. https://www.theglobeandmail.com/ canada/article-canadas-data-gaps-hampered- pandemic-response-hurting-vaccination/

Ryan, A. J., & Hamilton, B. A. (2012). Thinking in systems.

Saldaña, J. (2013). The coding manual for qualitative researchers (2nd ed). SAGE.

Sanders, E. B.-N., & Stappers, P. J. (2012). Convivial design toolbox: Generative research for the front end of design. BIS.

Sanders, L. (2008, November 1). An Evolving Map of Design Practice and Design Research. Dubberly Design Office. http://www.dubberly.com/articles/an-evolving- map-of-design-practice-and-design-research.html

Scammell, R. (2021, June 1). Getting the green light: Big Tech's smart city power grab. Verdict. https://magazine.verdict.co.uk/verdict_ magazine_may21/big_tech_smart_cities

Schlesinger, M. (2020, November 30). A Growing Digital Economy Means More Cybersecurity Challenges. Forbes. https://www.forbes.com/sites/ forbestechcouncil/2020/11/30/a-growing-digital- economy-means-more-cybersecurity-challenges/

Schott, B. (2020, October 30). Covid-19 Has Made Us All Dashboard Junkies. Bloomberg. https://www.bloomberg.com/opinion/ articles/2020-10-30/coronavirus-has-turned- us-into-digital-dashboard-junkies

Shaw, J. (2019). Designing with intentional intersectionality. Design & Content. https://content.design/2019/08/designing-with-intentional-intersectionality

Siipkan Creative. (n.d.). Reading [Image]. Retrieved September 3, 2021, from https://thenounproject.com/search/?q=reading&i=3503879

Simon, H. A. (1995). Problem Forming, Problem Framing, Problem Solving in Design. In Design and systems: General applications of methodology (Vol. 3, pp. 245–257).

Starting an Open Data Initiative. (2019). The World Bank. http://opendatatoolkit.worldbank.org/en/starting.html

The 5 stages of Data LifeCycle Management—Data Integrity. (2019, March 12). Dataworks. https://www.dataworks.ie/5-stages-in-the-data-management-lifecycle-process/

The Canadian Press. (2021, May 12). Cyberattacks on Canadian businesses up since remote work increased: Report—National. Global News. https://globalnews.ca/news/7854432/cyberattacks-canada-business-remote-work/

The Futures School. (2015). What Is Strategic Foresight? Kedge. https://thefuturesschool.com/2015/01/what-is-strategic-foresight/

The Icon Z. (n.d.). Law [Image]. Retrieved September 3, 2021, from https://thenounproject.com/term/law/3325339/

Tisne, M. (2021, May 25). Collective data rights can stop big tech from obliterating privacy. MIT Technology Review. https://www.technologyreview.com/2021/05/25/1025297/collective-data-rights-big-tech-privacy/

Townsend. (2021, February 14). How far right uses video games and tech to lure and radicalise teenage recruits. The Guardian. http://www.theguardian.com/world/2021/feb/14/how-far-right-uses-video-games-tech-lure-radicalise-teenage-recruits-white-supremacists

Tufte, E. R. (2001). The visual display of quantitative information (2nd ed., 8th print). Graphics Press.

Ubaldi, B. (2013). Open Government Data: Towards Empirical Analysis of Open Government Data Initiatives (OECD Working Papers on Public Governance No. 22; OECD Working Papers on Public Governance, Vol. 22). https://doi.org/10.1787/5k46bj4f03s7-en

Ulrich, W. (2000). Reflective Practice in the Civil Society: The contribution of critically systemic thinking. Reflective Practice, 1(2), 247–268. https://doi.org/10.1080/713693151

United Nations. (n.d.). Ensuring the protection of human rights in the digital era. Retrieved July 31, 2021, from https://www.un.org/techenvoy/content/digital-human-rights

Van Alstyne, G., & Logan, R. K. (2007). Designing for Emergence and Innovation: Redesigning Design. Artifact, 1(2), 120–129. https://doi.org/10.1080/17493460601110525

van Amstel, F. (2021, April 7). Designing for Liberation [Koln International School of Design]. Köln International School of Design. https://kisd. de/termine/designing-for-liberation/

Verhulst, S., Young, A., Zahuranec, A. J., Aaronson, S. A., Calederon, A., & Gee, M. (2020, October). The Emergence of a Third Wave of Open Data. The Govlab Blog. https://blog.thegovlab. org/post/the-third-wave-of-open-data

Wakefield, J. (2019, May 17). The Google city that has angered Toronto. BBC News. https://www. bbc.com/news/technology-47815344

Warner, J. (2020, June 12). What is an economic recovery and what are the types? IG. https://www.ig.com/ en/trading-strategies/what-is-an-economic- recovery-and-what-are-the-types-200612

What is Augmented Reality? (n.d.). The Interaction Design Foundation. Retrieved August 19, 2021, from https://www.interaction-design. org/literature/topics/augmented-reality

What is geospatial data? (2021). IBM. https:// www.ibm.com/topics/geospatial-data

Woetzel, J., Remes, J., Boland, B., Lv, K., Sinha, S., Strube, G., Means, J., Law, J., Cadena, A., & von der Tann, V. (2018, June 5). Smart city technology for a more liveable future. McKinsey Global Institute. https://www.mckinsey.com/business- functions/operations/our-insights/smart-cities- digital-solutions-for-a-more-livable-future

World Health Organization. (2021). Infodemic. https://www. who.int/westernpacific/health-topics/infodemic

Yankova, M. (2016, May 12). Journalism in the Age of Open Data. Ontotext. https://www.ontotext. com/blog/journalism-in-the-age-of-open-data/

Young, A. (2021, June 7). Understanding "The Five Whys": How To Successfully Integrate This Tool Into Your Business. Forbes. https://www.forbes.com/sites/ theyec/2021/06/07/understanding-the-five-whys-how- to-successfully-integrate-this-tool-into-your-business/

Zolkin, S. (2017). Work on notebook [Photograph]. https://unsplash.com/photos/_UeY8aTI6d0

Appendix

Appendix A: Interview participants

Thank you to all of the interview participants who participated in this research. The interviews played an instrumental role in the research process. The following interview participants gave permission to be identified in this document. This research was approved by the OCAD University Research Ethics Board (approval number: 2021-01).

- **Derek Alton**, President, Canadian Open Data Society
- **Mike Branch,** Vice President, Data & Analytics, Geotab
- **Darrell Bridge,** Sr. Data Analytics Strategist I Open Data Lead, City of Ottawa
- **Rene Cravioto,** Program Manager - Enterprise Data & Analytics, City of Vancouver
- **Matt Eason,** Senior Data Analytics Strategist, City of Ottawa
- **David Eaves,** Lecturer of Public Policy, Harvard University - Kennedy School of Government
- **Christine Hagyard,** Senior Manager, Ontario Government, Treasury Board Secretariat, Ontario Digital Service
- **Alan Harnum,** Senior Inclusive Developer, OCAD University - Inclusive Design Research Centre
- **Jaron Heard,** Creative Director, Civic Software Foundation
- **Leslie Kern,** Associate Professor, Mount Allison University
- **Jury Konga,** Executive Director, GO Open Data Association
- **Jeff Lamb,** Manager, Partnerships and Special Projects, Regional Municipality of York
- **Tracey P. Lauriault,** Associate Professor, Critical Media and Big Data, School of Journalism and Communication, Carleton University
- **Alex Lougheed,** Management Consultant, City of Toronto, Technology Services Division
- **Chris Makris,** Sr. Associate, Smart Cities at MaRS Solutions Lab
- **Skaidra Puodziunas,** Co-organizer, Civic Tech Toronto
- **Carlo Ratti,** Founding Partner, CRA-Carlo Ratti Associati
- **Lauren Reid,** President, The Privacy Pro
- **Rebecca Rosen,** Data Scientist, Vibrant Emotional Health
- **Monica Swamiraj,** Director of Data, ThinkData Works Inc.
- **Stefaan Verhulst,** Co-Founder, The GovLab (NYU)
- **Peeter Wesik,** Chair, Wesgroup Properties
- **Bianca Wylie,** Co-Founder, Tech Reset Canada

Appendix B: Interview trends

The interview trends referenced throughout this document are summarized in the following sections. The first section outlines the interview trends used to understand the current state of the system. The second section includes the interview trends that supported the development of the emerging potentialities. The third section demonstrates what an ideal future looks like for participants. The future interview trends were used to develop the alternative future metaphors.

Interview trends about the current state of the system

- Municipal capacity and resources constraints limit the growth of OGD initiatives
- Building the public's data literacy capacity is an area for improvement
- One of the risks of OGD is data users publishing their own insights without substantiation and spreading mis-/dis-information
- The growth of the OGD programs ebbs and flows based on political decisions and leadership
- The COVID-19 pandemic increased the public consciousness of OGD
- There are different interpretations of OGD requirements amongst levels of Government and jurisdictions
- Re-evaluating the OGD pipeline to encourage external secondary use is an area for improvement
- The systems governing Canada's cities are out-of-date and do not reflect the way we live in cities today
- The value or ROI that OGD brings to the data ecosystem is unclear
- The growth of Municipal OGD programs is driven by internal data stewards advocating for more openness
- The focus is how to improve the data itself, not the value it could create for society
- The bureaucracy as a whole is a roadblock to the growth of OGD programs
- The term 'open' has caused confusion
- There is an opportunity for cities to partner with the local development community to foster open data driven growth in Municipalities
- Government resistance to collaboration with other Government departments and agencies, the private sector and citizens stems from conflicting mindsets and perceptions of value
- OGD is not reviewed by subject matter experts before publishing
- OGD has long lead times from collection to publication
- The fundamental infrastructure of OGD is outdated and is a barrier for user engagement
- OGD accelerates inequality
- The Government publishes data because it can be published, not because of its potential impact
- More research is required to understand the data sharing system as a whole
- Government privacy analyses are comprehensive. It is easier to purchase private sector de-anonymized data than re-identify Government datasets
- The data sharing system is missing a governance framework to manage the sharing of data across borders
- Cities are constantly evolving and it is difficult represent continuous change in datasets
- There is growing public distrust of open data sources including OGD
- Data has become an economic driver for the private sector

Interview trends about how the data sharing system is changing

- Privacy is a growing concern of general interest
- The open data industry is changing to focus on purposeful data that solves community problems
- There is growing concern of the manipulation of personal data by the private sector
- There is uncertainty how privacy regulations can govern data collected by new technologies
- There is growing demand for OGD visualizations and dashboards
- More citizens want to be in control of their personal data
- More analysis tools are being developed using machine learning for processing data
- There is a growing demand for sensors in cities
- There is a growing number of large complex data systems
- The proliferation of IoT devices is changing Government services

Interview trends about the ideal future for the participants

- Increased collaboration with the community in Government decision making
- OGD initiatives driven by community needs
- More data literacy initiatives
- OGD to include more context about the lineage of the data and systems it originated from
- Real-time data that adapts urban services to citizen needs
- Stakeholder participation to understand the system as a whole
- Interoperable OGD portals
- A strategy to define the city's problems before implementing new technologies
- Sector wide legislation for the entire data sharing system
- More openness in the Government's decision making processes rather than publishing more data about decisions that have been made
- Immersive data experiences using visual and tactile formats
- Personalized data experiences
- More nuanced conversations about what data should be published and why
- More OGD to be used as a tool for urban stakeholders to imagine better cities

Appendix C: Iterative Process of Inquiry

The application of Gharajedaghi's (2011) Iterative Process of Inquiry is shown below. Gharajedaghi argues that to understand the whole of the system, we first must understand the function, structure, process and context (2011). Five system levels are identified: OGD pipeline suppliers, urban open data ecosystem, data policy and information governance, corporate digital economy, and the lives of city residents. The information is drawn from the literature review and supported by interview trends.

Legend:
- **Function:** What outcomes/results does the system produce?
- **Structure:** What are the system's components?
- **Process:** What activities does the system undertake to reach its outcomes?
- **Context:** What is the situational environment of the system?

(Gharajedaghi, 2011)

Micro: OGD pipeline suppliers

1. Function

This system level processes and aggregates existing Government data for new uses. The purpose is to advance secondary analyses and data informed decision making in cities. Internally, this system level aims to foster collaboration between Government departments and agencies. Externally, the objective is to develop Government transparency and accountability with the public through the sharing of data and information as a public good.

2. Structure

Who:
Internal Government actors:
- Political leaders who set research agendas

- Public servants and external contracted workers (e.g. researchers, nonprofits, crowdsourcing stewards) responsible for data collection
- Government data processing specialists and contracted external data processing agencies
- Public servants who evaluate the data's fitness for publishing (e.g. legal, privacy)
- OGD leadership responsible for aggregating data across departments to be made Open by Default
- Internal data stewards who advocate for openness
- Public servants who leverage OGD from other departments and agencies in policymaking

External societal actors and actants:
- External contracted workers (e.g. researchers, nonprofits, crowdsourcing stewards) responsible for data collection
- Contracted external data processing agencies
- External open data informants who participate in public consultations
- Data users who engage with OGD portals
- City residents and local biomes actants who provide their data to Governments as a part of collection efforts

What:
- Data and information produced by Government departments, agencies and Crown Corporations made Open by Default
- User Access to Information Requests for specific data, information and knowledge to be published

Where:
- Municipal OGD portals hosted by Government websites
- Other OGD portals containing data related to urban communities (e.g. Federal, Provincial, Territorial, Crown Corporations, First Nations Information Governance Center)

3. Process

- Scoping: Research agendas align with political priorities and allocated funding.
- Collection: Government departments gathering data for specific projects or mandates. Collection methodology is decided based on project scope.
- Processing: Minimum viable analysis of the data. Additional processing is often required to meet departmental publishing requirements.
- Pre-publishing evaluations: Internal assessments to determine if data and information meets publishing requirements.
- Sharing: Uploading approved data and information to OGD portals.
- Engagement: Stakeholder consultations to determine community needs and responding to Access to Information requests.
- Maintenance: The development of standards to maintain individual OGD portals.
- Assessments: Periodic evaluations of successes and failures.

4. Context

Regulatory:
- Subnational OGD providers can set their own portal standards, but they must adhere to Federal Open Government policy frameworks.
- Government process requirements slow the speed to publish. Often, stakeholders will only see the data they contributed to once it is no longer useful to them.

Economic:
- The OGD pipeline co-exists with several other Government functions. The lack of incentives to use the data and unclear ROI is leading to low funding. As a result, governance efforts are typically short-term solutions rather than long-term strategic changes.
- Governments consider the broader economic impact of the data being published. Corporations do not want OGD about private sector activity in cities because it could crowd out existing markets.

Environmental:
- The success of OGD thus far has been driven by the sharing of maps and geospatial data. Geospatial/satellite data continues to be a leader in the OGD space providing data used for GPS and mapping services (e.g. Google Maps).
- City residents want data and information about the health of the ecosystems that surround them and Governments are the primary provider.

Values:
- Some public servants want Governments to be as open as possible while others want Government data and information to be withheld due to fears of lack of control, scrutinization and mis-use. Conflicting mindsets continue to be a roadblock to growth.
- City residents are spending more time in virtual spaces and turning to new internet voices for information. The spreading of mis-/ dis-information is leading to diminishing trust in Government data sources.
- OGD does not have a brand strategy. Public servants consider publishing data and information on Government websites enough to engage users.
- Misappropriating data has major implications. If there are uncertainties in respect to privacy, it is better that the data is withheld from the public.

Technological:
- Cities often have multiple OGD portals that are not interoperable. Data and information are not shared amongst OGD portals.
- OGD portals are operating on legacy systems. OGD does not have a centralized archival system to store data diminishing the ability for long term impact.

Meso: Urban open data ecosystem

1. Function

The Urban Open Data Ecosystem aims to foster socio-economic development in cities through the sharing of data and information. This system level encourages sector-wide collaboration in support of community needs. The purpose is to gather disparate data sources and share user friendly outputs. This level works to grow the the public's knowledge capacity.

2. Structure

Who:
- Investors and donors who fund open data initiatives
- System actors such as Governments, corporations, non-profits, academic institutions, and multilateral organizations who publish open data portals
- Open science administrators overseeing the development of scientific research sharing
- Researchers looking to advance the open data ecosystem through new theories and practices
- Data intermediaries responsible for processing large volumes of heterogeneous data to produce specific outputs
- Civic tech networks that create open data interfaces
- Data collaboratives offering sector-wide open data platforms
- Open data stewards and activists looking to advance openness as a part of social justice movements
- City residents and local biome actants who supply their data to data collectors

What:
- Data collection technologies including Apps, IoT devices, and smart city infrastructure (e.g. sensors)
- Data processing technologies (e.g. machine learning)
- Data and information produced by several sources and stakeholders

Where:
- Open data portals

3. Process

- Financing: Securing ample resources to maintain open data initiatives such as angel investment, venture capital, private sector, non-profits.
- Collection: The process of gathering data and information from various sources.
- Processing: Analyzing data and information for purposeful outputs.
- Sharing: Sharing data on open data portals or with specific system actors.
- Portal Maintenance: Managing portals based on organization mandates.
- Learning: Developing new methods and strategies to expand open data ecosystems and collaborate with other cities.

4. Context

Regulatory:
- Open data providers must act in accordance with Federal privacy and data rights legislation.
- Open data providers must acknowledge the sources of the data collected and aggregated as a part of licensing agreements.

Economic:
- The open data sector co-exists with other open source markets such as open-source software and education. The open data system benefits from openness being a central part of the cultural values of other sectors.
- Big tech companies' misappropriation of personal data has increased the demand for open data systems and personal data autonomy.

Environmental:

* An immense amount of energy is required to maintain this system.
* Open data discussions are often grouped together with smart cities discussions. Associations with smart cities are instilling fear in the system, as a result lowering investment and growth opportunities.

Values:

* Digital platforms and productivity tools are being used to promote social justice movements.
* There is a growing awareness of the correlation between data inequality and social justice.
* Initiatives to close data gaps are integrated in efforts to combat systemic inequalities.
* Open data is identified as a critical component in achieving the United Nations Sustainable Development Goals.
* City residents are more willing to give their personal data to tech companies due to the fact that they are unaware of how their data is used.

Technological:

* The proliferation of IoT devices is creating new sources of data. However, it requires more complex systems to manage the volume of data collected. System actors must have the funding and resources to advance their data systems.
* AI is being used to manage the volume of data collected. There are growing concerns of the implications of biased algorithms in data processing.

Exo: Data policy and information governance

1. Function

This system level regulates the sharing of data and information in cities. This level aims to protect civil liberties and natural biomes impacted by information ecosystems. The intention is to maintain public trust in Governments as a regulatory body and a credible source of data and information. The purpose of this level is to maintain public sentiments that Canada's cities are safe and sensitive to residents' needs.

2. Structure

Who:

* System actors who oversee the development of federal Open Government and information sharing policies such as the Treasury Board of Canada Secretariat, Employment and Social Development Canada, Canada Digital Service, Open Government Working Group, Multi-Stakeholder Forum on Open Government.
* Global Open Government partners such as the International Open Data Charter and Open Government Partnership.
* External policy informants, consultants and reviewers.
* Departments, agencies and Crown Corporations at all levels of Government who develop their own OGD standards, policies and bylaws based on federal guidelines.

What:

* Political agendas and resource allocation plans
* Federal policies and initiatives such as the Directive on Open Government, National Action Plan on Open Government, Canada's Digital Charter and the third Biennial Plan to the Open Government Partnership

- Guidelines and toolkits for OGD portal implementation

Where:
- Federal Government online resources
- Federal Open Government portal (Open Canada)

3. Process

- Agenda setting: The process of setting political priorities.
- Scoping: Funding allocation for Open Government and information sharing initiatives.
- Problem finding, framing and solving: Designing policies in alignment with political agendas and funding allocation.
- Government engagement: Supporting Open Government policy users (e.g. the City of Vancouver) through the OGD portal implementation process.
- Procurement: Sourcing new technologies to develop the system level.
- Citizen engagement: Supporting citizens engaging with Open Canada resources.
- Assessments: Periodic evaluations of policy successes and failures.

4. Context

Regulatory:
- Policy making must follow Government protocols and approval processes.
- Initiatives are developed in accordance with existing regulation such as the Privacy Act, Access to Information Act, and Policy on Government Security.
- Government actors can only explore problems within their jurisdictional authority.

Economic:
- National allies are investing in open data to develop AI initiatives. Open data is a part of national collaboration efforts.

- The information ecosystem co-exists with other Government functions requiring funding. During economic downturns, efforts to stimulate the economy are prioritized.

Environmental:
- Land developers influence policy agendas, but have minimal involvement in Open Government.
- There is a growing corporate influence and gentrification in cities. The private sector is gaining more control of public spaces.

Values:
- Historically, openness has been driven by negative events such as misappropriations of data, policy failures and corruption. The public expects Government openness to ensure accountability.
- Citizens are susceptible to greater risk in protesting for new policies.
- Canadians do not trust politicians. Also, they do not distinguish between public servants and politicians.

Technological:
- Governments are investing in digitization and the integration of information communication technologies (ICT) in core services.

Exo: Corporate digital economy

1. Function

The corporate digital economy facilitates the distribution of resources through the internet. This system level measures the impact of digital technologies on production and consumption and the distribution of goods and services. This level sets the value of resources available and aims to maximize growth. The digital economy is a subset of the economy that is used to generate tax revenue and Government spending.

2. Structure

Who:
- System actors responsible for regulating digital economic activity such as Innovation, Science and Economic Development Canada
- Financial institutions and investors who fund corporations operating within the Digital Economy
- Corporations who supply goods and services
- Shareholders responsible for driving new strategies within existing corporations
- Workers who produce the goods and services sold within the Digital Economy
- Civil society actors and biome actants who contribute knowledge, understanding, wisdom and biophysical stocks to the production of new products and services
- Researchers working to produce new discoveries and innovations to advance the Digital Economy
- Customers (B2B, B2C, and B2G) who purchase goods and services on the internet

What:
- Physical and digital products and services
- Data as a commodity
- Technologies and infrastructure to support business operations
- Currencies traded amongst system actors

Where:
- The internet

3. Process

- Price setting: The valuation of products and services based on factors such as competitive valuation and stock market activity.
- Infrastructure production: The production and selling of infrastructure required for digital economic activity such as internet routers, tech support and computer software.
- Corporate processes: Transitioning business operations to online mediums

- Transactions: The selling of products and services through the internet.
- Skill development: Education for the civil society to maintain digital production and consumption.

4. Context

Regulatory:
- The digital economy must act in accordance with existing economic policies.
- Geopolitical uncertainties impact national trade regulations.
- New regulations are being developed to limit the sharing of personal data by big tech companies.

Economic:
- There are major financial barriers to enter the data processing market. The computing capacity is primarily held by big tech companies.
- New economic models that advocate for balancing human needs with ecological capacity are growing in importance.
- Digital black markets sell unregulated products and services on darknet and crypto-marketplaces.
- 'Leapfrog' technologies such as 5G networks are allowing increased international participation in the domestic workforce.

Environmental:
- There are growing concerns of the environmental impact of the digital economy.
- The data that enables the digital economy is collected in space, but is processed and stored on earth. The environmental impacts of space commercialization and the proliferation of satellite providers is unclear.

Values:
- Data is a commodity of the digital economy where the value is attained when it is withheld from others.
- Canadians fear that the automation of

products and services will lead to job loss.
- Canadians fear the use of AI for surveilling digital marketplaces.
- Canadians are realizing that their personal data is commoditized. They are purchasing products and services from SMEs, but still engaging with the digital economy.

Technological:
- Cyberattacks are an ongoing concern limiting the growth of the digital economy.
- New technologies such as blockchain are streamlining interactions within the eigital economy.

Macro: Lives of city residents

1. Function

City residents combine data and information with their life experiences to develop new perspectives. Individuals' perspectives are used to shape decisions, form social connections and understand the world. This system level guides the exploration of urban information and satisfies the human need to understand. The purpose of this level is to apply human understanding for personal and collective problem solving.

2. Structure

Who:
- Societal actors who leverage data and information to make decisions: the private sector, civic tech community, non-profits, researchers, activists, the media and the general public.
- Public servants who use OGD for urban policy making.
- Entrepreneurs looking to design new urban innovations.
- Data and information providers such as Governments, open data organizations and the private sector.

- Biome actants who provide data for new knowledge generation.

What:
- New ideas, perspectives, theories, products, and services in support of socio-economic development in cities

Where:
- Digital and physical information sharing platforms

3. Process

- Exploration: Learning new ideas, theories, and perspectives.
- Selection: The process of choosing what data, information and existing knowledge should be combined and analyzed. Individuals may place greater emphasis on specific sense-making models.
- Interpretation: Finding the meaning within data, information and knowledge then enhancing it with individual perspectives. This activity is influenced by existing norms and biases.
- Reframing: Looking at problems from new perspectives based on the interpretation process.
- Sharing: The process of sharing new knowledge with others.
- Product, service and policy development: Applying new knowledge to develop urban innovations.

4. Context

Regulatory:
- Individuals are not legally required to share the results of their data analyses. Individuals have the right to withhold the discovery of new problems of which the city is unaware.
- Canada does not have national data literacy and digital safety educational requirements. The OECD reports that Canada has a significant in-country digital literacy divide.

Economic:

- Intrinsic and extrinsic motivators influence how city residents interpret data and information.
- Organizations must have the absorptive capacity to implement ideas. Often, only large corporations have the resources to implement changes.
- City residents pay taxes to Governments with the intention that tax revenues will be allocated to initiatives that improve city life.

Environmental:

- Climate change is becoming increasingly difficult to ignore. The need for urban climate change strategies is evident.

Values:

- More Canadians are growing up with technical skills and are aware of the misuse of data. There is a shift towards more qualitative data and stakeholder involvement in decision making processes to minimize the negative externalities of data.
- Data journalism is prevalent within the media industry. If data providers do not process the data, media companies will process the data themselves.
- The abundance of information available has made it increasingly difficult to find factual information. People are seeking out reliable information sources.

Technological:

- Canadians are spending more time in digital spaces that spread mis-/dis-information.

Relevant sources:

Arctic Spatial Data Infrastructure. (n.d.). Retrieved August 22, 2021, from https://arctic-sdi.org/

Canada's Digital Charter in Action: A Plan by Canadians, for Canadians. (2019, October 23). Government of Canada; Innovation, Science and Economic Development Canada. https://www.ic.gc.ca/eic/site/062.nsf/eng/h_00109.html

Cassandra, P. M., Apache. (2015, March 9). Internet of Things: Where Does the Data Go? Wired. https://www.wired.com/insights/2015/03/internet-things-data-go/

Catalini, C. (2017). How blockchain technology will impact the digital economy. MIT Initiative on the Digital Economy, 2017.5, 4.

Daigle, T. (2020, January 2). "Completely unsustainable": How streaming and other data demands take a toll on the environment. CBC. https://www.cbc.ca/news/science/data-centres-energy-consumption-1.5391269

Davies, T., Walker, S. B., Rubinstein, M., & Perini, F. (2019). Open Data Stakeholders. In The State of Open Data: Histories and Horizons. African Minds and the International Development Research Centre (IDRC). https://www.stateofopendata.od4d.net/chapters/stakeholders/introduction.html

Dawes, S. S., Vidiasova, L., & Parkhimovich, O. (2016). Planning and designing open government data programs: An ecosystem approach. Government Information Quarterly, 33(1), 15–27. https://doi.org/10.1016/j.giq.2016.01.003

Developing a Data Reuse Strategy for Solving Public Problems. (n.d.). Open Data Policy Lab. Retrieved August 22, 2021, from https://opendatapolicylab.org//academy/data-reuse-strategy/syllabus-2021/

Directive on Open Government. (2014, October 8). Government of Canada. https://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=28108

Gurin, J., Manley, L., & Ariss, A. (2015, September 25). Sustainable Development Goals and Open Data. World Bank. https://blogs.worldbank.org/digital-development/sustainable-development-goals-and-open-data

Kassen, M. (2019). Open data politics. Springer Berlin Heidelberg.

Kern, L. (2019). Feminist city: A field guide. Between the Lines.

Martin, J. (2020, May 4). The darknet – a wild west for fake coronavirus "cures"? The reality is more complicated (and regulated). The Conversation. http://theconversation.com/the-darknet-a-wild-west-for-fake-coronavirus-cures-the-reality-is-more-complicated-and-regulated-137608

Multi-Stakeholder Forum on Open Government. (2021, July 27). Government of Canada. http://open.canada.ca/en/multi-stakeholder-forum-open-government

OECD (Ed.). (2018). Open government data report: Enhancing policy maturity for sustainable impact. OECD Publishing. https://doi.org/10.1787/9789264305847-en

Open Government. (2021, February 19). Government of Canada. http://open.canada.ca/en

Policy on Government Security. (2019, July 1). Government of Canada. https://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=16578

Principles. (n.d.). International Open Data Charter. Retrieved August 22, 2021, from https://opendatacharter.net/principles/

Privacy Act. (2021, August 12). Government of Canada. https://laws-lois.justice.gc.ca/eng/acts/P-21/page-1.html#h-397172

Raworth, K. (2017). What on Earth is the Doughnut?... Kate Raworth. https://www.kateraworth.com/doughnut/

Schrock, A. (2018). Civic tech: Making technology work for people.

Strickland, E. (2019, April 30). With "Leapfrog" Technologies, Africa Aims to Skip the Present and Go Straight to the Future. IEEE Spectrum. https://spectrum.ieee.org/with-leapfrog-technologies-africa-aims-to-skip-the-present-and-go-straight-to-the-future

Tattrie, J. (2019, October 24). Canada and the Digital Economy. The Canadian Encyclopedia. https://www.thecanadianencyclopedia.ca/en/article/digital-economy-in-canada

The First Nations Principles of OCAP®. (2021). The First Nations Information Governance Centre. https://fnigc.ca/ocap-training/

The global legal group. (2018). The international comparative legal guide to Data Protection 2018: A practical cross-border insight into data protection law (5th ed.).

Third Biennial Plan to the Open Government Partnership. (2019, August 20). The Government of Canada. http://open.canada.ca/en/content/third-biennial-plan-open-government-partnership

Walsh, B. (2013, August 14). The Surprisingly Large Energy Footprint of the Digital Economy [UPDATE]. Time. https://science.time.com/2013/08/14/power-drain-the-digital-cloud-is-using-more-energy-than-you-think/

Weinzierl, M., & Sarang, M. (2021, February 12). The Commercial Space Age Is Here. Harvard Business Review. https://hbr.org/2021/02/the-commercial-space-age-is-here

Appendix D: System archetypes

Appendix D outlines the causal loops used to distill the insufficiencies within the current state of the system. The causal loops were drawn from William Braun's (2002) *The System Archetypes*. The content applied to each archetype was deduced from the interview trends. The causal loops follow the same format. The '+' and '-' signs demonstrate when the following action respectively increases or decreases and the "II" symbol indicates when an action is delayed.

1. Limits to growth system archetype

The limits to growth system archetype (Braun, 2002) is used to demonstrate how mis-/dis-information is hindering the success of OGD. Data journalism has increased public awareness of OGD. The increase in public awareness has resulted in more visitors to Municipal OGD portals, which leads to more secondary data analyses. However, previous exposure to mis-/dis-information by trusted voices of authority often influences the way individuals make sense of the data. This leads individuals to share incorrect outputs. Outputs that criticize the Government diminish trust in OGD and as a result lower OGD portal engagement. Growing volumes of mis-/dis-information are often shared by the media contributing to more data journalism.
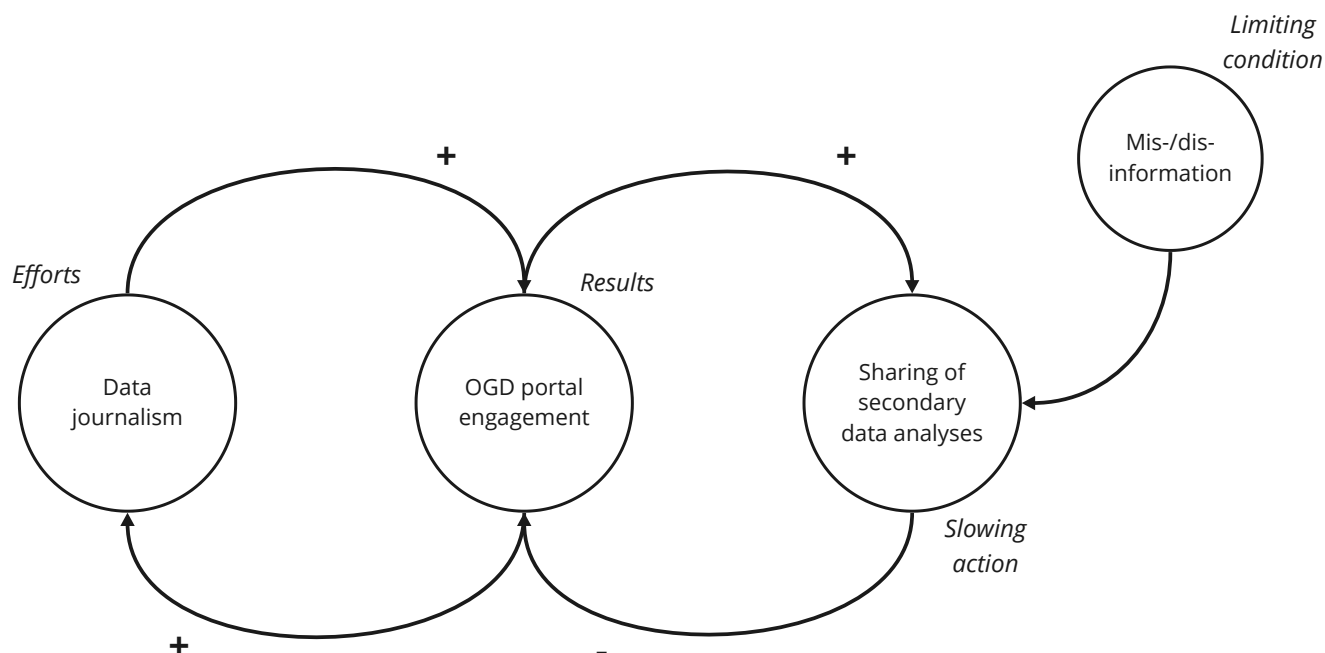
2. Shifting the burden system archetype

The shifting the burden system archetype (Braun, 2002) is used to demonstrate how the publishing of OGD is obstructing the implementation of skill development initiatives. OGD about cities is often published with the intention of promoting social innovation. Publishing the data is often seen as enough to drive new innovations and there is limited training on how to interact with the data. The Government funding allocated to publishing data is limiting the resources available for innovation process education. Increasing the learning capacity for the entire innovation process is necessary to develop the urban innovative capacity.
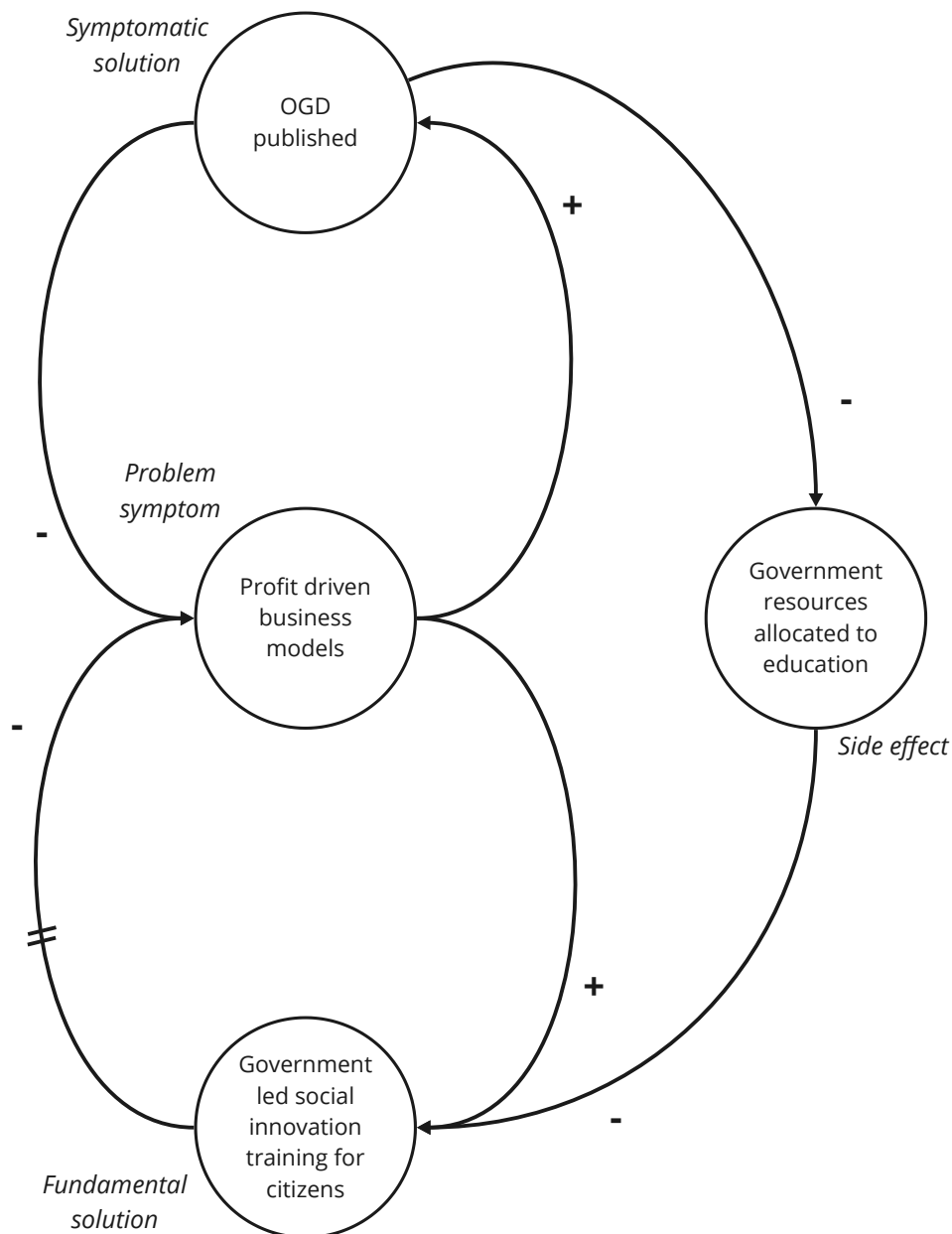
3. Attractiveness principle system archetype

The attractiveness principle system archetype (Braun, 2002) is used to describe how system conditions are limiting Governments' ability to enforce personal data privacy. Two limiting conditions are included in this causal loop: data brokerages and surveillance technologies. Since there are not enough resources to address both at the same time, these limiting conditions ultimately result in less control over the system and more re-identification of personal data. The resources allocated towards reducing data re-identification results in less Government data approved for publishing.
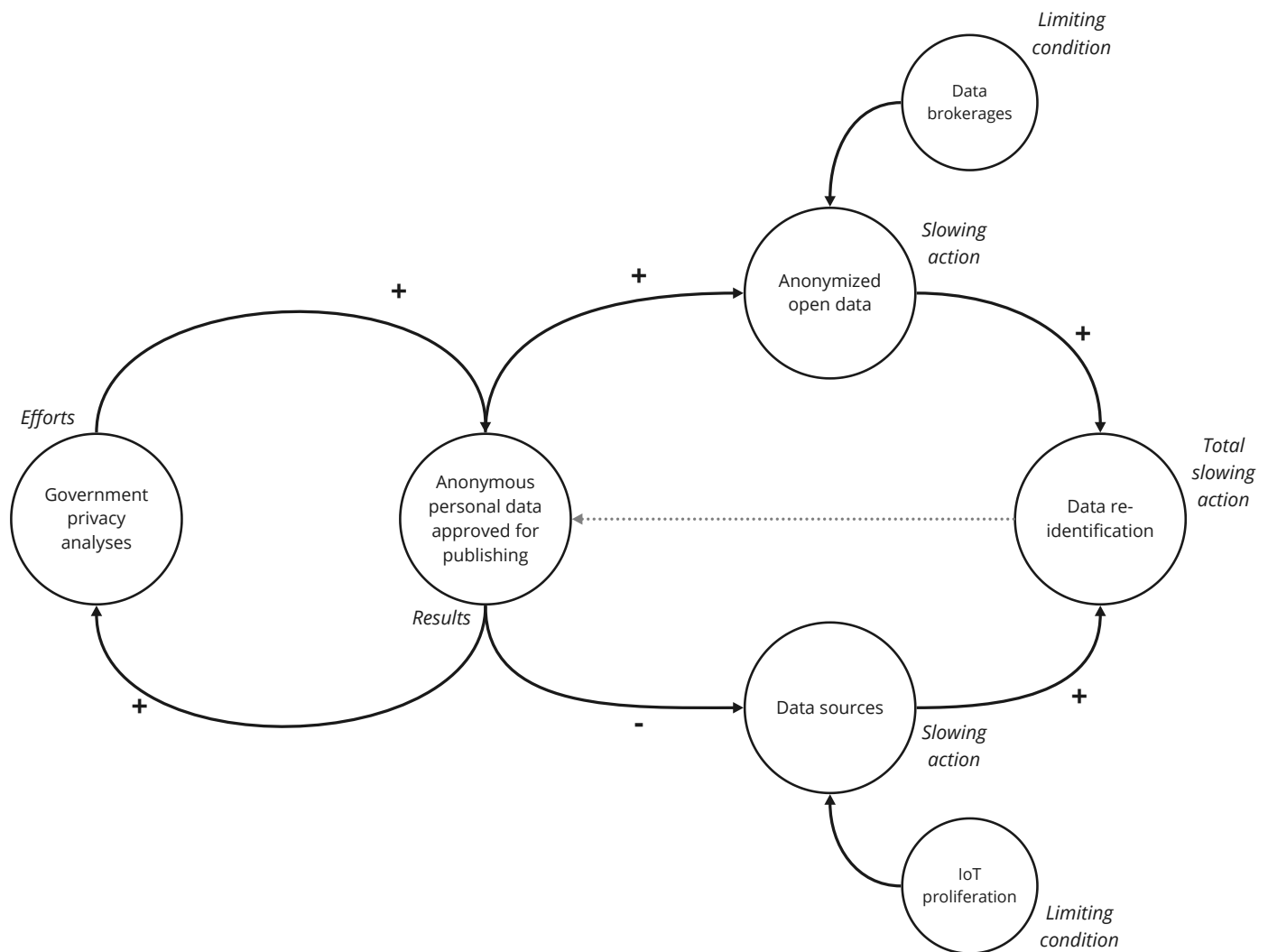
4. Success to the successful system archetype

The success to the successful system archetype (Braun, 2002) is used to demonstrate big tech companies' influence on OGD. The public is able to contribute to Government data collection decisions by attending consultations. However, we are seeing OGD that primarily benefits the private sector because Large Corporations have the resources to attend consultations and lobby for data. In contrast, open data community actors who may not be able to attend consultations are finding different ways and sources of data to support sustainable development. The success of the open data community coupled with the pressure from big tech companies to publish data has resulted in less resources allocated to the open data community.
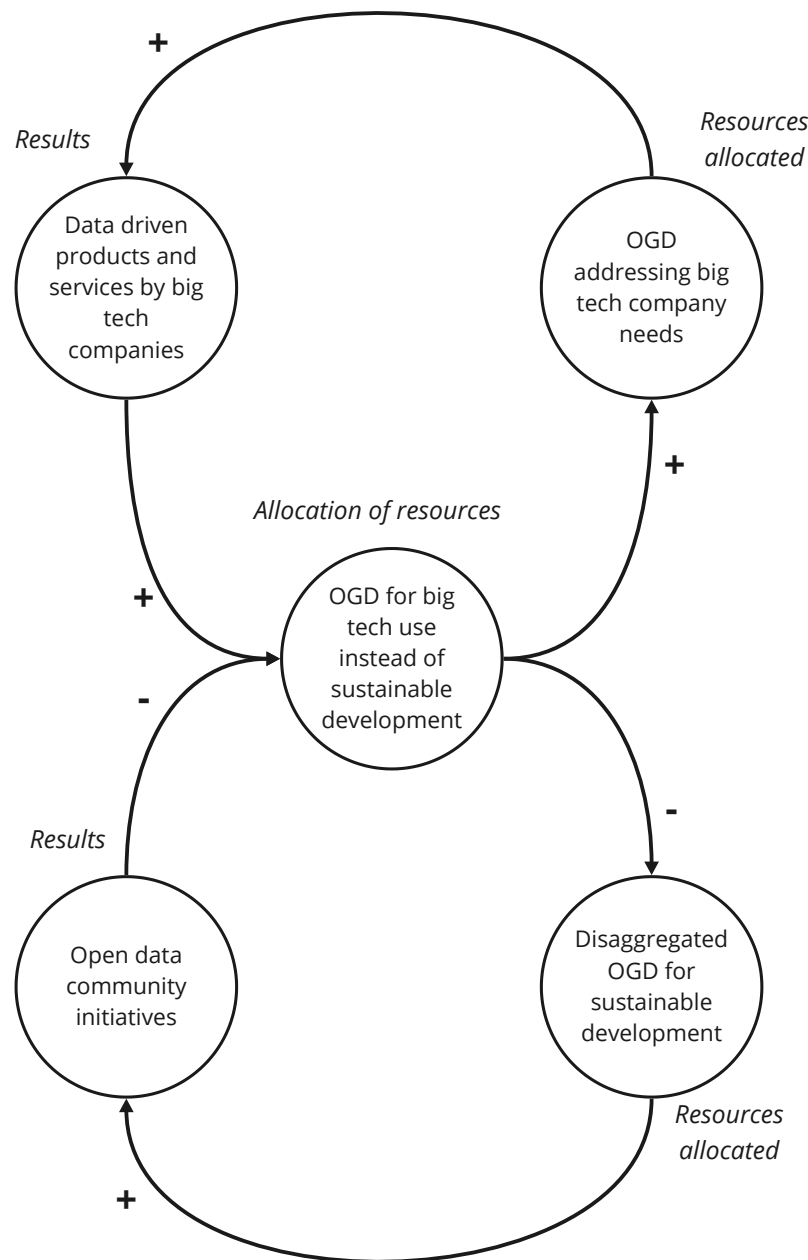
5. Fixes that fail system archetype

The fixes that fail system archetype (Braun, 2002) demonstrates how unintended consequences can exacerbate problems in the system. Open data ecosystems were developed to limit data hoarding. But, before data owners consent to sharing their data, they want to understand the value of it. This has led to more skepticism of open data and less willingness to share.