CODED ENGAGEMENT: DATA-DRIVEN PARTICIPATION IN THE SMART CITY

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Algorithm - A series of operations for carrying out a certain type of task, usually in a computational context.

Application (Apps/Application) – Computer programs designed to perform a group of integrated activities for the benefit of the user.

Application Programming Interface (API) – A set of access points, software libraries, protocols, and/or tools that allow for integrating different data, software, and hardware systems.

Artificial Intelligence (AI) – A broad field of computational sciences focused on programming machines to act with an apparent intelligence resembling those of human cognitive functions. There are varying definitions of AI that lead to a range of meanings in contemporary use, including fields of machine-learning, data mining, and statistics. See also: machine learning, data mining.

Big Data – A popular marketing phrase, with various definitions in industry and academic literature. It generally refers to the collection of data that had been impractical prior to the proliferation of computational resources. Often big data is discussed about the 4 V's: volume, variety, veracity, and velocity. In this way, big data refers both the collection and nature of data sets that are so large and complex they become difficult to capture, transfer, store, process and interpret with traditional data processing applications. See Also: VGI, User-generated content.

Business Intelligence (BI) – A form of data analysis narrowly focused on business performance and optimization.

Citizen or Civic Engagement – A process and practice that seeks to include residents in the decision-making around city building. This can be led by individuals or groups, by public or private organizations, or by the government. See Also: Public Participation, Citizen Centric

Citizen-centric – An approach to the delivery of public services based on solving the needs and challenges of the people they serve. It is used to increase public satisfaction, improve efficiency and reduce costs, often through a technologically focused lens. See also: Smart City, City-as-a-Service.

Citizen-focused – Focusing on priorities and solutions at the individual citizen level.

City-as-a-Service – Combines Infrastructure-as-a-Service (IaaS) and Software-as-a-Service (SaaS) technologies for use as a common, city-wide platform for the deployment of integrated smart city technologies. A common reference in this context is an "operating system" for the city.

Community of Interest – A social group sharing interests on various topic matters relevant to their daily lives.

Community of Practice – Individuals who either collectively or independently engage in similar activities.

Connectivity – The ability of individuals and devices to connect to communications networks, services, or each other.

Data Analysis – This discipline is the "little brother" of data science. Data analysis is focused more on answering questions about the present and the past. It uses less-complex-statistics and generally tries to identify patterns that can improve an organization.

Data Exploration – The part of the data science process where a scientist will ask basic questions that help in understanding the context of a data set. What is learned during the exploration phase will guide more in-depth analysis later. Further, it helps in situations where results may be surprising, thereby warranting further investigation.

Data Mining – Generally, the use of computers to analyze large data sets to look for patterns that let people make business decisions. While this may appear to be similar to data science, popular use of the term is much older, dating back at least to the 1990s. See also: data science

Data Science – Given the rapid expansion of the field, the definition of data science can be hard to nail down. Basically, it is the discipline of using data and various forms of advanced statistics to make predictions. Data science is also focused on creating understanding among potentially poor-quality and disparate data.

Data Set – A collection of data.

Data Visualization – The art of communicating meaningful data visually. This can involve infographics, traditional plots, or even full data dashboards.

Data-Driven – The use of data to support decisions, policies, and actions as evidence-based choice making.

Hyper-local data – Data originating or circulated within a very small geographical area, such as a street or apartment block.

Information and Communications Technology (ICT) - The integration of telecommunications, computers, and associated enterprise software, middleware, storage, and audio-visual systems that enable users to access, store, transmit, and manipulate information.

Infrastructure – Both the physical and virtual resources, facilities, and systems serving a city.

Internet-of-Things (IoT) – In a general context, the IoT is the provision of networked capability to electronic devices and everyday objects for an interrelated system of computing devices, sensor technologies, algorithms, and people. See also: Big Data, Citizen-as-Sensor

Interoperability – The capacity to integrate networks, computers, and systems for the sharing of resources and exchange of information. See also: Siloed Cities, Big Data, IoT, API

Machine Learning – The use of data-driven algorithms that perform better as they have more data to work with, "learning" (that is, refining their models) from this additional data. See also: algorithm, data mining, artificial intelligence

Model – The specification (mathematical or probabilistic) of the relationship that exists between different variables. Since "modelling" has a variety of meanings, the term "statistical modelling" is often used to more accurately describe the type of modelling undertaken by data scientists.

Open Data – Data that is freely available to all for use without copyright, patent or other restrictions.

Optimization –The process of achieving the best possible outcome relative to a defined set of success metrics.

Privacy – In the context of smart cities, privacy primarily focuses on the ability of an individual or group to control the types, amounts, and recipients of data about themselves.

Public Participation – A concept of democracy involving any process that directly engages the public in decision-making and gives full consideration to public input in making decisions. In this sense, participation is often seen as a process and not necessarily a single event. See also: Civic Engagement, Smart City, Citizen-Centric.

Real-time – When used in a computing context is the capacity of hardware and software systems to respond very rapidly to continuously streaming data feeds.

Sensors – An electronic component, module or subsystem used to detect events, triggers or changes in the surrounding environment.

Siloed cities – Cities that demonstrate poor integration across departments, between various responsibilities, amongst communication networks, and with other regional governments.

Smart city – A city that uses smart technologies and connected infrastructure to gather data, improve the provision of public services, reduce civic costs, increase the livability of citizens and boost sustainability.

Smart City – In a basic sense, the "smart" city uses information and communications technology (see: ICT) to enhance the livability of citizens and the workability, resilience, and sustainability of city operations. In practice, the operational definition of "smart city" is defined in reference to the objectives and agendas of those using the phrase. For example, IBM defines a smart city as "one that makes optimal use of all the interconnected information available today to better understand and control its operations and optimize the use of limited resources"; whereas Cisco defines smart cities as those with "scalable solutions that take advantage of information and communications technology (ICT) to increase efficiencies, reduce costs, and enhance quality of life."

Smart city application (Smart Solutions) – A type of smart-city technology or system that has a specific function: such as smart street lighting, smart bins or smart drains.

Social media – A catch-all term for a variety of Internet applications that allow users to create content and interact with each other.

User-Generated Content (UGC) – Content produced by individuals on various Web 2.0 platforms. See also: VGI, Big Data, IoT, Connectivity.

Volunteered Geographical Information (VGI) – A special case of UGC with geographic information. See also: UGC, Big Data, IoT.

Web 2.0 – A form of socially-connected Internet technologies and services that allow for greater connectivity between content, services, and people.

Adapted from: https://www.dataquest.io/blog/data-science-glossary/

ABSTRACT

This dissertation explores the concepts of *coded engagement* as they relate to the role of citizens' ability to participate in smart cities. Coded engagement is what we call the perspective of citizen-as-sensor in the smart city, as it meets the ubiquitous world of interconnected sensing-technologies and big data. Because of the perceived difficulties in harnessing public participation and the hyperbolic promises of smart city technologies, *coded engagement* stands as a developing mode of engagement between local governments and citizens. The primary method of realizing coded engagement is often through the harvesting of data from social media, cameras, or citizens themselves to fuel data-driven methods for smart cities to offer citizen-centric services.

The literature review presents public participation in the context of its role as a cornerstone of democracy and follows its evolution to a technologically enabled method for engaging with citizens. The discussion highlights how public engagement practices have followed increasing interests in identifying communities of interest and using technologically-driven methods to capture wider and more representative participants. However, as Web 2.0 technologies become more increasingly involved, so does the increased concern for the nature and quality of actors and data harnessed through these mediums.

A crowd-sensing system has been designed to "remove the black-box" of many proprietary algorithms designed to harvest public opinion from user-generated content. A novel methodological approach is provided that conflates multiple attributes from social media to identify communities of practice and interest within local geographic contexts. Through the use of spatially situated social networks, space-time analysis, and natural language processing, inferred links could be explored through a 3-D visualization platform in the pursuit of informed decision-making.

Two case studies are also provided on the City of Toronto. The first contextualizes corporate control on a Toronto Waterfront community as vast amounts of public resources were leveraged for a failed implementation of an *intelligent community* where citizens could provide real-time feedback to community leaders through crowd-platforms. The second case study provides a deeper context into the City of Toronto's pursuits to become a smart city leading the 21^{st} century. However, the mechanisms of governance and control of corporate interests have a grip on the future role of public participation in the smart city. Namely, participation converges through the private ownership of citizen-centric services that are fueled by collecting the passive contributions of the public.

RÉSUMÉ

Cette thèse explore les concepts de l'*engagement codé* en relation avec le rôle de la capacité des citoyens à participer aux villes intelligentes. L'*engagement codé* est défini comme la perspective du citoyen- capteur dans la ville intelligente, dans un monde où capteurs interconnectés et grandes données sont omniprésents. En raison des difficultés perçues dans l'exploitation de la participation publique et des promesses hyperboliques associées aux villes intelligentes, l'*engagement codé* est un mode d'engagement entre les gouvernements locaux et les citoyens en développement. Le principal mode d'engagement consiste souvent à recueillir des données à partir des médias sociaux, des caméras ou des citoyens eux-mêmes pour alimenter des méthodes axées sur les données afin que les villes intelligentes puissent offrir des services axés sur les citoyens.

L'analyse de la littérature présente la participation du public en tant que pierre angulaire de la démocratie et suit son évolution vers une méthode d'engagement des citoyens axée sur la technologie. La discussion met en lumière la façon dont les pratiques d'engagement du public ont suivi l'intérêt croissant pour l'identification des communautés cibles et l'utilisation de méthodes axées sur la technologie pour attirer des participants plus nombreux et plus représentatifs. Cependant, à mesure que le rôle des technologies du Web 2.0 grandit, la nature et la qualité des acteurs et des données exploitées par ces médias deviennent de plus en plus préoccupantes.

Un système de détection de foule a été conçu pour " supprimer la boîte noire " de nombreux algorithmes propriétaires conçus pour capter l'opinion publique à l'aide du contenu généré par les utilisateurs. Une nouvelle approche méthodologique est fournie combinant de multiples attributs des médias sociaux pour identifier les communautés de pratique et d'intérêt dans des contextes géographiques spécifiques. Grâce à l'utilisation de réseaux sociaux spatialement situés, à l'analyse

spatio-temporelle et au traitement du langage naturel, des liens inférés pourraient être explorés au moyen d'une plateforme de visualisation 3D dans le but de prendre des décisions éclairées.

Deux études de cas sont également fournies sur la ville de Toronto. La première met en contexte le contrôle exercé par l'entreprise sur une collectivité du secteur riverain de Toronto. Cette étude analyse l'implémentation défective d'une *collectivité intelligente,* où les citoyens pouvaient fournir une rétroaction en temps réel aux dirigeants communautaires au moyen de plates-formes virtuelles, financée par de vastes quantités de ressources publiques. La deuxième étude de cas fournit un contexte plus approfondi des efforts de la ville de Toronto pour devenir une ville intelligente avant-gardiste. Cependant, les mécanismes de gouvernance et de contrôle des intérêts des entreprises privées ont une emprise sur le rôle futur de la participation publique dans la ville intelligente. Il s'agit notamment de la propriété privée de services aux citoyens qui sont alimentés par la collecte des contributions passives du public.

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TBD.

So Long, and Thanks for All the Fish. – D. Adams

CONTRIBUTION OF AUTHORS

This thesis contains original scholarship focusing on the topic matters of smart cities and public participation within the discipline of geography. In each chapter, a distinct contribution of original knowledge is offered through four distinct manuscripts that have either been published, submitted for publication, or are in preparation for peer-reviewed journals. Matthew Tenney (primary author) has conducted all relevant fieldwork, collected all relevant data, performed all data analysis, developed all methodologies, and retain the role as the primary author of all chapters within this research.

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CHAPTER 1 - INTRODUCTION

1. Research Context

> The new industrial revolution, which is taking place now, consists primarily of replacing human judgment and discrimination at low levels by the discrimination of the machine. The machine appears now, not as a source of power, but as a source of control and a source of communication. We communicate with the machine, and the machine communicates with us. Machines communicate with one another. Energy and power are not the proper concepts to describe this new phenomenon. (Wiener 1989, p. 71) – Published initially in *Cybernetics*, 1948

Cities are becoming smarter through their use of complex machines, distributed sensors, and data-driven algorithms. However, there remains an incomplete understanding of what actually constitutes a smart city outside of the opposing imaginaries created by techno-solutionist visions or speculative dystopian-narratives. The term "smart city" usually refers to the effects of embedding advanced technologies and data collection techniques (e.g., via the Internet of Things-IoT) into urban infrastructures and environments. In this context, even the citizens themselves play the role of a connected device that feeds back information to government decision-makers (i.e., the citizen as sensor).

In this way, the smart city concept encapsulates ideas beyond that of just combing the economic innovation and the direct application of information communication technologies (Kondepudi and Kondepudi 2019). This is evident in cases where the data to drive city operations direct the kinds of services offered and keep a pulse on the public will are harvested through information gathered from the citizens themselves as they live in, or pass through, both the physical and digital space of a city (Costa *et al.* 2018, Witanto *et al.* 2018, Nummi 2019). It is data produced from these sensors, in addition to the recasting of citizens as sensors, that mark a more substantial sociological change in the interactions between people and urban environments. These changes include the repositioning of citizen engagement through digital services that are data-driven by the data collected about them through these ubiquitous sensors and the harvesting of big data to make sense of their lived geographies (Lai 2016, Pan *et al.* 2016, Yigitcanlar *et al.* 2018, Osman 2019). "Data-driven" describes the use of these large datasets to personalize, contextualize, and operationalize evidence-based decision-making to direct local governance.

In this perspective of the smart city, the citizen is viewed as a transactional unit inside city operations, providing input to the processes of algorithmic governance. The role of the citizens is defined by their data, which is positioned as a form of engagement with digital technologies and smart city projects. Kitchin (2014, p. 1) describes the phenomenon as "cities that, on the one hand, are increasingly composed of and monitored by pervasive and ubiquitous computing and, on the other, whose economy and governance is being driven by innovation, creativity and entrepreneurship, enacted by smart people." Increasingly, the smarter a city, the more citizen services are automated and integrated with technological solutions to assuage the inefficiencies of municipal operations. In this regard, smart cities may be viewed as material-hybrids, assembled through physical infrastructures, citizens, and social realities mediated through a multiplicity of hardware, software, and data (Batty 2001, p. 479).

The data revolution is often referred to as the fourth paradigm of science, where abduction from data, over-deduction or inference, were the primary methods of knowledge discovery (Hey *et al.* 2009). Elwood et al. (2013) summarize these three previous paradigms as 1) the empirical – focused on describing natural phenomena through direct observation, 2) the theoretical – focused on developing and testing models for the discovery of general laws, and 3) the computational –

focused on simulation through the use of synthetic datasets created for a specific purpose. With respect to the fourth paradigm, epistemologically, there is an inherent assumption that, due to the availability of real-world data as a result of behavioural-technological convergence, data provide enough information about the world to end the era of theory and need for laboratory datasets (Anderson 2008). Evangelicals of the no-theory models of science make the claim that theory-driven models are inadequate and inappropriate in the face of the opportunities afforded by the volume of big data that are by their nature detached from the very thing they are meant to study (Morozov 2013). Therefore, this data-driven science is viewed as an elevated perspective over the relationships of society (Miller and Goodchild 2015).

In relation to smart cities, the role of big data derives from the simple proposition that *most* big data are produced by the user, or the citizen, from the perspective of government administrations and would, therefore, act as a direct line to their desires. Kitchin (2013, p. 1) connects the smart city and user-generated content (UGC) of citizens by stating:

> […] cities are being instrumented with digital devices and infrastructure that produce 'big data.' Such data, smart city advocates argue it enables real-time analysis of city life, new modes of urban governance, and provides the raw material for envisioning and enacting more efficient, sustainable, competitive, productive, open and transparent cities. (Kitchin 2013, p. 1)

In a similar vein, Batty (2013, p. 274), argues that the use of big data in city operations and the planning process represents "a sea change in the kinds of data that we have about what happens where and when in cities." It is a scenario in which the increasing role of big data and data-driven analyses is "shifting the emphasis from longer-term strategic planning to short-term thinking about how cities function and can be managed." Here the urban planners and policymakers shift to decision-making to fit the agendas of corporate interests, hyperbolic rhetoric, and the aspirational promise of data-driven participation through coded engagement (Tenney and Sieber 2016). The control of data, technology, and engagement is of utmost concern when it comes to the governance models of smart cities. The belief that "vendors know best" and an endless desire for "development" prioritize *efficiency* over *effectiveness* in public services (Bel *et al.* 2013). These narratives are strongest amongst senior leadership in local governments, as a discourse set by corporate story-telling, and often combine the multifaceted efforts of engaging with public participation in the decision-making process. The case study and examples presented in Chapters 4 and 5 of the dissertation highlight this disconnect between policy and practice using empirical examples from the City of Toronto.

Thus, a big-data-driven smart city is one that promotes an understanding of the city as a complex system where: 1) both physical and social operations can be reduced to the calculation of variables that represent actualities of human existence and lived geographies in near real-time; 2) the system can then be optimized through these derived indicators (i.e., data) and a series of algorithmic tweaks; and 3) that will, in turn, inform city officials and policy formulation to serve its public better. It is a public that is increasingly making use of social technologies that create these volumes of user-generated content (e.g., social media) and lends support to the notion of increased connectivity between citizens and government operations, as well as promoting the accumulation of social capital by individuals and communities. Bertot and Choi (2013, p. 1) relate the combination of big data and smart city concepts to the operations of governance with a claim that: "Big Data can foster collaboration; create real-time solutions to challenges in agriculture, health, transportation, and more; and usher in a new era of policy- and decision-making." This data-driven policy formation entails a direct use of citizen-produced content to act as a means of civic engagement and constitute direct public participation in decision-making and planning processes. Automating these processes, according to Cardone et al. (2013, p. 1), represents "the power of collective although imprecise intelligence" that smart cities will employ to make policies and plans of the future. Such a vision suggests that future iterations of these concepts include a:

> […]visionary goal to automate the organization of spontaneous and impromptu collaborations of large groups of people participating in collective actions. Where people or their mobile devices act as both sensors that collect urban data and actuators that take actions in the city, possibly upon request. (Cardone *et al.* 2013, p. 1)

Algorithmic procedures on big data presume to act as corrective lenses for our ability to see the contours of the digital divide. Any remaining concerns seem to be negated by the promises of unparalleled insights furnished by the use of big data (Boyd and Crawford 2012).

One of the primary modes of automation is to utilize data-driven methods to "engage" with citizens, better understand their needs, and offer more streamlined services to them through various technological solutions. Through its popularity, social media data is posed to be of particular interest in the "smart city paradigm," with promises of being better able to engage citizens in the decision-making process. Further still, the observation of the behaviours, interactions, and other digital footprints of citizens are looked upon as a rich resource to refine municipal operations. For example, Bousquet (2018) argues that social media can be ethically used by public safety organizations for more responsive government services:

> Social media posts are full of data that, when made accessible to governments, can make interventions quicker, more effective, and more representative. From pictures of emergency conditions to posts about crimes in progress, users constantly

> inundate Facebook, Instagram, Twitter, and other platforms with posts that may contain rich and timely information about events relevant to public safety. Using social media mining that leverages advances in natural language processing and machine learning to pull useful data from text and images, cities can transform these social posts into data points ripe for analysis. (Bousquet 2018)

It is the data-driven revolution, resulting from this data deluge, that has given way to the positioning of citizen-as-sensor and enabled forms of coded engagement. In other words, coded engagement is the use of the citizen as sensor and the leveraging of data-driven methods to refine, redact, or measure the level of government services. In this context, I use the term coded engagement to refer to the utilization of data collected from the viewpoint of "citizen as sensor" to alter government operations and public resource access.

2. Overview of the Research Problem and Research Objectives

This research takes the position that the combination of software, data, and governance is a starting point to understanding the concept of coded engagement. The primary focus is on the role of participation by citizens inside the smart city. More specifically, the goal of this research is to understand where digital services are aimed at harvesting the behavioural and user-generated data from citizens in order to improve city operations and what the implications of this coding of participation entail. Thus, it focuses on exploring the use of data-driven methods to construct potentially large mineable and relevant stores of data that emulate passive public participation in decision-making processes within future smart cities. Furthermore, the institutional and societal processes leading to the adoption of smart initiatives, through corporate storytelling and political agendas, are critically evaluated with regard to how participatory democracy is transformed in such imaginaries. The goal is to evaluate how this form of passive participation might impact different levels of municipal operations because of the shifting role of participation within visions of a smart city. These efforts will help to fill the gaps in empirical research on participation through networked technologies, and critically evaluate their corresponding use in data-driven cities. The critical evaluation of the concepts, practices, and realities of coded engagement are framed within the applied and academic context but also framed to be representative of the issues applicable across specific geographic areas.

Several important issues emerge from the concepts related to coded engagement. This perspective of optimization and real-time feedback systems primarily positions the citizen as a resource to make government processes more efficient, rather than ensuring they are effective. For example, a system that is designed to be optimized for efficiency based on incoming data-feeds can only optimize itself based on the parameters being set (i.e., the values held by the designer, etc.) and what information or who is represented in the data being consumed. The quality of the data, the values embedded within the parameters of algorithms and end-goals, as well as knowing what you do not know are lost in the assumptions inherent to coded engagement. This dissertation seeks to explore these layered concepts and unquestioned assumptions of coded engagement as they manifest in use across different real-world examples.

As this dissertation seeks to demonstrate, what makes smart people—or smart citizens—in the data-driven city is the initial positioning of coding public participation so that the citizen becomes subsumed by the imaginaries of a smart city. These citizen-centric technologies and mediated services of governance in the smart city are those that open the door for traditional forms of participation in local government to be transformed into passively sensed data-driven decision-making (c.f., Tenney *et al.* 2019, Chapter 3). This juxtaposition of the citizen as not only being integrated within the political and physical aspects of smart cities, but also driving the technological solutions to urban issues, is what techno-solutionists frame as “solving the messiness of democracy through citizen-centric services” (c.f., Tenney and Sieber 2016, Chapter 4). The modern rhetoric of the smart city, therefore, produces a washing effect by the utilization of words such as *inclusion*, *innovation*, and *modernization* in references to democratic processes (c.f., Chapter 4). Since the majority of smart city developments arise from technocratic values and are “top-down,” or from executive-level policies as opposed to grassroots-driven movements, these so-called smart initiatives are often imposed on citizens without consultation on their deployment (c.f., Chapter 5).

In essence, this dissertation examines the concept of the smart city, and positions it as more than simply a modern buzzword for marketing enterprises (Gibbs *et al.* 2013); a driver of commercial interests (Hollands 2014); a vision of (dis)utopian futures (Datta 2015, Wiig 2015) and ubiquitous forms of governance/control (Kensicki 2019); or, as purely the technical development of electronic hardware (Bliek *et al.* 2010, Anttiroiko *et al.* 2013, Zanella *et al.* 2014). Instead, the smart city is positioned as a data-driven city where the very principles of participatory democracy are subsumed by the urge to innovate without questioning the unintended impacts of *coding* engagement.

3. Research Questions

Two primary research questions and several ancillary questions are addressed in the research. These questions focus both on the problems associated with the future of coded engagement, as well as the interrogation of the realities that exist now in smart city operations. The questions are:

1) How does traditional public participation differ from emergent practices of coded engagement in the context of cities that are seeking to become “smart”?

a) What are the concerns and values of traditional deliberative forms of public participation as they meet the concepts of the smart city? That is, as more deliberative engagement mechanisms (e.g., public meetings) between citizens and governments give way to more data-driven methods (e.g., social media forums and keyword summarizations), what are the advantages and disadvantages of this shift?

b) What are the concerns and values in relation to the various degrees of coded engagement?

2) How reliant is the understanding of coded engagement as a form of public participation on the ability of various algorithmic treatments (the data handling and analysis techniques)? Given that many of the “off-the-shelf” solutions are black boxes, can reconstructing a data-driven method for coded engagement provide substantive impact for government decision-making?

a) Are sufficient data available for making coded engagement resemble collective or communal interests (e.g., communities of interest or practice in local populations)?

b) How sensitive is coded engagement (the algorithms) to variations in data (e.g., Twitter public streams), methods (e.g., deep learning for natural language processing vs. stochastic modelling using bag-of-words probabilities), and visualizations (e.g., word cloud vs. 3-dimensional modelling of social networks in spatial contexts with community interest diagrams)?

c) In what ways could coded engagement maintain its relevance in city operations?

4. Thesis Outline

To achieve the goal of this research, a case study approach was utilized. The case study was developed by working with UGC, conducting interviews with public officials, using content analysis on secondary data sources, and through direct participation with city officials from municipalities surrounding the Greater Toronto Area (GTA). The City of Toronto was chosen as a primary research area because of its importance in Canadian economic development, efforts in becoming a smart city, and the openness to participating in this research. The level of access granted at the City of Toronto was unparalleled in other potential study areas. Furthermore, Toronto is the fourth largest city in North America and has continuously strived to position itself as a leader in "smart technologies." To remove the black box of many operationalized forms of coded engagement, a novel methodology was developed to represent one possible way to emulate this form of technologically mediated participation, using spatially situated social networks, natural language processing, and spatial analysis of Twitter data in the City of Toronto. Qualitative methods such as content analysis directed formal interviews and grounded theory open-coding of results were used to determine the possible applications and perceived benefits, risks, and failures seen to be derived from the use of coded engagement.

In order to frame the role and theory of coded engagement in the context of traditional forms of participation, in light of big data, passive participation, and the algorithmic future of smart cities – a comprehensive literature review is provided. In Chapter 2, this literature review aims at framing the remaining chapters of this thesis in the context of public participation's development as it has been integrated with forms of *coding engagement in smart cities*. The review covers the importance of public participation, the transition from "traditional" to "e-Participation," and the ultimate role of *coded engagement* in the smart city. The chapter ends with the lead-up to coded approaches to harvesting public participation through data-driven methods and leveraging big data.

The primary contribution of Chapter 2 lies in the detailing of the difficulties in defining what exactly participation entails, outside of an idealized political process that has been adapted to forms of tokenistic forms of "engagement." The focus is on how the political process of participation is transformed into the smart city context, vis-à-vis big data, black-box algorithms, and uncertainty/complexity. The treatments and decision-making processes that code participation through data often occur in plain sight in the algorithms of black boxes or the control of corporate visions for what *could* be.

To shed light on the black-boxes of coded engagement and big data, a novel methodological approach using big data was developed to study the decision-making process by harvesting public opinions from big data. Chapter 3 presents a novel data model for computing the social-theory concepts of communities (i.e., communities of interest and of practice) to explore the usability of social media data. This process itself presents risks by imposing an organizational model of reality upon data that is absent of connections. Furthermore, the dynamic and uncertainty of big data, specifically within user-generated content like social media, makes it particularly challenging to assess in terms of representativeness.

The crowd sensing system (CSS) presented in Chapter 3 captures geospatial social media topics and ties them to geographic contexts for the identification of community interests. Using UGC derived from social media platforms, the CSS uses a spatially-situated social network graph to harvest user-generated content from selected organizations and members of the public. Such a methodology, as provided in this chapter, allows 'passively' contributed social media-based opinions, along with different variables, such as time, location, social interaction, service usage, and human activities to be examined, as well as used to identify trending views and influential citizens. This chapter presents a possible means of extracting meaningful information from social media data through the identification of communities of interest and practice within a particular geographic locality. The data model and CSS are used for demonstration purposes to identify geotopics and community interests relevant to municipal affairs in the City of Toronto, Canada.

In Chapter 4, I critically explore the interplay of algorithms and civic participation in visions of a city governed by equation, sensors, and tweets using a case study on the City of Toronto. I begin by applying content analysis to deconstruct the rhetoric surrounding techno-enabled paths to participatory democracy and frame the concept of coded engagement within the smart city. These empirical examples led to us interrogating how the city is impacted by a discourse that promises to harness social/human capital through data science. The study moves to a praxis level and examines the motivations of local planners, from evidence gathered from secondary sources and project plans, to increasingly adopt and automate forms of volunteered geographic information (a form of user-generated content with spatial information) as a proxy of citizen engagement. Using the City of Toronto as a case study, I investigate the "intelligent community" initiatives within a Toronto neighbourhood as an example of the hyperbolic promises. The impact of these promises made by technology companies is then examined as they are used to gain control over public resources. Many of the promises given by the corporate interests commissioned to install these sensor arrays and sensing platforms have failed to meet their hype in practice. Furthermore, the case study approach to the City of Toronto facilitates the demonstration of the mechanisms used by technology firms to supplant public resources by feigning the ability to reduce the burden of democracy through digitally-driven citizen services.

The policies, projects, and promises of "smart" initiatives at the City of Toronto are investigated in detail and evaluated, as they manifest through a technological convergence between local-government services and an increased focus on citizen services through data-driven mediums. The case study of the City of Toronto provides a focused account on how and from where these “smart” motivations for increasing a data-driven engagement with the public have arisen over the past several years. Our case study methodology includes direct participant observations, formal interviews (see Appendix B), and content analysis on secondary materials. I further the analysis with an account of multiple versions of the image of the smart-city held simultaneously within one organization, which itself will contribute to the uneven impact and implementation of what the smart city may entail in the Canadian context. In doing so, I identify key characteristics that both enable and hinder the actually existing smart city in the forms of access to open data, the use of increased computational methods, and the engagement of public services through digital-space as requirements for the future of participatory governance that utilizes coded engagement.

The dissertation concludes with Chapter 6, which outlines the implications and contributions of this research to original knowledge in the field of geography, the challenges and limitations encountered undertaken this research project, as well as a discussion on future avenues for work in these topic areas.

5. Conclusion and Contribution to Original Knowledge

Several reviews have been undertaken—for example, by Albino *et al. (*2015)—to show the divergence in definitions for smart cities; they show little convergence in the concepts from over 40 examples of the use of the smart city in literature. Similarly, Ching and Ferreira (2015) surveyed “smart visions” from six cities against four theories of "smart" cities; (a) "smart machines" and organization, (b) engaging communities, organizations and businesses, (c) learning and adaptation, and (d) investing for the future. Again, there was little agreement in the projects, practices, and policies of each city to encompass a holistic definition of the smart city. However, the role of the citizen in this *smart* future is an open-ended question where the focus is on efficiency and optimization, often over the notion of effectiveness in civic services (Chapter 5).

The aim of this dissertation is to contribute to furthering the discussion on the notion of the smart city and the engagement of citizens in this context. Some limitations were encountered in conducting the research given the variety of issues associated with the data-driven approach, such as the availability of data, the quality of data, the black box of many proprietary algorithms used in smart-city solutions, and the replicability of results across different use-cases and geographic contexts. Despite the challenges, a novel methodology was developed with the capability of integrating multiple dimensions of user-generated content and presenting these in a queryable application format for evidence-based decision-making. The model has the capacity to identify social groups and to use computational approaches in capturing emergent topics in the local context—using social media data—for coded engagement and the operationalization of concepts pertaining to participation in local decision-making (Abbott 2013).

A case study on the aspiring smart city of Toronto was developed, which highlights the divergent efforts of actually implementing coded engagement by monitoring citizens' behaviour in the smart city as they go about their day-to-day activities of living, working, and playing. A key argument throughout the dissertation is that many of the promises of coded engagement as a means of solving the "democratic messiness" of participatory governance in the smart city, lack feasibility or fail to be implemented. In addition, the values and degrees of dissociative values pertaining to democratic and open governance in the context of *sensing the citizen are deconstructed*. Exploration of the main themes that frame the case study provided invaluable insights into coded engagement, the role of corporate entities and the visions of the smart city perpetuated in their interest, and the disconnect between the projected imaginaries and actuality.

CHAPTER 2 - CODING ENGAGEMENT: A REVIEW

Matthew Tenney (primary author)

1. Introduction

Coded engagement is the facilitation of participatory democracy—the notion of citizen involvement within the decision-making processes of governance—through technologically mediated platforms and data-driven operations (Tenney and Sieber 2016). Participation is *coded* through engagement with big data collection technologies, processed by algorithmic treatments, and synthesized into visions of *actually existing* as a smart city characterized by citizen-centric services (Brenner and Theodore 2002, Shelton *et al.* 2015). In this way, the smart city is positioned as a data-driven city; however, the very principles of participatory democracy are subsumed by the urge to innovate and embrace smart technologies (Ben-Haim *et al.* 2013). There are many implications of coded engagement that impact the lives and rights of citizens, primarily arising from the dangers associated with the uncertainty of big data and the risk of algorithmic biases, which are often embedded in its use (Aradau and Blanke 2015). Furthermore, the duplicitous intent of the rhetoric and popular narratives used to describe the smart city obfuscate the institutional powers behind its proliferation and the true capabilities of technological "solutions" (Blanco *et al.* 2014, Alizadeh 2018, March and Ribera-Fumaz 2018). Because the practice of coded engagement is manifested through passive engagement by the collection of data from citizens as they go about their daily lives in a smart city, it poses a risk to the very fundamental principles of public participation in democratic governance (Berntzen and Johannessen 2016). This chapter seeks to highlight the multifaceted influences on public participation in municipal governance, and to demonstrate instances of coded engagement, as it is facilitated through technology and big data analytics, and furthermore, to present the theoretical framework for the empirical evaluations of the use this type of engagement that are presented in later chapters of this dissertation.

While there are apparent advantages to the use of technology in refining government operations, for the achievement of more effective citizen-services, these promised *solutions* are often cases of hyperbolic rhetoric and the *imaginaries* of a smart city (Kelley 2011, Wiig 2015a 2015b, Belanche *et al.* 2016, Chatfield and Reddick 2016). This washing offers the story of smart cities as the vehicle through which *inclusion*, *innovation*, and *modernization* may be fostered in the democratic processes of local governance. Since the majority of smart city developments are premised on technocratic values and are "top-down," or the product of executive-level policies as opposed to grassroots-driven movements, these so-called smart initiatives are often imposed on citizens without consultation on their deployment (Shelton *et al.* 2015, Shelton 2017, Cardullo and Kitchin 2018a). For citizens, the choice in coded engagement is to either "opt-in" or "opt-out" of being a recipient of the services fielded by corporate surveillance in the city; it is not one of being able to decide whether or not their city becomes smart in the first place (Batty 2003, Brown *et al.* 2012, Christensen and Jansson 2015, Ball *et al.* 2016).

1.1 A Framework for Viewing Coded-Engagement within the Smart City

In smart city visions, the primary focus is on the citizen (Miciukiewicz and Vigar 2012, Abend and Harvey 2017) as the producer of data for tailored data-driven services, as the user of these same smart services, and also as the politically engaged constituents that enable their implementation (Balakrishna 2012, Lee and Lee 2014, Sebastian *et al.* 2018). In this smart city view of the citizen, public participation is portrayed as a messy mechanism in the co-production of governance that is beset by difficulties that are presumed to be best alleviated by smart technologies (Bimber 2000, Desouza and Bhagwatwar 2014, Steinberg 2015). However, behind the beliefs of a citizen-centric smart city model are the complex influences and motivations of political agendas and corporate profiteering that are often washed in *smart* discourse (Joss *et al.* 2017, Fernandez-Anez *et al.* 2018). Given that smart city projects utilize technology, consideration must be given to how this affects public participation in both their development and implementation. Theoretically, such exploration falls within the framework of software and data studies, as well as political-economy, with a focus on progress and neoliberalism. That is to say, there must be an interrogation into how smart-services (mis)use data and algorithmic treatments to emulate public participation against its implications to traditional forms of public engagement in governance, as well as how a technologically mediated form of participation would allow for citizen input to municipal operations. Therefore, a framework for inquiry into the citizen-condition, as part of coded engagement in the smart city, should encompass an understanding of a variety of factors ranging from the technically nuanced bias in big data analytics to the systematic societal dynamics of civil and economic agendas (Bozdag 2013, Diakopoulos 2014, Pasquale 2015). These factors would include the nature of big data, the values of algorithmic treatments employed in treating these data for use in city operations, and the forces of political-economy that give rise to their use in the first place (Lee *et al.* 2017).

Thus, the theoretical framework used to interrogate the processes and implications of coded engagement includes a means to address relevant questions such as: 1) how does technology impact traditional forms of citizen-government interactions? Or, said another way, how does traditional public participation differ from emergent practices of coded engagement in the context of cities who are aspiring to be "smart"? and, 2) how does coded engagement rely on the ability of various algorithmic treatments (the data handling and analysis techniques) to be understood as a form of public participation? This framework for understanding the implications of coded engagement presents an opportunity to discuss the future of smart cities, citizen engagement critically, and to provide some recommendations for future work.

1.2 Situating Public Participation in the Smart City

Public participation in local government affairs is a cornerstone of democracy (Hoffman 2012). The notion of public participation promises to keep "community life vital and public institutions accountable" (Roberts 2004, p. 315); ensures that "the have-not citizens" are "deliberately included" in policy formation (Arnstein 1969, p. 216); and ensures that citizens are regarded as "co-producers of public services" (Whitaker 1980, p. 240). From a traditional perspective, public participation can be viewed as any process that directly engages the public in some form so as to influence the decision-making in government (c.f., Roberts 2004; Whitaker 1980; Arnstein 1969). In a participatory democracy, it is held that those making decisions (e.g., politicians, planners) give (multiple) opportunities for public input in deciding the outcome of a decision of governance and acts as a form of political empowerment. In this way, public participation is a deliberate political process involving citizens or stakeholders, as constituents within the activities of government and planning, and is not limited to being only a single event (Laird 1993; King et al. 1998). Participation is the culmination of activities and actions by members of a governing agency to both inform members of the public and to obtain their input so to guide the outcome of some decision (Hoffman 2012). Thus, a general definition for participatory processes is those that allow stakeholders, being citizens with an interest or stake in an issue, to exercise their influence over policy outcomes that affect their lives (Michels and Graaf 2010).

Despite these benefits, the effective implementation of public participation and the role it ultimately plays in city operations remain in a state of ambivalence (Innes and Booher 2004). Many reasons are put forward for the exclusion of public participation in city decision-making processes. These include the difficulties governments encounter in assuring citizens that they are being heard (Rowe and Frewer 2004); the lack of influence (or improvement) in the decisions of agencies and public officials (Chess and Purcell 1999); and the failure to capture a broad enough spectrum of public opinion (Lowndes *et al.* 2001). Traditional participatory methods used at the city level are viewed as antagonizing participants, pitting individuals or interest groups against each other, and making the objectives of city officials more challenging to accomplish (Innes and Booher 1999). Such issues with the implementation of citizen-government engagement have inspired the view that many institutionalized mechanisms of public participation, such as public hearings and citizen surveys, prove "to be nothing more than rituals designed to satisfy legal requirements" (Innes and Booher 2004, p. 419). Thus, effectively harnessing public participation through traditional means has been widely acknowledged as a difficult task to accomplish by city administrators.

Increasingly, local governments have looked to the "use of information and communication technologies (ICT) to foster citizen engagement" (Cegarra-Navarro *et al.* 2014, p. 660) and assist in alleviating these burdens of participation. The pervasiveness and *de rigueur* of these technologies have evolved from being an effective tool for mass communication to be seen as a digital window into the lives and activities of urban populations (Kavanaugh *et al.* 2012). Technological adoption in urban contexts is particularly of interest with the spread of Web 2.0 capabilities and mobile technologies (Sandoval-Almazan and Gil-Garcia 2012). Goodchild (2007) frames the convergence between society and these technologies as "citizens as sensors." He sees citizens' user-generated content (UGC)—a form of big data—as volunteered participation in efforts to replenish the dwindling support of various public services or support for a public run/owned resources (Goodchild 2007). These sources of citizen-content would also include the collection of data through crowd-sourced platforms or those derived from the outputs of our daily interactions and interest contributed to technological systems (i.e., social media). There is presumed suitability of UGC for appropriateness in the context of smart cities, primarily driven by the assumption that it represents the local knowledge and interests of a community (Hecht and Gergle 2010, Elwood *et al.* 2013). In addition to the increasing availability of UGC, it is these hyper-local claims (i.e., access to local knowledge), which have garnered widespread credence in using UGC as a form of public participation in city operations (c.f., Raetzsch et al. 2019; Nummi 2019a; Witanto, Lim, and Atiquzzaman 2018; C. B. Williams et al. 2018; Bousquet 2018; Soares, Recuero, and Zago 2018; Simpson et al. 2018; Di Minin et al. 2018; Rahwan 2017; Aitken 2017). In summary, smart city concepts seek to engage citizens through digital services that are created and refined by harvesting their data through a process of *coded engagement.*

The remaining sections of this literature review are structured as follows: Section 2 provides further context on why and how coded engagement is being utilized in cities as a form of public participation, and also frames public participation within relevant academic literature as a complicated process to define and utilize. An interrogation of definitions on "who" constitutes the "public" and what it means to "participate" is provided in Section 3 through the lens of social theory and public administration theory. Section 4 situates these perspectives and methods of public participation within the social dynamics of technological integration and the data revolution that have led to the emergence of smart cities and coded engagement. The chapter concludes with a discussion on the difficulties of coded engagement; including the problems arising from the duplicitous narratives perpetuated by those with conflicting agendas who seek to control the actualities of smart cities, the concerns arising from studying the implications of big data technologies and methods, and the challenge of tying the study of coded engagement into the existing research frameworks of critical software studies, as well as society and technology studies.

2. Promises of Easing Difficulties with Participation Through Technology

The concept of public participation has developed in multi-disciplinary literature over the past few decades. Changes in the approaches taken to public participation in theory and practice have been framed alongside their convergence with digital-technology and Web 2.0 services. public participation is positioned as being subsumed into the discourse of a smart city and big data future. In this regard, I argue that coded engagement stands to replace traditional and active forms of public participation in city operations (c.f, Lai 2016, Pan *et al.* 2016, Conti and Passarella 2018, Osman 2019, Trencher 2019). Specifically, widespread speculations are asserting that public participation will be an automated function of citizen-government interactions through the data-driven use of data and technological "solutions" (Bariaran 2018). Because of the perceived difficulties in harnessing public engagement effectively and the burden this presents to the citizen, there is an ongoing and multiplicative urge to seek more frictionless means for citizens to participate in government operations.

2.1 Frictionless Participation: Attention Economy and the Smart Future

The futurist Duperrin (2015) makes a case for UGC as part of future citizen engagement with government. He argues that a shift to digitally-mediated forms of "passive" participation suits the ongoing societal convergence with Web 2.0 technologies and that citizens seemingly prefer these practices:

> It is not participation that wearies people, nor its lack of sense but its active nature. It requires time (without being sure to get anything in return) and attention. No one

> denies the advantages of information sharing but employees don't understand why it requires extra work and citizens are happy from the benefits they get from the use of collective data (even unconsciously) but won't spend their life behind their screen to provide a predictive, analyzing and proposition machine with ideas, feedbacks and experiences. (Duperrin 2015)

Arguably, it is the intentional allocation (and amount) of a person's time or attention that marks a fundamental difference between the active participation of the past to the passive participation of the future. The former is best characterized by Webler and Tuler (2002, p. 182) as follows: "Attendance is primary, and for every process, it must be decided who has a legitimate right to participate." Active participation requires a citizen to interact directly with a city representative in some way for their collective opinions to be considered in municipal decision-making. The active selection, filtering, and prolonged retention of participants are also often required by such participatory approaches:

> An active, engaged citizen (rather than the passive recipient of information) is the prescription of the day. This current trend has emerged, in part, from the neo-liberal consumerist and customer-centred public sector management philosophy that has dominated the 1980s and 1990s and from a governance philosophy that fosters reciprocal obligations between citizens and governments and emphasizes participation for collective rather than individual purposes. (Abelson *et al.* 2003, p. 240)

It is this sort of active participation (e.g., public hearing and citizen panels) that people seem increasingly unwilling to engage with, perhaps due to the uncertainty of its effectiveness, clarity on its intended function, or because other activities are increasingly taking precedence over traditional forms of civic engagement (Putnam 1995, Poore 2011, Abelshausen *et al.* 2015). Furthermore, marginalized populations, who stand to benefit the most from engaging in the participatory practices of traditional town halls or public meetings are often those who lack the resources to do so in any consistent manner (Chandler 2015, Building the Social Town Hall 2016). An alternative, passive participation through UGC, takes a different approach to citizen-government relationships by use of indirect interaction methods (i.e., asynchronous, automatic, and the re-purposing content) that harvest public opinion, or a form thereof, from UGC to be used within municipal decision-making. These methods of participation often make use of unstructured data, behaviour-analytical algorithms, and distributed computing infrastructures to collect, transform, and extract relevant social signals from massive datasets from a variety of sources.

Duperrin (2015) and others (c.f., Abelshausen *et al.* 2015) discuss the "social fatigue" extant in forms of active public participation. Overcoming social fatigue often includes methods that use UGC and mobile technologies to sense the real-time opinions and activities of the public from various Web 2.0 services. Sensing citizen content to inform government officials can be considered a form of passive participation and aligns with the rhetoric of big data and smart city industries. Surmounting the social fatigue that afflicts forms of active public participation, as argued by several contemporary pundits (c.f., Anthopoulos and Fitsilis 2015, Doran *et al.* 2016, Bousquet 2018, Service 2019), often includes methods that use UGC and mobile technologies to sense the real-time opinions and activities of the public from various Web 2.0 services. Sensing citizen content to inform government officials can be considered a form of passive participation and aligns with the rhetoric of big data and smart city industries (Cardone *et al.* 2013, Zhang 2019). Crowd-sensing systems that perform such tasks are computational instruments (i.e., computers, sensors, software, and algorithms) designed to automatically harvest relevant content, contexts, and relationships between UGC (and citizens) in the form of citizen-sensor-networks (Levy *et al.* 2015). These citizen-sensor-networks are used to fulfill passive public participation in two ways: "one where the citizens are passive entities that need to be tracked to understand and optimize better the Smart Cities, and the second where the citizens, motivated by their common sense and using their mobile device to communicate the sensed sample" (Villatoro and Nin 2013, p. 1). It is this coded form of passive participation that stands to replace active forms of public participation as it is presented as integral to the efforts of becoming a "smart city" driven by "big data" (Townsend 2013, Iafrate 2014, Cardullo and Kitchin 2019). This process of leveraging the citizen as sensor and informing government services through big data is one I term *coded engagement.*

Just as there are a variety of ways for a citizen to participate in democratic processes at a local level through traditional forms of direct and active engagement (Miller *et al.* 2017), there are just as many forms of coded engagement. In a fundamental way, sensors collecting data on human behaviour and the subsequent application of some algorithmic treatment to place these bits into contextual information is an iteration of *coded engagement.* Of course, *coding* occurs in varying degrees of complexity and may require different levels of active citizen engagement.

One Orwellian form of coded engagement comes from the Chinese national government with its instituted Social Credit System (Campbell 2019). This distributed feedback system is aimed at harvesting big-data to evaluate a reputation score on citizens and businesses to open or close their access to certain civil rights. Actions like being late for work, jay-walking, and other normative infractions observed through different sensors or database records are algorithmically combined into a citizen national reputation score that in turn can carry punitive consequences such as revocation of passports, access to education, or may even lead to incarceration (Moran 2019). This represents a more extreme and dystopian incarnation of what *coded engagement* could look like through the use big-data, sensors, and algorithmic feedback systems that control citizens' engagement with government services.

Another version of *coded engagement* is an example being undertaken in Louisville Kentucky called “AIR Louisville” (www.airlouisville.com), a data-driven environmental monitoring program for air quality that is co-sponsored by the City government, private and public institutions, and citizen volunteers. Using “smart” asthma inhalers with a GPS device, public health officials are alerted as to when and where people are using their inhalers as a proxy for poor air quality. Louisville Mayor Greg Fischer describes the advantage of this program as providing:

> […]a heat map like this is produced and then we overlay what the weather was and that day what the traffic patterns were on that day and they come up with mitigation techniques so that we can improve public health, so the citizens say that's what government is supposed to do it's supposed to make my life easier improve the quality of life. What happens as a result of that is that we build what I call “social muscles,” the belief in the community that when we work together maybe when that inevitable tragedy takes place in our community, we will be better able to respond (Greg Fischer 2015)

Following the initial outcomes of AIR Louisville, the city has been striving to institute more conscious transportation policies, instituted new zoning regulations to reduce emissions, and planted more trees in identified locations from the project (Barrett *et al.* 2018).

Perhaps a less extreme version of coding civic participation in government operations comes from the technological sovereignty movement occurring in Barcelona’s smart city model of governance. Their promotion of the web-based *Decidim* platform (Catalan for “we decide”) is aimed at helping "citizens, organizations, and public institutions self-organize democratically at every scale" (Decidim 2019). Barcelona city council has engaged nearly 40,000 people and 1,500 organizations that have contributed over 10,000 suggestions through this online platform (Stark 2017). The project leader, Xabier Barandiaran, outlined the vision of Decidim in an interview as:

> The potential for open knowledge like Wikipedia, or information spreading like Twitter, or intense relationships like Facebook, also applies to politics. However, it does so with high controversy (post-truth, lack of privacy, democratic deficit, no-transparency, etc.). With Decidim we talk about a new generation of political networks that are oriented to decision making, commitment, and accountability. This new generation of social or political networks has to be open-source, guarantee personal privacy and public transparency, the sovereignty of the infrastructures, independence from private corporations and they have to enforce, by design, digital rights and equity. This is what Decidim provides. (Barandiaran 2017)

The above provides a tangible example of the range in which coded engagement occurs. How technology alters citizen-to-government interactions can be varied in purpose and process. In this way, the purpose of utilizing more traditional forms of public participation can vary, and so too, the number of ways of engaging in the process of citizen-government interaction in the interest of decision-making. In the following section, public participation is reviewed in terms of a variety of perspectives on its purpose, as well as the diverse ways it is put into action.

2.2 Public Participation: A Purpose in Search of a Process

Public participation is an active field of research with contributions from many different perspectives on its purpose and approaches for its practice. It would be myopic to suggest that, from the past half-century of participation research, the single point of agreement between these views is an acceptance that objectively it is a "good" thing. As Arnstein (1969, p. 216) notes in her seminal work on participation, "The idea of citizen participation is a little like eating spinach: no one is against it in principle because it is good for you." Taking into consideration this point that public participation is "just good," there is a clear tension amongst participation scholars who continually attempt to redefine its purpose and its process to fit an ever-changing context (and scale) (c.f., Sieber *et al.* 2016, Miller *et al.* 2017, Spil *et al.* 2017, Violi 2017, Cardullo and Kitchin 2018b, Trencher 2019, Zhang 2019). While this tension presents a polarized field of research perspectives, it also proves such scholarship has an inherent value that perpetuates its relevance by adapting to contemporary issues, as well as justifying why public participation must remain an integral part of city operations:

> It is widely argued that increased community participation in government decision-making produces many important benefits. Dissent is rare: It is difficult to envision anything but positive outcomes from citizens joining the policy process, collaborating with others, and reaching consensus to bring about positive social and environmental change. (Irvin and Stansbury 2004, p. 56)

The purpose of participation is often positioned as a defining aspect of the concept itself. For example, Innes and Booher (2004) identify several purposes that can be seen as defining public participation. First, public participation is viewed as a mechanism to "*inform*" decision-makers – that is, to extract public opinions from proxy sources, so these can play a part in decision outcomes. Second, participation is perceived to improve decisions by incorporating the "local knowledge" of citizens into decision processes. Access to this local knowledge has been a desired goal of public participation even before the debut of UGC as the digital record of local citizens (Taylor and de

Loë 2012, Rinner and Fast 2015, Verplanke *et al.* 2016, Okner and Preston 2017, Czepkiewicz *et al.* 2018). However, the legitimacy of this knowledge in terms of being local, representative, or its accuracy and validity is a major issue in public participation through assertive data (Venkatesan 2008, Williams *et al.* 2014). Thirdly, public participation is seen as a means of fostering social equity and justice. This position often manifests itself through the rhetoric of power dynamics and prioritizes the pursuit of social fairness and justice. This pursuit has been a long-standing issue in active participation and is exacerbated by the "uncertainty" of transitioning to a form of coded engagement in the face of the digital divide, in terms of its effectiveness, clarity on its intended function, or because other activities are increasingly taking precedence over traditional forms of civic engagement (Sieber 2006, Zook and Graham 2007, Stephens 2013). The fourth purpose of participation focuses on the tokenistic use of public participation as attesting to the legitimacy of an outcome from policy or planning decisions. Giving a tacit public stamp of approval is accomplished by having the public involved in the process (although not necessarily choosing an outcome), thus justifying the end choice made. Finally, participation is often legally mandated in local-regional by-laws making it "something planners and public officials do because the law requires it" (Innes and Booher 2004, p. 218). There can be one or many of these types of perspectives on the purpose of participation held within a single organization.

In addition to the purpose-driven definitions of public participation, scholars have described public participation as having social support functions in creating a civil society that becomes process-oriented. For example, Webler et al. (2001) view participation or rather the various discourses of participation, as being from one of five distinct perspectives:

> One perspective emphasizes that a good process acquires and maintains popular legitimacy. A second sees a good process as one that facilitates an ideological

> discussion. A third focuses on the fairness of the process. A fourth perspective conceptualizes participatory processes as a power struggle—in this instance a power-play between local landowning interests and outsiders. A fifth perspective highlights the need for leadership and compromises [...]Conflicts may emerge about process designs because people disagree about what is good in specific contexts. (Webler et al. 2001, p. 435)

In the process perspectives outlined above, it is clear that the many divergent views on participation are representative of those held in the participation processes themselves. That is to say, not only do many scholars not agree on the purpose or definition of participation in the political process, but also the people involved in participatory processes often do not agree. In many ways, this underscores the one reoccurring purpose of participation, which is to resolve the various viewpoints into a specific outcome suited for all those involved.

There are several factors to be considered concerning the purpose and processes of participation, including who are the participants, how they are participating, and why they are participating. These factors must be viewed both from the standpoint of the individuals involved, as well as from that of those engaging them (i.e., a municipal government). For example, Fung (2006) contextually differentiates participation efforts by three primary dimensions, namely participants, process, and power. These dimensions form a "democratic cube"—a model used to compare public participation approaches across contexts (see Figure 1). The first dimension is concerned with the level of selectivity behind "who" constitutes the public (i.e., how participants are chosen). More selective approaches are those that engage only a few representatives or specific interest-groups (i.e., sampling targeted communities). At the other end of the spectrum are more democratic and "fair" techniques that strive to include everyone without restriction (i.e., exhaustive approaches for representing entire populations). The second dimension is focused on the "how" or the freedom with which participants must exchange information with decision-makers (but not explicitly considering their ability to interact with peers). It is the interaction between participants themselves that is often seen as being an essential factor in participatory effectiveness in other models. For example, Webler and Tuler (2002, p. 179) describe the general purpose of participation as "no matter what they are called, these processes involve bringing people together so they can talk about a specific issue, become informed about it, and arrive at a strategy for what to do." The third dimension, offered by Fung (2006), describes the link between chosen processes and the level of influence or "power" participants have on the outcome of a decision. Fung (2006, p. 74) concludes that "no single participatory design is suited to serving all three values simultaneously; particular designs are suited to specific objectives." It also remains difficult to determine the ideal combination of these dimensions in the practice of public participation. Thus, there is an apparent need for consideration of local issues of the public, who are engaged through tailored processes of participation in relation to the purpose of their participation in the first place.

It is the notion of tailoring processes or methods of engaging with a local and relevant definition of the "public" that becomes an increasingly difficult relationship to fit into simple taxonomic structures and act as a "roadmap" for civic engagement across all issues and locations. Despite the sophistication behind the democratic cube model (i.e., Figure 1), there is still little evidence that a causal relationship exists between variables, even when considering qualitatively similar examples of public participation (Fung 2009, p. 99–102). This difficulty with cross-comparison also makes this, along with many other models of participation, challenging to implement or entirely irrelevant to a local context. At least, this was the common narrative in relation to traditional means of public participation, where the distinctions between each level and axis of the democratic cube become warped by uncertainty (Elwood 2005). Thus, it becomes increasingly difficult to gauge whether civic engagement, through public participatory processes, is successful – regardless of the purpose.

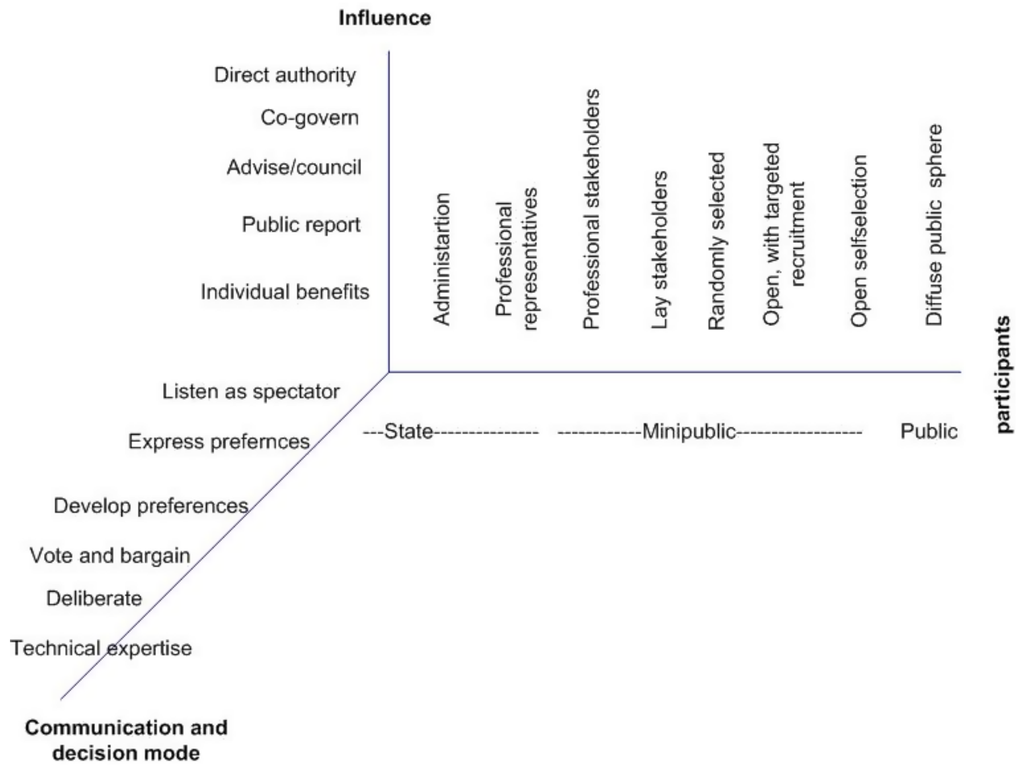

Figure 1 Democratic Cube Model for Participation Influence. Adapted from Fung (2006)

As discussed, the actuality of engaging with the public, implementing the mechanisms for their participation, and the purpose of their participation in the operations of governance is difficult to define and replicate. In this way, so is the ability to determine whether or not engaging with the public for a particular purpose is successful in its outcome. McLeod et al. (2001, p. 273) describe participation literature as being "[f]raught with conceptual and empirical inconsistencies." Some claim a more salient agreement amongst participation authors is on "the paucity of rigorous evaluations" (Abelson *et al.* 2003, p. 249) of its effects and implementation. Techniques for evaluating successful public participation are therefore highly debated with still no widely accepted system for evaluation, mainly due to its contextual definition (Yang and Pandey 2011):

> [P]erhaps most important, is the question of how can we be sure that participation results in any improvement over previous ways of doing things, or indeed, or of any effective or useful consequences at all.[...]In addressing this issue, the dearth of high-quality empirical evaluations will be highlighted, along with the lack of any comprehensive framework for conducting such evaluations. (Rowe and Frewer 2004, p. 215)

It is the polarized perspectives within participation literature that have led some to conclude the concept has been stripped of much of its importance to the modern democratic process (Leal 2007). These internal tensions within public participation scholarship have led to its constant refinement over time. Specifically, these efforts bring theoretical and empirical inconsistencies of participation to light. However, with still no definitive "recipe for success" for public participation, there has been an effort to address the fundamental and implicit assumptions behind the concept itself (Barnes *et al.* 2003).

The critical evaluation of language and its interpretation within public participation research is an emphasis that seeks to resolve the ambiguity inherently attached to the concept itself. According to Tulloch (2003), a significant amount of confusion on public participation stems from its duplicitous use and mixed definitions for both "public" and "participation." Such an issue means that answers to epistemological questions like "Who is the public?" and "How do they participate?" cannot be given without an ontological commitment on each of their meanings and specific relationships. This becomes increasingly difficult as engagement practices take on more digital mediums (e.g., through Internet services), where the identities and certainty of who is participating in some processes are difficult to ascertain or irrelevant to the system ingesting it.

In the next section, some approaches used for defining “public” and “participation,” as well as how they have been connected through contextual factors like shared interests and level of influence, are introduced (Brown and Kyttä 2014). This defines the relationship between who constitutes the public in a given circumstance and the mechanism used to engage them or involve their participation. In this way, the purpose of participation is often positioned as a defining aspect of the concept itself. As reviewed in this section, there is a continuum of divergent perspectives, uses, and relationships within the broad concept of public participation.

3. Defining “Public” and “Participation”: Methods for Stakeholder Influence

Defining what constitutes the “public” being referenced in public participation literature is commonly done by adopting what has been called the stakeholder perspective (Bracken *et al.* 2015). Stakeholders are the individuals or groups that are likely to affect or be affected by specific planning or policy decisions (Reed 2008). It is also common to view the smaller groups formed within the stakeholders as being communities of shared interests, while also being collectively deemed to represent a community of interest or practice (i.e., having factions that share or diverge in their position on an issue, while they all stand to be impacted by its outcome). It is the idea of having a shared interest or being mutually affected by a decision that defines each use of the word “community” here, which in turn also constitutes the nature of the “public” being engaged (Currie *et al.* 2009). Using shared interest and community membership definitions as being the “public” has also allowed for more generalized classification typologies to arise by way of the stakeholder perspective. Often, these frameworks include a measure of influence like social capital (individual or community) through social-network analysis that further distinguishes the importance or role of one stakeholder from another (Meyer *et al.* 2014). Social capital "is the collective value of all social networks and the inclinations that arise from these networks to do things for each other (i.e., norms of reciprocity)" (c.f., Portes 1998). This measure reinforces an underlying principle of the stakeholder perspective, which sees each individual and community as having the chance to influence the decision-making process (i.e., affect an outcome) (c.f., Shah 2001, Holman and Rydin 2013). How this influence manifests internally (i.e., between stakeholders) and externally (i.e., impacting the decision's outcome) can vary depending on the approach to participation that is taken and the network organization of the stakeholders themselves (c.f., Burt 2000, DeFilippis 2001, Quan-Haase *et al.* 2002, Sommerfeldt 2013).

One way the stakeholder perspective is seen as being beneficial to public participation is by allowing government officials to sort (i.e., classify and rank) members of the public by different qualities. For example, identifying opinion-leaders within communities can help city officials focus their efforts (like building trust or using an agenda) on these specific individuals. Opinion leaders are often identified by measuring the social capital (i.e., peer influence) and importance held by stakeholders (Subbian *et al.* 2014). Conversely, low-influence stakeholders, like a minority and marginalized communities, may also be identified so as to ensure a level of social fairness and equity (Currie *et al.* 2009).

The stakeholder perspective allows citizens the opportunity to identify all different "stakes" at play in a decision-making process, thereby providing increased transparency on what views are held, who holds them, and ultimately how they factor as part of government operations. This increased transparency afforded by public participation is seen to inform citizens better and foster self-organizing communities (a citizen joining an established interest-group) to maximize their influence over other stakeholders and the outcome of a decision (Fung *et al.* 2008). However, the choice of community membership, through self-ascription, may not always arise from shared interests. For example, a citizen may align with a particular group with the strategic purpose of limiting a third-party's influence. That is, an individual may temporally side with a community only to stand in its opposition later. Thus, the dynamics of influence in public participation varies with how individual and collective actions of stakeholders coalesce over time (Hodson 2011). This coalescence also means that the external and internal membership a citizen identifies with or how an official assign them to a community may not be congruent throughout the entire process (Bracken *et al.* 2015). The integration of Web 2.0 connectivity to the notion of the stakeholders and community formation is often translated into the models of social-networks, topic-interest, and group affiliations (e.g., Chapter 3).

An issue taken against the stakeholder approach to public participation is its inherent selectivity (i.e., the selection of participants (generally those with influence in the community) to be included in the stakeholder group). It is also important to note that such individuals are rarely given the position of delegation or power without expert oversight (Kumar and Vragov 2009, Vervoort *et al.* 2010). Removing the expert oversight (e.g., an issue with cities incorporating OpenStreetMap data is liability and lack of "expert" oversight in the collection and/or verification of this data) means that because of the lack of delegation status, a citizen or community is only ever capable of informing or co-creating an outcome in conjunction with government representatives, not make any decisions in the absence of official or expert oversight (King *et al.* 1998, Oguz 2014). It is also common that only a single representative from a stakeholder position or community is included in the later stages of the decision-making process (Fung 2009). This not only excludes any internal variation between interest-groups but further obstructs the input of any misclassified stakeholders initially deemed to be a member of such a group (Fung 2003). This ability to connect with the opposition is also a “solution” promised in smart city rhetoric through their “user-centric” design, where technologies are capable of collecting every citizen's opinion in real-time (e.g., Chapter 4 and Chapter 5).

Participation is often defined through the formal or institutionalized methods that officials use for engaging with the public. However, there are some more radical perspectives on what is included as civic engagement with the aim of influencing government decisions (c.f., Conge 1988, Eagan 1996, Fung 2005, Parkins and Mitchell 2005). Traditional methods of participation such as public meetings, consultation documents and co-option to council committees are seen to complement political management structures but give little “influence” to the public (Wilson 1999). Before the pervasiveness of Internet-related technologies, these methods coexisted alongside opinion polls and surveys which, “from the standpoint of individual action, are relatively passive and essentially seek to obtain a general view” (Wilson 1999, p. 247).

During the 1980s, more consumer-oriented methods, such as feedback systems (i.e., complaints/suggestion schemes) and service satisfaction questionnaires, were being used as ways to gather public opinion on government services. In the mid-1990s, more involved methods of consultation, including citizens' panels and focus groups, became widespread (Birch 2002). However, the burden of undertaking these involved processes (requiring detailed planning, advertising, participant recruitment, and carrying out of the event itself with sometimes over multiple iterations) left them only to be used when specifically needed (Smith and Wales 2000). These more “involved” methods, also called active or deliberative participation, include activities like citizen juries that require participants to reflect deeply on all positions identified with specific issues and entering into a negotiation to determine the final decision (Kumar and Vragov 2009).

Active and deliberative participatory methods seek out cross-sections of people, ideally representative of the population (or of specific sectors) (Abelson *et al.* 2003).

The emphasis on power relationships and the level of influence of public participation has become a substantial theme in the available literature. These critical perspectives often resonate with the field of communicative planning. Such perspectives have emphasized how language and modes of communication play a key role in shaping planning practice, public dialogue, policymaking, and processes of collaboration (Pelzer *et al.* 2015). A common point made is the claim to active, exhaustive (requiring long-term interactions/discussions), and comprehensive (including not only "identified" stakeholders but everyone) aspects being as necessary for participation to be effective. Ploger (2001, p. 219) describes the current state of these arguments as follows:

> These days, however, discussions on planning seem to reestablish an old philosophical confrontation between Juërgen Habermas's plea for a discursive ethic and Michel Foucault's thesis of the omnipresence of discursive powers. Some -- mostly overlooked -- central themes to this controversy are the epistemological and ontological conditions of Habermas's theory of communicative action. Furthermore, theories of communicative and collaborative planning are criticized because they do not deal with questions on government and governmentality.

Fairness, or communicative democracy, is an essential argument from these perspectives. In this way, citizens are seen as being "heard" if they are provided with an open opportunity to discuss, debate, and determine aspects of governance collaboratively (Healey 1992). Unfortunately, these arguments largely denounce any forms of passive participation and rely on the assumption that individuals are inherently driven to take part in active forms of public participation regardless of the level of commitment required. This provides an interesting point of contention considering the rapid expansion of passive forms of participation that are already being established in "smart cities" around the world (Kreiss 2015, Tenney and Sieber 2016, Shelton and Lodato 2018).

4. Digital Participation: Web 2.0, e-Participation, and Data-Driven Insights

The emergence of Web 2.0 technology, location-based services and social networks has ushered public participation into an era of digital participation with an increased focus on issues of place (Elwood 2008, Sui 2008, Graham 2010). Web 2.0 "technologies serve to re-present place-based memories and facilitate dialogue among community members located in dispersed geographic settings" (Corbett 2013, p. 224). However, as many scholars have demonstrated, the realities of technology do not always meet the promises of solving the real problems faced by people.

Technology (i.e., spatial, Web 2.0, and mobile) accentuates today's digital and data revolution, and brings a circus of duplicitous efforts from corporate agendas, political will, and public appetite that urge participatory approaches to adapt with information age demands (Greco and Floridi 2004, Chandler 2016, Gil-Garcia *et al.* 2016). Toward this end, it is worth examining an earlier perspective on how technology was positioned to solve the issues of participation through the literature of public participatory geographic information systems.

Many similarities can be conjured up between current discussions on *coded engagement* and literature on participatory uses of desktop geographic information systems (GIS) (Elwood 2006), or in other words, the role of citizens in the collection of data, and the use of this process in the decision making of governments. As a field, public participation geographic information systems (PPGIS) have shared a focus on interrogating the many social- barriers and implications born from the GIS (i.e., technology) and participation merger (Sieber 2006). Similar to claims for other ICT and now the Web 2.0, PPGIS has often positioned technology as a tool to empower people, while at the same time being one that carries unintended social implications (Sieber 2006). GIS provided a platform for dialogue between the local knowledge of a community and the knowledge of experts and officials, although not always evenly or accurately representing all those involved (Pickles 1999, Carver 2001).

PPGIS processes were aimed at incorporating public contributions of geographic information with established goals to map, build, and develop their community. This was positioned as integrating the local-knowledge of communities into the expert planning processes they were before they were excluded due to knowledge barriers between the perceived expert/amateur perspectives. According to Carver (2001) and others (c.f., Carver *et al.* 2000, 2001, Kingston *et al.* 2000, 2003), this was not always the case – where the difficulties of public participation were exacerbated by the technological gap of GIS systems and the overstated capabilities of computer-mediated systems of participation. However, in common perspectives, PPGIS is assumed to be a bottom-up approach, in that the public co-creates answers to "how?", "where/when?", and moreover, "for what?" for which GIS is to be used (i.e., retaining a perspective that public participation is for community empowerment) (Elwood 2005, Jankowski 2009). While there are divergent perspectives on how effective participation through GIS was in terms of successfully engaging citizens, there is yet another shift in views on the role of PPGIS versus the capabilities of the Web 2.0 and the data revolution. It has been purportedly brought modern approaches to science. This difference between PPGIS and e-participation today stems from a shift in roles that experts and citizens play within the Web 2.0 production-cycle and decision-making processes, as well as how the information is created, gathered and positioned as a form of passive participation within the data-driven smart city.

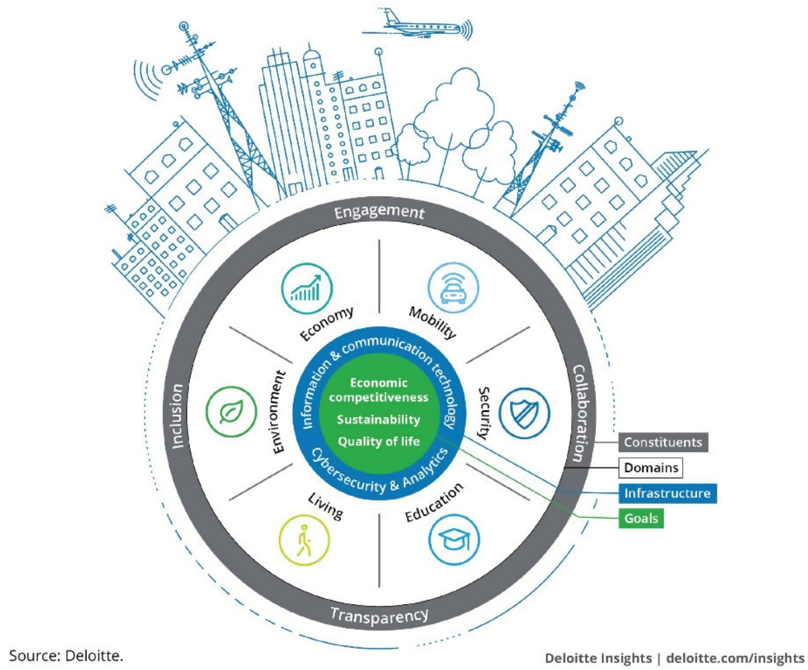

Figure 2 Deloitte's "citizen insights" infographic for smart city citizen-centric services that promise better engagement and participation

The pervasiveness of easy-to-use technology is sometimes seen to have removed the need for any form of expert facilitation (Connors *et al.* 2012). For example, the planners, technicians, or scientists in most PPGIS projects retained a level of oversight on the collection and use of the spatial data (Pocewicz *et al.* 2012, Gottwald *et al.* 2016, Tang and Liu 2016). Web 2.0 capabilities are assumed to have removed the technology/domain expert as the content "producer" and the amateur (i.e., public or citizen) as a passive "user" of this technology and content (Bruns 2008). Part of the "Produsage" model, for instance, allows users (i.e., amateurs) to contribute actively, transform, and even analyze content of all kinds for their purpose (individually or as a group) (Haklay *et al.* 2008). However, with public participation increasingly being part of the spatially-enabled Web 2.0 (GeoWeb), the planner and specialist may eventually have no part in what some see as an entirely user-driven process (Ali and Fahmy 2013). Furthermore, the nature of this data is that of being assertive, from unknown sources, without context, and often providing no means of verifying an entirely user-driven process by expert mediation.

Part of the impetus for the diminishing role of expert mediation is by an increased societal view of empowerment through access to information granted by Web 2.0 capabilities. Nichols (2017) elucidates a combination of influences from increased access to higher education of inferior quality, the real-time access provided by Internet resources, and the explosion of dynamic and pervasive media options have encouraged an era of the anti-expert and anti-intellectual sentiment. This "Death of Expertise" according to Nichols (2017), is not because there is the case that experts do sometimes fail, but the false sense of "equalization" from things like social media, pseudo-education of the masses, and real-time access to confirmation biased media. That is to say, social media can connect people in ways never before possible and can provide a platform to presumably equalize the ability to enjoy the same platform as an accomplished statesperson, scientific expert, or thought leader. However, as more people are endowed with the false sense of being "educated" through real-time access to interest-based material (i.e., Fake News, Yellow Journalism, and misinformation), as well as the lowered quality of a higher-education, laypeople believe they are capable of deciphering complex situations without the need for expert distillation. For example, the pseudo-research and information contagions spread on Anti-vaccination campaigns have been primarily propagated by college-educated mothers who have "researched" the negative impacts of vaccinations on children on their own accord (c.f., Poland and Jacobson 2001, Wolfe and Sharp 2002, Kata 2012). Several of these resources documenting the negative impacts of vaccinations are reported to cite the same handful of falsified studies from discredited pseudo-experts in the early 2000s (c.f., Kata 2012, Dubé *et al.* 2015). These sociological shifts are an obvious downside to the empowering nature of Web 2.0 capabilities and ultimately represent some of the negative consequences of the promises of the participation touted to be realized through coded engagement.

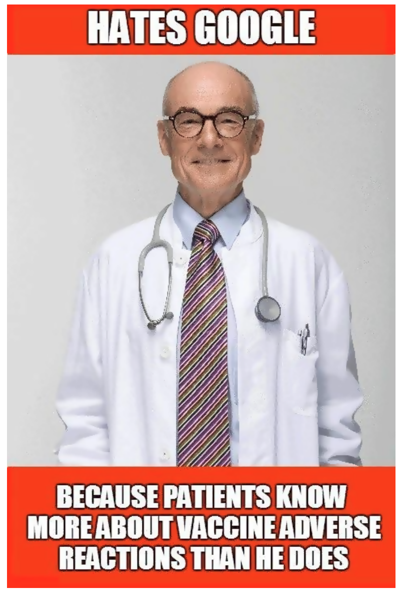

Figure 3 Image posted on the Facebook Group "The Refusers" a popular (over 90,000 people following this page, with over a million unique likes on their posts as of June 6th, 2019) page dedicated to circulating anti-vaccination information

Further to these issues on the role of expert-citizen relationship as that of deliberate gate-keeping and access to the services in the first place, in some cases, public participation on the GeoWeb has even deliberately limited any outsider involvement (i.e., outside of the community) or purposely regulated the sharing of their collective knowledge with officials. For example, Brandusescu and Sieber (2018), assessed the effectiveness of a crowd-sourced mapping platform in Francophone and Anglophone communities of Canada. Their findings indicated persistent technical challenges, consistent with the literature, although crisis mapping allowed increased opportunities for the developer to insert their knowledge. However, this ability for "anyone" to contribute revealed tensions in conceptualization and differing "visions" of what the local knowledge represented and resulted in progressive censoring of content or withdrawal from platforms. These "gatekeeper techniques," although not unprecedented prior to the Web 2.0, are increasingly mentioned as points of concern by officials, as well as the declining influence of public participation on a decision's outcome, despite once being seen as a clarion form of community empowerment (c.f., Kobayashi 2015, Brandusescu and Sieber 2018).

Another significant change in the Web 2.0 shift concerns active participation, such as those requiring deliberative and prolonged engagement with citizens, and methods that have a less pronounced role on the influence a particular method provides (Haklay 2013). Rather than the number of engagements in which citizens participated, the e-participation model emphasizes having numerous participants to indicate or justify the level of influence over official decision-making (Kumar and Vragov 2009, Sweet 2012). Perhaps this change is fueled by the hope that public participation will reap the same benefits that successful crowd-sourcing and citizen-science projects found via the Web 2.0 (e.g., OpenStreetMap). In this view, the public is considered to be an omnipresent crowd and participation is viewed as contributed content (i.e., UGC) through digital media for change in their social, environmental, and political environments (Vesnic-Alujevic 2012). For example, instead of only a handful of highly-engaged citizens, perhaps a broad or general engagement (i.e., through some form of coded engagement) with many citizens could play an effective role in specific applications. Mossberger et al. (2013, p. 351) frame this perspective, emphasizing the major part social media data has played, with the following question and answer: "How has local e-government in the U.S. changed in the past few years? Measured by the scale of change, the unequivocal answer is social media." Thus, the level of influence of e-participation will be increasingly evaluated in terms of how big a scale it achieves in terms of the

V's of big data; the volume of bytes in data, variety of observations, or velocity in which data is collected and analyzed (Sieber and Tenney 2017).

Web 2.0 technologies have extended the means and reach of participation, from traditional forms like town halls and survey methods to digitally-enabled forms, including social media and automated feedback systems (Bertot *et al.* 2010). For example, a planning department can now send a digital survey directly to citizens entering a geofenced[1] neighbourhood by watching their movements on Twitter or their use of a Smart-phone "app" and collecting sensor data about vibrations to automatically report pothole locations while driving. Another example by Zhang et al. (2016), comes with their GMove system, which predicts urban resource needs and human mobility from geotagged tweets, and can effectively generate meaningful group-level mobility models to better attenuate issues of traffic, accessibility, and dynamic planning initiatives. Thus, these technologies offer the possibility for direct citizen-to-government (C2G) connections, enhanced citizen-to-citizen (C2C) interactions, and eventually lead to an "automated democracy" (Davis 2010, Larson 2018). In other words, the ideals of citizens having a direct and ongoing role in the outcomes of governmental decision-making have begun to merge with the data-driven methods of a "fourth paradigm in science" thereby ushering in an era of governance by the algorithm (Esty and Rushing 2007). This era uses:

> [R]obust data collection and analysis to illuminate problems and enable policymaking that is more nimble, tailored, and experimental. Closes gaps in knowledge by harnessing new technologies to collect, analyze and disseminate key data. Focuses on results by setting quantitative, outcome-focused goals, measuring

[1] A geofence is a virtually demarcated and event-triggered boundary for the filtering of digital observations to spatial-temporal zones.

> policy performance, and comparing results among peers. Develop systems to ensure that data are used to guide policy priorities and solutions. (Esty and Rushing 2007, p. 14)

Concerns regarding the quality of information, reach of a digital divide, and political nature of the technology itself persists in the Web 2.0 age of public participation. As Elwood et al. (2012, p. 584) observe, these forms of data "can be said to be asserted, in contrast to the authoritative products of traditional sources that derive their authority from their creation by highly trained experts." In turn, this raises concern about the nature of truth and data quality of UGC when used in "official capacities." In addition, Stephens (2013) and Haklay (2010) note that divisions between gender, race, and social class representation available in data from the Web 2.0; reinforcing the inequalities of social justice prevalent in modern society. These discrepancies in power, representation, and processes (i.e., data collection, data quality, and effects of data analysis) found across new web-enabled participation methods and crowd-sourced systems are still mostly unknown, prompting the need for further research in these areas (Boyd and Crawford 2012).

However, as Stephens-Davidowitz (2017) argues, the phenomenon of lying was not invented on the Internet, and while Web 2.0 technologies exacerbate the inherent issues of data quality they are, in many ways, the legacy of the same concerns that were always attached to data collection methods for behavioural studies. As Stephens-Davidowitz (2017) reports, it is common for many people to underreport their behaviours (especially regarding embarrassing or personal matters) and to suppress their "true" thoughts when traditional surveying methods are used. They want to look good, even though most surveys are anonymous. This phenomenon, termed the "social desirability bias" by Edwards (1957), is well known to the behavioural scientist. This is one of the better known cognitive biases that lead people to have false perceptions of reality covered by Stephens-

Davidowitz (*ibid.*), and as the "post-truth" era of online content is catalyzed by national governments (e.g., to sway political elections), private companies (e.g., Facebook experiments to nudge the moods of users by the content they are shown), and other agendas – there is reason to be critical of and diligent in the use of UGC, as with all data used in making decisions that impact the lives of people and the delivery of government services.

According to some, leading the hyped rhetoric for technological advancement in city operations are the promises of big data solutions for the smart city. Smart cities evoke the idea of a "programmable city" (Martins and McCann 2015) that includes the processes of public participation and C2G influence by integrating Web 2.0 technologies. The algorithms and insights from the data-driven analytics (i.e., data science) behind big data suggest the ability to have computer codes guide data collection and establish meaningful connections in UGC for local government interests (Cardone, Cirri, Corradi, Foschini, *et al.* 2014, Song *et al.* 2015, Cardone *et al.* 2016, Shen *et al.* 2017, Cai *et al.* 2019, Chen *et al.* 2019).

5. Participation Tomorrow: Smart Cities, Big Data, and Coded Engagement

The "smart cities" concept has attracted considerable attention in the context of C2G interaction and urban development. Batty *et al.* (2012, p. 481) see the smart city "as a city in which ICT is merged with traditional infrastructures, coordinated and integrated using new digital technologies." Here technology takes on the role of alleviating the burden of municipal operations and brings with it a machine-like efficiency, much like the way ICT has been employed in public participation projects (Papa *et al.* 2013). These digital technologies offer a variety of e-services (e.g., crime reporting, crowdsensing), act as imperative catalysts to urban development, and assuage the increasingly critical role assumed by cities as drivers of innovation in areas such as health, inclusion, environment and business (Luvisi and Lorenzini 2014, Schaffers *et al.* 2011).

The panoptic view offered by the smart city includes "sensing, capturing, collection and processing of real-time data from billions of connected devices serving many applications including environmental monitoring, industrial applications, business and human-centric pervasive applications" (Zaslavsky *et al.* 2013, p. 1).

Participation in the smart city is determined by both a city's ability to provide citizens with: 1) infrastructural resources, such as access to broadband Internet, so they can engage online (Hernández-Muñoz *et al.* 2011) and 2) the real-time collection of other data like their current location or movements to contextualize citizen activities to their UGC production (Roche 2014). The smart city, therefore, positions public participation as being a collection of human-centric datasets that can inform policymaking, as well as act as an economic commodity and infrastructural capability for stimulating development. However, even so-called "new build" smart cities such as Masdar, United Arab Emirates and Songdo, South Korea, lack much of the reality their smart rhetoric promised to deliver or to return tangible results from the massive public investments (Miller 2016), and serve to highlight the disconnect from the corporate storytelling that in many more cases "unfold[s] in the context of an ongoing neoliberal project promoting privatization and the rollback of the state." (Zook 2017, p. 4) In short, it remains unclear whether public participation as direct democracy or as an economic incentive is the primary motivation behind the rapid adoption of the smart city model.

Citizens are becoming consumers of the technologies, and this is often framed as being a form of empowerment without acknowledgement of the unknown and hidden consequences that these forms of coded engagements can have in terms of their political and environmental impact (Viitanen and Kingston 2014). Thus, the city-systems become a market for data-commodities, where citizen-consumers are participating through increasingly involuntary, or, passive forms of technologically mediated engagement and are funding the interests of global technology firms rather than exercising their democratic rights to influence government decision-making (Gooch *et al.* 2015, McNeill 2015). The consequences, still mostly unknown, are transforming the traditional democratic vision of the city into one where the city acts as an “intelligent system of systems”, defined through its passive participation in technological systems and data collection methods that are imbued with inherent biases and intrinsically leave parts of the city and its population left out of these smart perspectives (Jucevičius *et al.* 2014, Viitanen and Kingston 2014, Sanseverino 2017, van den Buuse and Kolk 2019).

There are many forces behind the motivations for the transition to a smart city. One motivation to be a “smart city” can be argued as resting upon “definitional impreciseness, numerous unspoken assumptions and a rather self-congratulatory tendency (what city does not want to be smart or intelligent?)” (Hollands 2014, p. 303). There is also an economic push to adopt smart technologies in city operations charged by a multi-billion-dollar industry of corporate interests and public-private partnerships (Williams *et al.* 2014). Shelton et al. (2015, p. 14) critique the common emphasis taken by these arguments that focus on merely adding more technology as reducing the smart city to “a kind of universal, rational and depoliticized project that largely plays out according to the terms of profit-maximizing, multinational technology companies.” The use of “smart cities” as a buzzword in neoliberal agendas to drive its adoption is overshadowed by the appealing promises of the development the smart city is assumed to bring. Leal (2007) makes the same case for “participation” and its use as a buzzword subsumed by neoliberal efforts. However, it is with the addition of, yet another similarly used term, “big data,” that a clear connection between public participation and smart cities is formed.

Big data, often defined as being the digital product of ubiquitous sensors and citizen participation on Web 2.0 technologies, is positioned as being a robust representation of many "human-centric" applications (Bizer *et al.* 2012, Hitzler and Janowicz 2013, Bail 2014, Chen, Mao, and Liu 2014). Kitchin (2013) contends that big data is much more than just having access to *more data*. Instead, supporters of big data and data-driven analysis (i.e., data science) claim a new way of "*knowing*" the world (Abramson *et al.* 2014). It is with big data that city officials and decision-makers could gain an unprecedented ability to establish new meaning from human-data and address more complicated social issues:

> Big data holds the promise of a data deluge – of rich, detailed, interrelated, timely and low-cost data – that can provide much more sophisticated, broader scale, finer-grained understandings of societies and the world we live in […] (Kitchin 2013, p. 263).

Both the smart city and big data concepts exist in large part because of the pervasive previously mentioned Web 2.0 technologies and computational advancements over recent years (Chen, Mao, Zhang, *et al.* 2014). Each concept also includes many kinds of data, which Chen et al. (2013) argue are primarily observed in two forms, namely transactional data (e.g., parking meter payments and traffic counts) and UGC (also called VGI in geography). UGC, which has a direct link to public participation inside of big data with corresponding uses for smart cities, is further described as:

> …[T]weets, blogs, discussions, photos/videos posted and shared by users of many Web 2.0 applications. The data of these applications are directly contributed by users, and therefore, they are typically unstructured for user convenience. As for

unstructured data, accompanying metadata such as tags and user names are critical. (Chen *et al.* 2013)

Activities found in the Web 2.0, such as crowdsourcing and UGC found on social media, derive much of their appeal from a sense of participation and connection to local knowledge in the locality of origination (Tulloch 2007).

Furthermore, an increasing amount of all the UGC found in big data emanates from social media platforms (Lenhart *et al.* 2010). These platforms also inherently link data by social, spatial, or topical connections between users (e.g., being friends, living in the same area, or having similar interests) (Boyd and Ellison 2007). Thus, a large portion of UGC takes on a graph-like structure, which can be defined as a social network with space-time constraints (Hollenstein and Purves 2010). This connection that UGC has to social networks is an crucial component of understanding what constitutes participation and community membership (i.e., which public-stakeholder interest you have or share) (c.f., Rathore *et al.* 2017, An and Mendiola-Smith 2018, Chatfield and Reddick 2018, Dabas *et al.* 2018, Dawes and Gharawi 2018, Estrada-Grajales *et al.* 2018, Garreta-Domingo *et al.* 2018, Picon 2018, Rosenschein and Davies 2018, Sarkar 2018).

Using abductive data science techniques to overcome data quality issues, to repurpose our content, to find connections between datasets, and to digitally-replicate our social relationships (e.g., our friends, influence, and social capital) is what broadly defines this coded form of passive public participation (c.f., Frank 2016, Gaudiello *et al.* 2016, Leung *et al.* 2016, Marciniak 2016, Booth 2017, Pink *et al.* 2018, Torabi Asr and Taboada 2019). For example, by liking, another person's post on social media could be interpreted as directly supporting the topics in that content and all similar content. These data can be used further to gauge the importance of the topic itself as well as respective social influence and status as community opinion leaders. Hence, this definition of participation does not *necessarily* require deliberative intent or direct C2G interaction aside from the algorithmic treatment of passively produced UGC, although it does not necessarily exclude active engagement either (e.g., citizen science projects).

Participating in the deluge of data, or data revolution could soon be the most direct form of political engagement many citizens will contribute, with each tweet, post, and pin, constituting another drop in the bucket of collective public opinion (Philip *et al.* 2013). The evangelists who promote such a future, like Executive Chairman of Google Eric Schmidt and Director of Google Ideas, Jared Cohen, welcome a digital age for the democratic processes with the following prediction:

> The future will usher in an unprecedented era of choices and options. While some citizens will attempt to manage their identity by engaging in the minimum amount of virtual participation, others will find the opportunities to participate worth the risk of the exposure they incur. Citizen participation will reach an all-time high as anyone with a mobile handset and access to the Internet will be able to play a part in promoting accountability and transparency. (Schmidt and Cohen 2013, p. 93)

A faulty assumption in these approaches is that by fully embracing the idea that eventually, every citizen's online identity will match in representation, if not extend, their offline lives (Bullingham and Vasconcelos 2013). It also ignores the disparities mentioned in the empirical studies on which and by what means citizens unevenly participate in Web 2.0 services (c.f., Zook 2006, Graham *et al.* 2014, Kelley 2014). Still, the Schmidt and Cohen view contends that "We are what we tweet" (Schmidt and Cohen 2013, p. 83). That is, believing that an honest self-representation is found within UGC will have an incontestable advantage in decision-making processes. Thus, it is argued that big data and data science are a means of providing a direct line to informing officials on the collective interests of their constituents without the prolonged messiness associated with traditional forms of public participation and reducing the friction between citizens and government officials primarily through a process which I call c*oded engagement* and the automation of sensed-citizen data in city processes through data-driven methods.

In this portion of the research, the role code and algorithms are examined as redefining the social production of space in the city. Revisiting the concept of the digital or smart city introduced earlier, Couclelis (2004, p. 6) notes that:

> In the narrowest and most straightforward sense, the digital city thus is a very large software application. The technical challenges of digital-city design and development are manifold and very complex, as shown by the growing literature on the subject. Equally clearly, however, the digital city is much more than a technical and practical issue. It has dimensions that are cognitive, social, cultural, political, ideological, and, no doubt, also theoretical.

Kitchin (2014, p. 9) extends this view to clarify the arrival of the smart city concept as “not a vision of a future city...it already exists in practice through the millions of interconnected, digital socio-technical assemblages embedded into the fabric of cities that frame how people travel, communicate, manage, play, consume, work, and so on.” Thus, “smart” can be viewed as a process of transforming urban life by software, with “tightening bonds between code and the city” (2014, p. 8). This approach explores the overtaking of old and new city operations by “software-enabled technologies [that] are transforming cities and urban life.” (Kitchin 2014, p. 9) For example, in the “The Great Target Outage of 2019,” a computer glitch effectively ceased the operation of all Target retailer’s checkout registers that prevented customers from making any purchase from the store.

This glitch effectively transformed the national retailer from a shopping center for the purchase of goods into a series of disorganized warehouses. These sorts of transductions of space through code are similar to the processes that can/will occur in the adoption of public participation in government decision-making through forms of coded engagement.

The study of computer code and algorithms that play a significant role in urban life and operations connects to the media theories of Marshall McLuhan (e.g., 1994) and the geography of technology research (e.g., Ernst Kapp (1877) is an early example of the geographic study of technological extensibility afforded to human capacities and society that, it has been argued, influenced McLuhan[2]). Just as telecommunications technology "reduced the distance" in a connected world, so do these data-driven methods of coded engagement reduce the friction of participation in local governments (Adams 1995, 2011)—at least that is the argument. As a research area, this topic has developed into overlapping literature that includes software studies, human-computer interaction (HCI), society and technology studies (STS), and new media studies. Several prominent contributions in these fields include those by Manovich (2011, 2013), Fuller (2003, 2008), Galloway (2004, 2013), and Lessig (2001, 2006). Each of these contributors approaches the role of software as a form of cultural practice, or as the acting forces behind new protocols and platforms for society (e.g., McLuhan and Lapham 1994). For example, the title of this dissertation "coding participation" appears in several other themes related to *coding* human and social phenomena through the lens of Galloway (2004, 2013). Wilson (2009), for instance, wrote a dissertation titled "Coding Community," which is a study of the interactions between technological innovation, urban revitalization, and the increasing use of government performance measurement as a quality-of-life metric in Seattle, Washington neighbourhoods. The recognition

[2] Sass H.-M. Man and his environment: Ernst Kapp's pioneering experience and his philosophy of technology and environment. G.E.Lich & D.B.Reeves (eds.), o.c., p. 82-99.

of how cities are increasingly being *coded* through technological mediation is one that traces the interconnections between urban sciences, governance, and technology as they are co-constitutive. These processes increasingly link public and private spaces to be digital observations within big datasets that are harvested through distributed sensors and ubiquitous information technologies. In this way, coded engagement seeks to trace the many ways in which the public is involved in the minds of local-government decision-makers through the use of sensors, data analytics, and big data.

Code/space is a framework for approaching the convergence of software in society (i.e., often called the digital or network society, or the information age) (Castells 2000). Studying the spatial effects of software can be useful for understanding the "smart" territorialization of different aspects of the city (i.e., old processes are defunct or perceived as dated when offered modern or "smart" alternatives). The theories of code/space have elaborated the work in software studies and earlier geographic inquiries into cyberspace (Benedikt 1992, Castells 1996, Adams and Warf 1997, Batty 1997) by the collective efforts of Martin Dodge and Rob Kitchin (e.g., 2004, 2007, 2009, 2010, 2011a, 2011b, 2014). The basic premise of code/space is that software conditions our very existence through the transduction of space (Kitchin and Dodge 2005). There are inherent limitations to the use of code/space and software studies perspectives, which is why there is a component of qualitative investigation on the relationships between coded engagement (i.e., through software) and traditional forms of participation as they coalesce within municipal forms of governance. In this way, how citizens will increasingly interact with government decision-making that will be mediated through software and algorithmic treatments must be investigated for a better understanding of the impact on democratic processes fundamental to contemporary forms of governance.

This research takes the position that a starting point to understanding coded engagement is through software, data, and governance. Thus, it focuses on exploring the use of UGC and data-driven methods to construct potentially large mineable and relevant stores of passive public participation in decision-making processes within future smart cities. The goal is to evaluate how this form of passive participation might impact different levels of municipal operations. These efforts will help to fill the gaps in empirical research on participation through Web 2.0 technologies and to critically evaluate their corresponding use in data-driven cities of the future.

Chapter 3 examines the nature of the analytical methods—that is, data models, UGC, and algorithms used in crowdsensing systems to understand public opinions—as an initial step toward understanding the potential impact of coded engagement. Furthermore, the role of the imaginaries of a smart city as defined by corporate profits and political agendas governing what they actually deliver to communities is outlined in Chapter 4. A deeper look at the multiple views and layered roles of participation in the smart city is presented as a case study of the City of Toronto in Chapter 5. Here, the conflicting views on how to involve the public, what their role is, and the contradictions of smart solutions are presented as empirical examples that bolster the contributions of this dissertation.

There are a variety of issues with coded engagement, as reviewed in this chapter, ranging from the availability of data, inherent bias within big data, compounding uncertainty within black-box algorithms, as well as issues of replicability across different use-cases and geographic contexts. Furthermore, an imminent danger comes from the impact's visions of smart-city have on the role and meaning of traditional public participatory processes. In this way, meaningful forms of participation can be subsumed by technocratic values and effectively remove the ability of citizens to direct their own version of a smart future while *actually existing* in the city of tomorrow.

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PREFACE: CHAPTER 3

With big data and smart city initiatives altering many of the traditional concepts guiding the form and function of public participation in civic decision processes, it is pertinent to interrogate the algorithms and datasets that are used in coded engagement within municipal operations. Recasting "citizens as sensors" (Goodchild 2007) and accepting "governance through algorithms" gives way to the notion that crowd-sensing data (i.e., through arrays of sensors, user-generated content) can assume the role of traditional methods of civic engagement (Tenney & Sieber 2016). Computational approaches are used for reducing the size of big data (i.e., making it feasible for use in most practical applications through aggregation, filtering, conflation, or elimination), making sense of spurious correlations, and gaining insights into massive stockpiles. These approaches utilize digital signals from our technological interactions in everyday life (Zúñiga 2015, Sieber and Tenney 2017). One such approach to harvesting public opinion and identifying communities of interest or practice from the big data deluge is presented in Chapter 3. Using Twitter feeds from around the City of Toronto, a novel methodology and geovisualization tool for exploratory data analysis were developed. This research explored the fitness-for-use of social media data (i.e., big data) from the popular Twitter platform (Hazen *et al.* 2014, D'heer and Verdegem 2015).

Some vital issues must be considered concerning the imposition of data and analytical models (which are themselves abstract representations of reality) on complex big data with a view to understanding social phenomena (Couclelis 2004, Floridi 2012, Brenner 2012). For example, with respect to data quality, in addition to the application of traditional concepts, now there must also be an understanding of positionality in the use of big data (Rose 1997, Sultana 2007, Moser 2008, Crampton 2009). The notion of positionality necessitates a clear understanding of "who" is determining the suitability of datasets (which may be assertive and laden with uncertainty) for use in particular situations. While it is necessary to focus on how big data is used (through a critical lens of "*for whom*" or "*for what*"), there is the additional need to open the box of algorithms and massage the uncertainty to explore within the context, the purpose they were created to fulfill (c.f., O'Neil 2016). Given the nature of big data (user-generated content, more accurately), it would be difficult to understand the "by whom," and more importantly, the "why," behind each observation within the big data universe within the framework of traditional standards of data quality (Brooker *et al.* 2016, Liu *et al.* 2016). The nature of big data poses a myriad of complexity and potential issues (Foody *et al.* 2013, Zook *et al.* 2017). However, essentially, there is utility in the use of data for the development and delivery of city services that are not *only* more *efficient* but more *effective* as well (Hochman and Manovich 2013, Bright and Margetts 2016). While an understanding of the *fitness-for-use* of a particular dataset is less relevant in a fourth-paradigm model of science than in previous paradigms, increased focus on disentangling the complexity of the algorithms applied to datasets represents an initial step (Fuller 2008, Manovich 2013 2014).

The creation of ensemble of methods from natural language processing, spatial, and network analysis, to emulate representations of the social and behavioural phenomenon would be a step toward illuminating the algorithmic operations used in big data analytics and particularly user-generated content. While the choice of the specific techniques used in Chapter 3 was informed by contemporary approaches fitting the current nature and normative uses—these will soon be outdated (Couclelis 2001, Angius 2014, Bogost 2015). Continuous development in data science techniques poses its own problems outside of the nature of the data and uncertainty of intent as discussed previously (see Chapter 2) and in the chapters which follow (i.e., Chapter 4).

The proliferation of techniques and tools used in data science has created added to the problem of understanding the data-driven embodiments of smart cities by introducing an ever-increasing number of choices with respect to analytical methods (Al-Hader and Rodzi 2009, Joss *et al.* 2017, Mainka *et al.* 2016, Fernandez-Anez *et al.* 2018). Furthermore, the complexity of the models has moved beyond that of explainability by way of "plain language" (Doran *et al.* 2017, Gilpin *et al.* 2018). Explainability is the extent to which the values of the features of a model relate to the results in a way that people can understand. In other words, explainability helps to answer the question "why is this happening?" in the model (Choo and Liu 2018). In addition to being able to explain the model, it is also important to use models that are of sufficient interpretability (Chakraborty *et al.* 2017). Interpretability is defined as the consistency in predicting the results of a model without necessarily knowing the reasons why the algorithms produce such outcomes (Zhang and Zhu 2018). This means the researcher or data scientist must often work backwards from the results to the inputs to understand which algorithmic treatments were introduced (Angwin 2016, Bucher 2016). In addition to the endless detective work in understanding the complexity in modern data analysis, there is the more than 10,000 open-source packages on CRAN (the global R repository), the hundreds of ever-changing algorithms that are integral to projects—like Scikit-Learn, Scipy and Pandas for Python, which are just the two most popular programming languages at the moment (Diakopoulos *et al.* 2014). These tools and techniques have facilitated the transition from simplistic rules-based or linear-regression models with modest yet suitable datasets into the treatment of dozens of complex models that leverage the latest unsupervised learning or convolutional neural net approach on massive databases of unknown quality (Yang and Pandey 2011, Pasquale 2015, Geiger 2017). As a result, the traditional focus on merely interpreting the results of well-known analytical methods is lost in the need to understand the process behind them better first, so as to determine whether or not the results are merely suitable (Diesner 2015, Ames 2018, Carter 2018).

Unfortunately, even for the most capable data scientists, peering into the bowels of algorithmic processes is not always possible (Berry 2004, Baytiyeh and Pfaffman 2010, Zielstra and Zipf 2010). While many of the algorithms and techniques used in the analysis in Chapter 3 are extensions of open source projects or code-bases, the majority of the big data "solutions" are part of proprietary software (Al-Hader and Rodzi 2009, Jaloudi 2015, McNeill 2015). Consequently, one of the more salient issues posed by the circus of private companies and proprietary "solutions" to smart city problems is that of interoperability (Scholl 2005, DeNardis and Hackl 2015, Ahlgren *et al.* 2016, Wilmott 2016, Bröring *et al.* 2017, Fietkiewicz *et al.* 2017). Interoperability is the ability not only to understand how one program or model within a solution works but how it is intertwined within the information technology infrastructure of an existing city. This concept of interoperability in the smart city, especially with regard to user-generated content from big data, must include the capability of different programs and software to be able to share inputs/outputs with one another, and also the capacity for the analyst or decision-maker to know what was done from one dataset to the other, and why it was done.

Chapter 3 was submitted and published in the peer-reviewed *International Journal of Geographic Information Systems* (IJGIS) in May 2019. This chapter is co-authored by Matthew Tenney, Dr. Brent Hall, and Professor Renee Sieber. Matthew Tenney is the primary author of the article and responsible for developing all included concepts, designing and implementing the methodology presented, as well as writing the manuscript for publication. Dr. Brent Hall, Director of Education and Research at Esri Canada, assisted in co-authoring the chapter by providing support and direction in the framing of ideas and methodological approaches, as well as in the editing of the manuscript for publication. Professor Sieber also assisted in the framing of content and ideas within the chapter in preparation for publication. This chapter was developed with financial support from "Uncertain Futures: Quality Assurance for Volunteered Geographic Information," a Mitacs Accelerate Ph.D. Fellowship in partnership with Esri Canada. While the primary author, Matthew Tenney, retains all intellectual property and source codes, they are accessible at (http://github.com/terratenney/geocollective), which is an open-source library and was built using a variety of other libraries (e.g., LDAViz).

This Chapter does not present empirical evaluations of the Twitter data, or the methodology developed. Instead, it presents a novel methodology for the conflation of social media data to identify communities of interest and practices, and for interactively exploring emergent topics in a local geographic context. Future work is required to explore the usability and quality of the methods, as well as the data in a series of experimental protocols with City staff. This work necessitates the purchase of complete historical datasets from Twitter, which has been funded and is expected to commence in 2020.

CHAPTER 3 - A CROWD SENSING SYSTEM IDENTIFYING GEOTOPICS AND COMMUNITY INTERESTS FROM USER-GENERATED CONTENT

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Abstract

This paper presents a crowdsensing system (CSS) that captures geospatial social media topics and allows the review of results. Using Web-resources derived from social media platforms, the CSS uses a spatially-situated social network graph to harvest user-generated content from selected organizations and members of the public. This allows 'passively' contributed social media-based opinions, along with different variables, such as time, location, social interaction, service usage, and human activities to be examined and used to identify trending views and influential citizens. The data model and CSS are used for demonstration purposes to identify geotopics and community interests relevant to municipal affairs in the City of Toronto, Canada.

1. Introduction

The smart cities concept has attracted considerable attention in the development of urban policies and operations as an umbrella term for technological convergence in the automation and refinement of municipal operations. Batty (2012) describes the smart city as a city in which information and communication technologies are merged with traditional infrastructures, so that city operations are coordinated and integrated using new digital technologies. These "smart" technologies offer a variety of e-services to citizens (e.g., Open-311 feedback systems, crime reporting, among others). They also act as catalysts to urban development and assuage the demand that cities should be drivers of innovation in areas such as health, inclusion, environment, and business (Schaffers *et al.* 2011). A multitude of factors has created the requirement that the managers of modern cities know as much as possible about what occurs within their jurisdictional boundaries so that they can respond with just-in-time agility to the pressures that their constituents face on a daily basis. This view of smart cities includes "sensing, capturing, collection and processing of real-time data from billions of connected devices serving many different applications including environmental monitoring, industrial applications, business and human-centric pervasive applications" (Zaslavsky *et al.* 2012, p. 1).

Smart cities have the potential to generate and consume enormous volume, velocity, and variety of data. Kitchin (2013a) contends that big data involve much more than just having access to *more data.* Rather, big data and data-driven analyses claim a new way of *knowing* the world. The epistemology of such big data offers city managers, including officials and decision-makers, an unprecedented ability to establish new meaning from human-data passively derived from multifarious sensors, as well as from applications that fall within the domain of what is commonly referred to as 'social media.'

Social media platforms such as Facebook, Twitter, and Instagram generate significant volumes and velocities of 'social, big data' that promise the examination of more complicated social issues within cities than was previously possible. In particular, Kitchin (2013a, p. 3) notes the common view held by many big data evangelists:

> Big data hold the promise of a data deluge – of rich, detailed, interrelated, timely and low-cost data – that can provide much more sophisticated, wider scale, finer grained understandings of societies and the world we live in.

There is already a robust research agenda focused on the nature and potential of such big data, including citizen-generated data, that range from theoretical frameworks (e.g., Sui and DeLyser 2012) to practical service implementations (e.g., Deng *et al.* 2012). In the realm of data production, there is currently only a limited amount of work being done on user-generated content (UGC) for the purposes of thematic and behavioural insights and decision-making processes at the local government level.

The use of data-structures like network graphs and the creation of data models for integrations that represent temporal, social, spatial, and relational characteristics of various aspects of UGC is still largely application-specific (e.g., to monitor a specific topic, or only a handful of users). The metrics and algorithms used on these data models are touted as capable of aiding in various practical applications that are relevant to city management, but as Zook (2017, p. 4) notes:

> These projects come together via complex negotiations and assemblages of technologies, policymakers, vendors and motivations (Shelton et al. 2014) and unfold in the context of an ongoing neoliberal project promoting privatization and the rollback of the state.

Furthermore, current data structures are hard-pressed to accommodate passively generated citizen content (i.e., UGC) in large volumes, and they are also characterized by problems that induce bias and force assumptions of homogeneity with social behaviours (Wojcieszak 2010). Traditional forms of spatial analysis applied to UGC compound uncertainty and often contain assumptions that neglect the complexity of social systems. Even more so, there are significant challenges to gauging levels of linked spatial and social flows of interaction and association (e.g., road-network accessibility versus mobilities and communication) through static representations of dynamic processes (Portugali *et al.* 2012).

1.1 Social Media Contributions as Public Opinion

Goodchild (2007) proposed the initial formulation of spatially-relevant UGC, termed volunteered geographic information (VGI). In the VGI paradigm, citizens are regarded as sensors. Through their contributions to data streams, they can enhance the flows of information (between, to, and from citizens and government decision-makers), and allow identification of salient topics that have the potential to influence the course of a democratic process (Dubois and Gaffney 2014). Such a position views the VGI produced passively from mobile technologies and crowdsourced projects as a means of replenishing declining support for municipal operations that were once seen as being solely the responsibility of municipal and mid-tier levels of government (Goodchild 2007). This form of *produsage* production-shift via UGC has gained widespread credence over recent years. Hence, the potential in re-purposing citizen-produced social media data is now regarded as a viable input for inserting a direct-participation loop in government operations (Roberts 2015).

In the fields of engineering and computational science, the concept of 'crowdsensing' represents a popular area of research (Cardone *et al.* 2013). Similar to citizen sensing, urban sensing and participatory sensing, crowdsensing systems (CSS) can be defined as an integrated hardware and software architecture that is designed to collect UGC via sensor networks and social media contributions (Sheth 2009). Many municipalities now offer digital service platforms designed to connect citizens and government officials for information sharing (Tenney and Sieber 2016). For example, the City of Toronto, Canada's largest metropolitan area, offers a variety of e-engagement media, including social media, to its citizens, seeing these as "an important channel for outreach, communications and engagement with the public, for recruitment of employees, volunteers and public appointees, employee training and for research and social marketing" (City Manager 2015).

This paper introduces such a CSS for social and spatial social media contributed themes and interactions of citizens (i.e., connections between the city, individuals, and locations of communities of interest or practice). In this context, communities of interest or practice are defined as spatially collocated, dispersed or socially-bound associations of individuals who are connected by personal ties and commonalities in themes of expressed interest revealed in social media contributions. The system is the product of passive 'coding of the social,' since contributors may have no active understanding or comprehension of the social networks, they, their peers, or the algorithms that are used reside within.

The CSS is novel in that it combines methods of natural language processing, spatial analysis, and social network analysis (SNA) to create a data structure that can be used to inform local decision-makers of concepts such as trending citizen views on municipal governance and other dimensions of daily life. Its goals are to extract, filter, understand, and establish place-based topics from assemblages of UGC-derived social media posts that can inform administrative decision-making processes.

This paper builds upon the accumulating smart city initiatives and research within the data-science and Internet of Things literature that advocate technological solutions to some of the difficulties that persist with extracting meaningful opinions and positions from geosocial media (Cardone *et al.* 2013). It proposes that the well-known difficulties in harnessing discernible public opinion through traditional means to be augmented by integrating data-driven techniques that automatically extract "similar" information (i.e., topical and trending public opinions) from UGC (Abelshausen *et al.* 2015). The primary contributions of this paper are the use of an ensemble of techniques and methods to build a spatially-contextual social network data model for the exploration of UGC and VGI in an urban context. In the following sections, methods for the extraction of communities of interest, communities of practice, and leveraging geographic context to make sense of these social-relationships through geovisualization are provided through the use case of Twitter in the City of Toronto.

2. Crowdsensing Methodology

The methodology for constructing the CSS uses a Citizen Sensor Network (CSN) data model, which acts as the framework for investigating public opinion through a geographically and socially situated network graph. To construct this data-model from sparse social media data, several network link propagation techniques are used to supplement the connectivity from UGC sources that are explicitly defined (e.g., 'Friend'- 'Follower' relationships within the CSN graph). Using this as a basis to infer social and geographic connections using natural language processing and spatial analysis helps to identify communities of interest or practice that reveal shared or common views on matters of relevance to public decision making.

Together, the CSN and associated methodology are illustrated through the process flow diagram shown in Figure 4. In this end-to-end schematic, data are first harvested and then conflated to extract the embedded UGC from social media platforms, measuring document similarity to establish communities of interest and conflict, and using the space-time clustering and topic modelling to formalize geographic communities of practice among local residents and city officials. In the final step, geotopics are extracted with the use of topic modelling to reveal themes of common interest and concern among contributors.

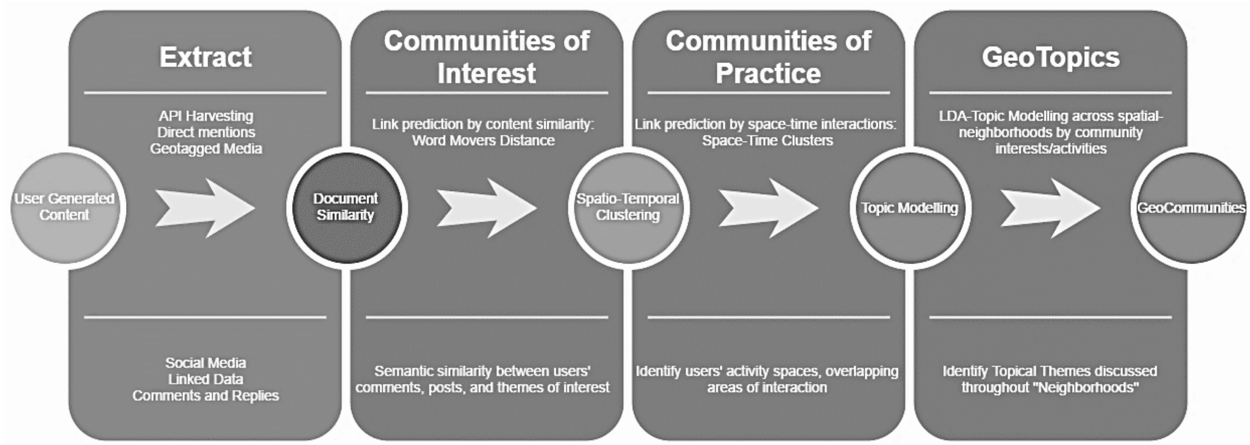

Figure 4 Process for extracting user-generated content, forming social connections, semantic similarity, clustering and topic modelling to formalize geographic communities of interest and practice.

2.1 Citizen Network Data Structure

The associated CSN data model for the CSS is defined as a mixed tripartite graph *G* with nodes *N* and edges *E* such that *G* = (*N*, *E*). Constrained by space-time dimensions, graph *G* is further divided into three connected subgraphs *U*, *C*, *T* containing unique node and edge types respectively defined as:

$$U = (Un, Ue), C = (Cn, Ce), \text{ and } T = (Tn, Te),$$

where *U*, *C*, and *T* are respectively a user graph, a content graph, and a topic graph, *Un* = User Nodes, *Ue* = User Edges, *Cn* = Content Nodes, *Ce* = Content Edges, *Tn* = (Geo)Topic Nodes, and *Te* = (Geo)Topic Edges.

The three connected subgraphs form spatially-situated networks where *Tn* and *Te* comprise the “geotopics” identified in Figure 1, anchored to a pre-defined location in geographic space. The information contained in each sub-graph includes:

1. User-network (*U* subgraph) contains social-network relationships between citizens (nodes) with two kinds of connections (edges) representing relationships from social affiliation or linkages to shared interest similarities;

2. Content-network (*C* subgraph) connects content (nodes – often being unstructured text) directly to the creator/user, has ties (edges) representing semantically similar content within the subgraph, a third edge-type that when established connects to other creators/users, and finally contains a set of ties (edges) connecting nodes from the next sub-graph that also represent semantic similarity (added in *U*).

3. Geotopic-network (*T* subgraph) is primarily populated with content nodes that represent "geotopics" about municipal issues. These nodes are tied to relevant locations, such as neighbourhoods or administrative boundaries.

All edges within a single sub-graph are undirected, but each set of "bridge" edges that connect different sub-graphs are defined as directed-edges. Using undirected and directed edges in this way allows for selectively applying analytical measures to specified graph-components such that the whole network structure of *G* can be used for different graph analytics. For example, finding communities of interest among contributors is achieved by considering only particular sub-graphs, or expanding the analysis to include all "in-edges" from the content-graph as available paths between users. The mixed-graph (both undirected and directed edges) design shown in Figure 5 also provides a network structure that is sensitive to variances in interaction-flows at both the local and global levels.

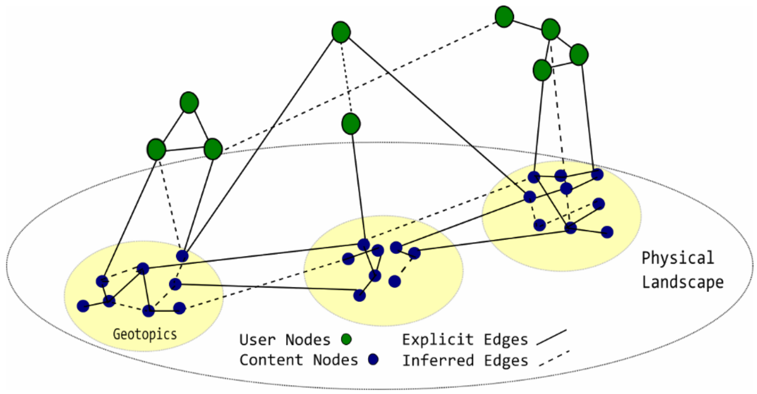

Figure 5 Proposed Network data structure for Citizen Sensor Networks (CSN), indicating the role of different edge types in a tripartite graph structure

While the defined network data-structure for the CSS is relatively complex in design as a three-component multi-graph, it has the advantage of providing a uniform model for integrating heterogeneous data from each collection-source (e.g., unstructured text from Web pages, as well as social media content from platforms such as Twitter and Facebook). A network-organization of assembled data feeds the additional advantage of clearly capturing and representing various social-dynamics that can be observed in reality (i.e., connections in social-relationships and spatial-interactions) (Scott 2015, pp. 449–452).

Together, the network graph model and associated processes can be linked to the process flow diagram shown in Figure 5. As noted earlier, this captures an end-to-end schematic of the extraction of UGC from social media platforms, the construction of social connections, the semantic similarity of views expressed in contributions such as Tweets from the Twitter platform, and their clustering and topic modelling to formalize geographic communities of interest and practice among local residents and city officials.

2.2 Link Propagation and Network Structure

The initial structure of *G* is defined with explicit ties found from the collected UGC and VGI data. An explicit edge means that all user connections (edges in *U*) can be formed from user relationships (i.e., Friends or Followers), and each user is directly connected (ego networks) to their content. As shown in Figure 6, additional connections can be created based on the similarity of content and interaction between users (dash-dotted lines). This relational phenomenon invokes the notion of homophily, or the tendency of individuals to associate and bond with similar others, as in the idiom "birds of a feather flock together" (McPherson *et al.* 2001).

The presence of homophily has been discovered in a large number of network studies. Similarly, Tobler's First Law applied to a space-time perspective gives reason to believe that people who live, work, and interact in the same areas and with the same information will, in general, be more similar in most ways, including expressed views, than others who are further away (Tobler 2004). A number of proxy and similarity measures (e.g., document similarity) through natural language processing (NLP) and spatial analysis (e.g., space-time clustering) can be used to examine the presence of homophily and used for link propagation weighting. Thus, establishing formal "links" between unconnected people through a social network is accomplished in the CSS by link prediction.

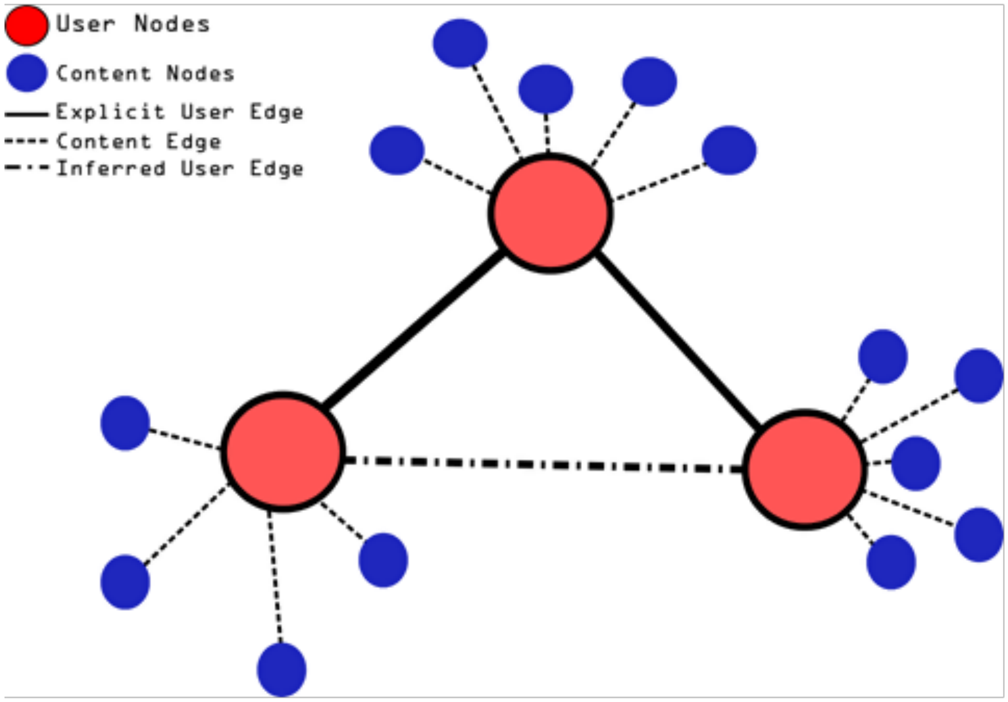

Figure 6 Example of the inferred links between users based on similarity measures.

Link prediction is defined as inferring "new edges" or latent connections within a graph in order to create links between previously unconnected nodes (e.g., Figure 6). Various methods exist for link prediction to analyze social networks and suggest potential interactions or collaborations that are not realized or observed explicitly (see, for example, Antaris, Rafailidis, and Nanopoulos 2014). In a number of domains, a network of interactions can be constructed based on observable data, and then links that are likely to exist are inferred (Clauset *et al.* 2008). The problem in predicting links refers to inferring missing links from an observed network. This approach differs from other problems in graph theory that work with a static snapshot of a network rather than considering network evolution (e.g., using network structure and measures like the Jaccard Similarity Index - c.f., Johnston 1976). The methodology used in this paper infers social-homophily from the network, rather than predicting linkages based purely on the graph structure.

2.3 Communities of Interest

A community of interest, as noted earlier, is defined simply as a group of people who share a common interest or passion (Newman 1981). These people exchange ideas and thoughts but may know little about each other outside of the common interest(s), which form their group identity (Flint 2009; Omer, Bak, and Schreck 2010). Communities of interest can be represented in a social network structure by establishing a series of similarity measures based on user connections, user interactions, and user content similarity. The similarity of topical discussions has been measured in other research on micro-blogs, and social media platforms, mostly using computational sentiment analysis. However, these studies have failed to take into account semantic relationships in natural language (Gryc and Moilanen 2014). This deficiency can be assuaged by embedding sentiment explicitly in the natural language processing (NLP) approaches used in measuring document similarity (Chua and Banerjee 2016). These relationships are defined as:

- User Connections: A connection on a social media platform like Twitter to be a ‘following’ or a ‘being followed’ relationship between two users is one of the most salient factors that produce online community structures (Stephens and Poorthuis 2015). Hence, an edge with a weight of 1 exists between two users if either follows or is a follower. Thus, the user’s social connections (or the user adjacency list) is a two-column matrix with a link between two users who have a following or being followed relation.
- User Mentions: A mention is an event of referencing another user in the UGC (Boyd *et al.* 2010). The number of mentions that two users make about each other are counted as an edge-weight between user nodes (*u, v*), normalized by the total number of users mentions by each user.

- UGC Similarity: Unstructured content can be used as a similarity measure between different users that may not have indicated any form of interpersonal relationship within the platform (i.e., User A follows User B). For example, most users on Twitter use posts with 140 characters (including hyperlinks and multimedia content) to indicate what they are interested in commenting on. Hence, this unstructured content can be used as a semantic similarity measure between different users that may not have indicated any form of interpersonal relationship within the platform (i.e., User A follows User B).

2.3.1 Document Similarity

With this approach, the text of each item of UGC is treated as an individual document. The document similarity measure between items allows the extent to which users are interested in similar topics to be established. A similarity measure is defined between documents by transforming a user's corpus, which is a collection of documents into word-vectors (Řehůřek and Sojka 2010). Once in vector-space, a distance measure (commonly cosine or Euclidian distance) can be applied to identify how closely individual words are semantically related and therefore move beyond similarity based on sentiment alone (da Silva *et al.* 2014). Since documents are composed of words and form the ideas, views, and opinions of the users, creating them, their similarity can be used to create a similarity measure between documents. The reasoning behind this approach is that if users talk about the same topic, they are more likely to be interested in similar things. The stronger the similarity between words that describe common interests, the more salient a topic is within a community of interest.

2.3.2 Word Mover's Distance

Word Mover's Distance (WMD) is a method that allows a "distance" between two documents to be calculated, even when no words are shared between the documents. WMD measures the distance between two texts by summing the minimum distance each word in one document must move in vector space to the closest word in the other document, as shown in Figure 7 (Marinai *et al.* 2011). Using the implementation-defined by Kusner et al. (2015), a word2vec word-embedding approach was used in the CSS, as further explained in Goldberg and Levy (2014). Using word2vec vector embeddings of words is effective at reaching the semantic information within a sentence when compared to other k-nearest neighbour document classification approaches (Goldberg and Levy 2014).

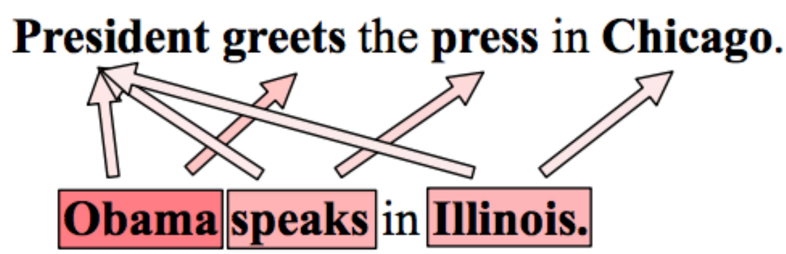

Figure 7 An example of WMD (Adapted from Kusner et al. 2015)

As noted above, WMD can handle sentences that have no specific words in common but can match relevant words to each other. In this way, WMD can measure the (dis)similarity between two sentences accurately. The choice in using WMD was in part due to it having improved results in semantically matching short documents (i.e., such as Tweets) when compared to other approaches using topic-modelling or labelled corpus approached (Şulea 2017). How WMD works is by adapting the earth mover's distance[3] measure to the vector-space of documents, where the

[3] http://homepages.inf.ed.ac.uk/rbf/cvonline/local_copies/rubner/emd.htm

distance between two texts is given by the total amount of "mass" needed to move the words from one text into the other, multiplied by the distance the words need to move (Kusner *et al.* 2015).

2.4 Communities of Practice

Lave and Wenger (1998) first introduced the term communities of practice to describe community formation and integration through the practice and participation of community members. The relationships and structure of the community are created over time through a process of fringe participation or co-involvement in some activity between people ($n \geq 2$). This local perspective (through a spatial interaction perspective) reiterates the notion of proximity, and local milieu indicates a spatiality of knowledge creation in interactive learning processes (Bathelt *et al.* 2004). Thus, a community of practice is, as noted earlier, a group that shares a common interest and a desire to participate in the same area, issue or activity (Wenger 2011). Social interaction and participation together define the characteristic ways of belonging to a community.

In this paper, the peripheral interaction and similar activities or collective behaviours (e.g., mass attendance to special events) in geographic areas between users form a discernible identity in both the geographic and social worlds, that are brought together within the CSS (Coe and Bunnell 2003, Morgan 2004). Wenger (1999, pp. 73–74) formally defined communities of practice as consisting of three interrelated concepts, namely members share mutual engagement in activities or interests, members embark on joint enterprises through their interactions, and members have a shared repertoire of activities and resource uses. Informed by these concepts, similarity measures are identified between the activity areas of users as being members of a demonstrable 'geographic' community of practice (Roth *et al.* 2011).

2.4.1 User Activity Clusters and Inferences of Location

Not every item of UGC is attributed with a geotag and often there is a need to identify individual contributor activity centres according to their most frequently observed locations. Segmenting a contributor's daily timeline into four 6hr classes (0:01-6:00hr, 6:01-13:00hr, 13:01-19:00hr, 19:01-24:00hr), can allow identification of a geographic centre location for a specific time period to which UGC with missing location values can be assigned in the same time period of the day. If there are no observations from which to assign a mean geographic centre value to form a particular time period, then the contributor's global average centre value can be used. This value is calculated as the geographic mean centre of the individual's complete set of locations. While more sophisticated techniques for filling in missing location-based information exist, such as those utilizing network structure and social associations as well as self-reported information, a behavioural approach informed by the review done by Jurgens et al. (2015) was used for geo-inferencing user locations based on *a priori* judgments on work-life activities and similar concepts of temporal variations in geographic activity spaces.

An epsilon value can be calculated to set a maximum distance between two locations for an individual to be considered as being present within the same neighbourhood or geographic zone for any or all of the time zones noted above. This value was taken to be half the mean nearest neighbour distance between all user activity observations. This statistic allows clustered centres of activity areas to be identified by using the epsilon threshold in the DBSCAN algorithm to label each UGC item as a member of a particular activity area cluster (Gialampoukidis *et al.* 2016).

2.4.2 GeoTopics and Neighbourhood Interests

Topic-modelling can be used to calculate themes of discussion or interest in social media such as Twitter (c.f., Zhao *et al.* 2011, Smith *et al.* 2014). In this paper, the unsupervised Latent Dirichlet

Allocation (LDA) learning algorithm was used for the CSS to classify social media contributions into topics. The LDA algorithm has been used for some time in general text classification (e.g., Omar *et al.* 2015), and applied specifically to classifying Twitter data in various studies with geographic perspectives (e.g., Zhao *et al*. 2011; Lansley and Longley 2016).

LDA uses a "bag of words" approach, where each document (e.g., in this case, a Tweet) contains a random set of words tokenized into vector-space. The frequency of these words is extracted to create a probability distribution, consisting of key terms that identify each topic a document 'belongs' to (Taddy 2012). To address the approximate selection of the number of topics, we offer a dynamic model choice using the hierarchical LDA (hLDA), which model extends LDA to infer a hierarchy of topics from a corpus of documents (c.f., Blei *et al.* 2003). The end-user is able to override the number of topics being shown for each area by using a dynamic user-interface tool.

A dynamic visualization tool, discussed below, called LDAViz, was used to address this issue in the CSS and aid in topic selection and filtering. LDA allowed the construction of the specific "geotopics" evident in instances where topic emergence was limited to all content in the document within areas defined by specific geographic boundaries. For example, in the case of the City of Toronto, described below, municipal ward boundaries were used for convenience as "neighbourhoods" to represent specific "communities of interest" with spatial bounds. An approach of how to deploy a geographic topic model (i.e., to define geotopics) is demonstrated with an example in the following section.

Identifying topical themes in a particular area can inform decision-makers as to not only what interests' members of the public have relative to that area, but also all areas where related themes apply. To achieve this requires presenting and filtering complex and multidimensional data in meaningful ways. In this context, criticism of LDA topic modelling is how topic membership can best be interpreted from document keywords and term frequencies (Taddy 2012). Specifically, Siever and Shirley (2014) ask the following questions of a fitted LDA topic model: (1) “What is the meaning of each topic?” (2) “How prevalent is each topic?” moreover, (3) “How do the topics relate to each other?” To help answer these questions, Siever and Shirley created the LDAViz library to present different visual components that ease the burden of complexity.

LDAViz is designed to help users interpret the topic model that has been fit to a corpus of text documents. Through interactive sliders, density circles, and bar graphs LDAViz seeks to reduce the internal complexity of the LDA topics through a visually intuitive user interface. LDAViz leaves some parameters, primarily used for reducing the dimensionality and noise of the model, open to the user to select interactively, thus making it a suitable tool for exploratory data analysis. The left and right panels of the visualization shown in Figure 8 are linked such that selecting a topic (on the left) reveals the most useful terms that can be used (on the right) to interpret the selected topic. Using a split-pane view, LADviz similarly allows the user to select a term (on the right), which reveals the conditional distribution over topics (on the left) for the selected term. Having this kind of linked selection allows users of the CSS to examine a large number of topic-term relationships compactly and intuitively.

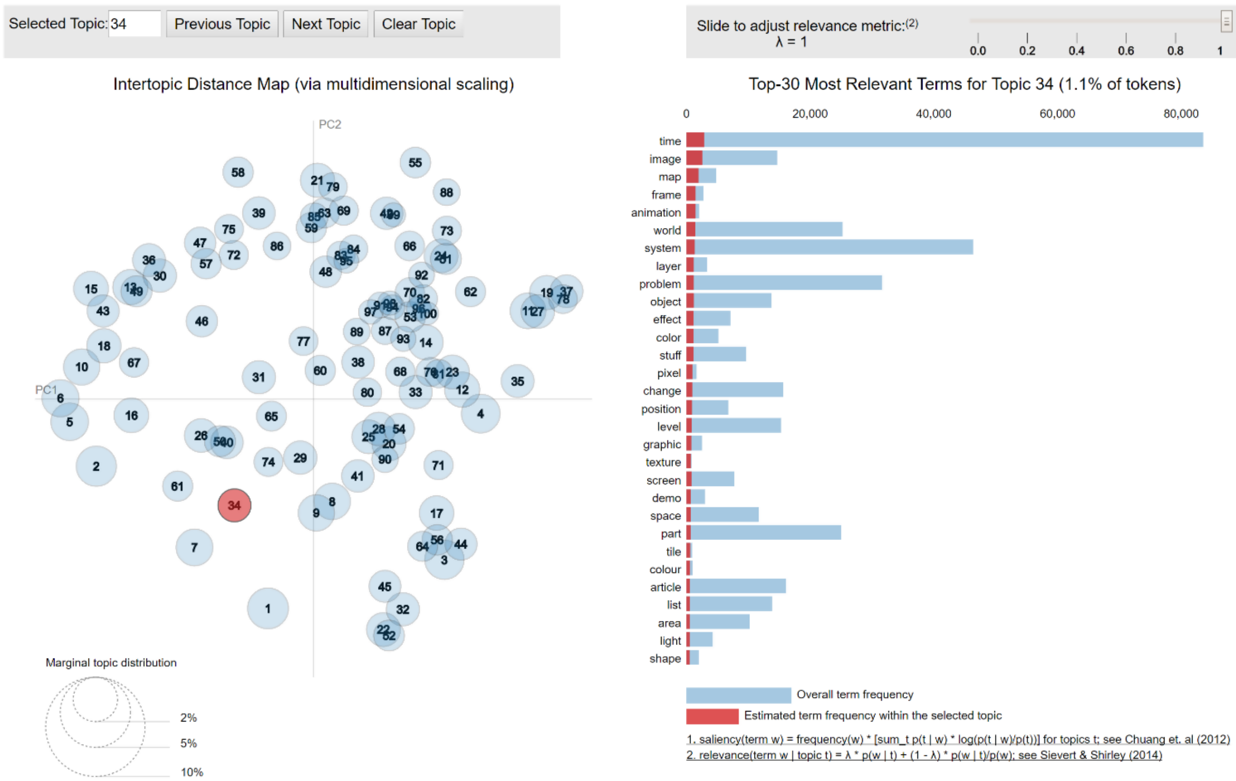

Figure 8 LDAViz Example (Siever and Shirley 2014).

Siever and Shirley further define four sets of visual elements that can be displayed to assist interpretation, depending on the state of the visualization:

- Blue circles, as shown in Figure 8, one to represent each topic, whose areas are set to be proportional to the number of topics across the N total words in the corpus.
- Red horizontal bars, each of which represents the estimated number of times a given topic, generates a given term. When a topic is selected, red bars are shown indicating the most relevant terms for the selected topic.
- Blue horizontal bars, each representing the overall frequency of each term in the whole corpus. When no topic is selected, LDAViz displays the blue bars

for the topmost salient terms in the corpus, and when a topic is selected, the blue bars are displayed for the most relevant terms (Chuang et al. 2013).

- Topic-term circles whose areas are set to be proportional to the frequencies of which a given term is estimated to be generated by the topics. When a given term is highlighted, the circle's transition areas change to be proportional to the selected term.

CSS geotopics presented through LDAViz alone can provide significant insight into the topics present in a specific geographic area. However, while the tool is useful, it fails to consider the spatial dimension of interactions between communities of practice and interest across multiple urban neighbourhoods. To achieve this, the CSS uses a custom-developed Web-app to visualize how the geographic connections between users and their content influence the data shown in LDAViz. This allows geotopics to be bound explicitly and importantly to the spatial dimensions of "who" is behind their creation.

3. Use of the CSS in the City of Toronto

The CSS described in the previous sections was applied in the City of Toronto, Canada, and, as noted earlier, its 140 municipal neighbourhoods were used as the boundaries for the subsequent data collection and analysis. The choice to use existing administrative boundaries, instead of arbitrary geometric tessellations or other regular areal units, was pragmatic in the sense that these boundaries are associated with current government decision-making processes, and hence they have practical meaning in the life of the city. Each ward has an elected city councillor (i.e., a representative for the ward's interests in city operations and decision making) with social and often historical associations to the area they represent.

Using the bounding area of the city limits as a first-level geographic filter, the CSS database was seeded for pilot testing with geotagged Tweets over several month-long intervals (initially June, July, and August of 2016). During this initial seeing period, over 11 million geotagged Tweets were collected from over 60,000 different contributors. According to Sloan et al. (2013), approximately 0.85 percent of all Tweets are geotagged, with a geographic variance between urban and rural areas and socio-economic classes. This amounts to approximately 500 million geotagged Tweets per day (Sloan and Morgan 2015). After collecting these initial 60,000+ user Timelines and their first-order connection Timelines the database was populated with over 71 million Tweets, including 1.54 million geotagged Tweets within the municipal boundaries of Toronto.

Geotagged Tweets are posted by Twitter contributors within the City of Toronto on a daily basis. However, these posts may be contributed by individuals, companies, and in some cases, Twitter bots. Hence, relying only on geotagged Tweets alone may cause significant inherent bias in observed findings, depending on the topic being studied. Sloan and Morgan (2015) also note that for geotagged data from the 1 percent Twitter application programming interface (API), the gender, age and class differences may be tolerable and not vary dramatically between broader Twitter contributor demographics, hence suggesting it comprises a representative sample of all contributors in specific geographic contexts.

The length of the initial database seeding phase is essential in terms of obtaining a representative sample of Twitter contributors who have posted content with a GPS tag within the City bounds (Marwick and Boyd 2011). Further, variation in the time would likely be a pivotal point of concern, depending on the specific application intended. Hence, these initial Twitter contributors act as the CSS entry-points for harvesting data from the Twitter-based social media networks associated with the urban area.

3.1 Data Harvesting

The Twitter platform provides an HTTP-based open-source API and shares posts with third-party applications. The API consists of two different parts, namely a Search API and REST API. The REST API allows Twitter developers to access historical Twitter data. These data include Tweets, Timelines, and contributor data, as well as their social connections (i.e., Followers and Friends). The search API allows developers to query Tweets, find contributors, and isolate relationships, all of which are required for application of the CSS data model.

Data harvesters were linked to each of the contributor's feeds found on Twitter. Using Twitter's streaming API, the collection and monitoring of all Tweets were automated from contributor account Timelines and subsequently from contributors' connections (i.e., retweets, Friends, and Followers). The initial 60,000+ contributors within the Toronto study area over the study time period comprised the entire corpus (i.e., Timeline) of Twitter data that were collected. Timelines of contributors' Followers and Friends were also collected for each of the contributor's accounts, as well as instances where others might create a Tweet with one of these accounts in the form of a "mention." Only first-order connections, direct connections explicitly made within 1 edge distance (i.e., Friend or Follower), were collected for all other users. Hence, 2^{nd} order connections were not collected for the friends of the initial contributors (i.e., "their Friends, Friends").

Second-degree social connections were also collected for each contributor's Friends and Followers who were connected to each Twitter account. Using each individual's social network from the ego node, links or edges were built to other contributor accounts according to each Follower and Friend list. For example, the @TorontoCouncil Twitter handle had 25,000 Twitter contributors following (i.e., "Followers") and 93 accounts it was following (i.e., "Friends"). The account's timeline of messages was collected, and all of the accounts referenced in mentions, replies, retweets, and favourites were identified. The same procedure was undertaken recursively for all individuals in the associated mentions and data collection stages.

3.2 Implementation

Consistent with the CSS methodology outlined earlier, WMD was used to perform a pair-wise comparison between contributors and the content of their accumulated Tweets to establish a global similarity matrix between all contributor content. Using the point of a maximum slope change, the first derivative of critical point $f(x)$ was calculated as the threshold for link prediction between users. If an individual's content scored a similarity value above this threshold, then a weighted edge was created reflecting this inferential tie through the content scores.

Activity clusters were then created from the documents (i.e., Tweets) contained in an entire contributor's Timeline using space-time clustering for each contributor. These clusters were subsequently classified as being a member of one of the activity area clusters (see the example in Figure 9). Pair-Wise comparison between contributors' centroids of their activity centres and to other contributors' activity centres was then performed to establish the global similarity matrix between all contributors' overlapping activity spaces.

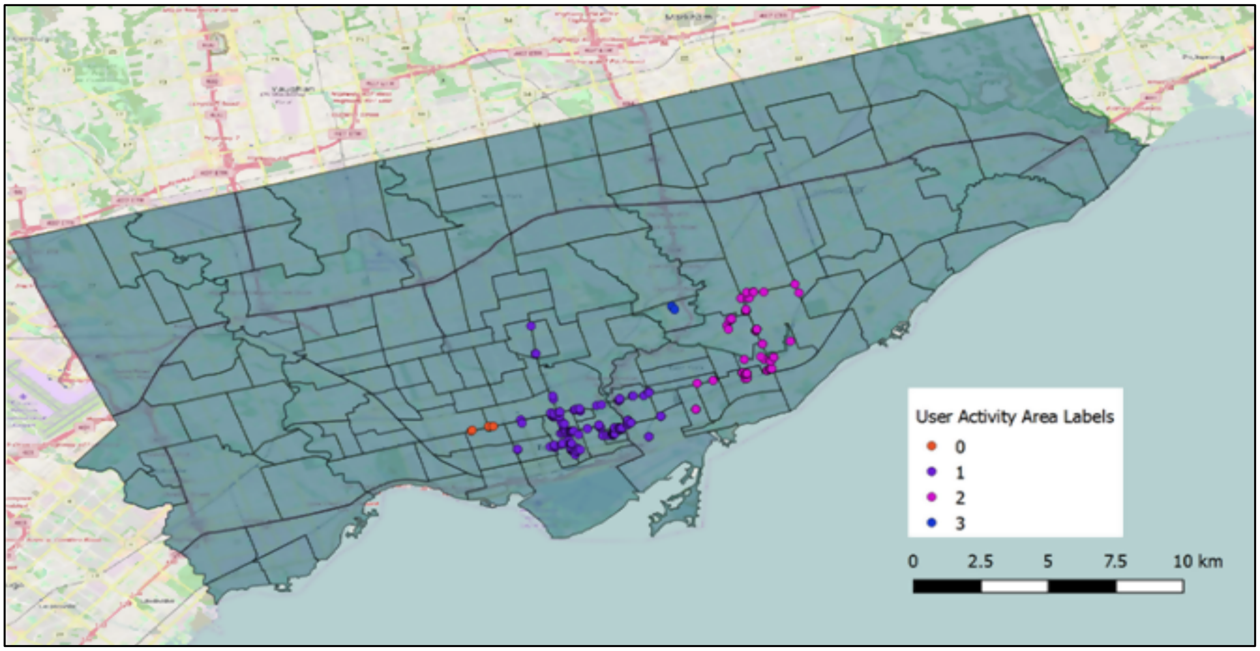

Figure 9 Example of determining User Activity Clusters in Toronto, ON.

Geotopics for the corresponding activity clusters were associated with the administrative boundary units independent of observed or inferred UGC connections. That is, the Twitter content found within the bounds of each of the ward polygons was examined, allowing for a series of activity-based observations to be collected on certain neighbourhoods to reflect the dynamic nature of activity patterns evident in the lives of city inhabitants. For example, everyday activities such as visiting a park, going to a coffee shop, or other activities allow the dynamics of the city to be reconceptualized, based on the way people interact with the urban realm.

Themes of information were extracted using the LDA natural language processing technique of topic-modelling described earlier, where a model was created for each corresponding ward polygon (Figure 10 Geotopics for Toronto wards presented by yellow area centroids for each city ward) to compare the content within these geographic boundaries.

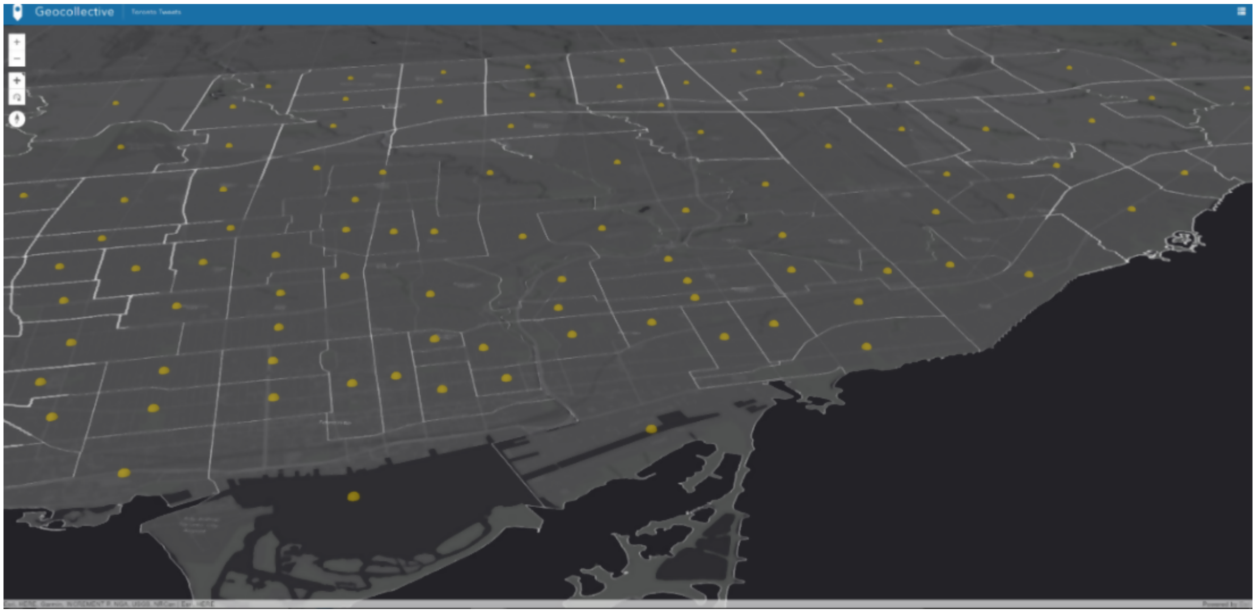

Figure 10 Geotopics for Toronto wards presented by yellow area centroids for each city ward

In order to visualize the resulting time and space assemblage complexity inherent in the geotopics and themes contained in the Twitter contributions, and to allow the information content to be filtered, visualized and used effectively to inform municipal decision processes, the CSS was further enhanced with the addition of three-dimensional (3D) visualization capability.

3.3 Using Geovisualization to Understand Complex Data Relationships

Three-dimensional geographic visualization (3DGeoViz) tools have appeared over the past several decades as a solution to the challenge of capturing public interest, making local issues more personal, and motivating community members to take action in relation to specific issues (Andrienko *et al.* 2007). Loosely described, the field of geovisualization is "the bounded domain that addresses the visual exploration, analysis, synthesis, and presentation of geospatial data by integrating approaches from various" (Kraak 2009, p. 492). Thus, 3DGeoViz is an extension of traditional cartographic visualization, with the emphasis placed on including varying levels of interactivity with and content filtering of data.

There is no single most suitable method of data visualization for an idea or problem. The choice of representation method depends on the situation, where the presentation of information is evidential of the reality that is being communicated. This is succinctly stated by Tufte (2006, p. 78) as follows:

> The evidence is evidence, whether words, numbers, images, diagrams, still or moving. It is all information after all. For readers and viewers, the intellectual task remains constant regardless of the particular mode of evidence: to understand and to reason about the materials at hand, and to appraise their quality, relevance, and integrity.

More generally, the use of geovisualization provides two major roles in research, namely analysis, which facilitates visual thinking and exploration of complex data, and communication, which visually communicates results so that they can be easily and consistently understood by a diversity of users (MacEachren and Kraak 2001). Here, the goal is to make the information easily disseminated. Second, it should not over-simplify the complexity of the information or dimensionality of the data to the point where information nuances are lost, misinterpreted, or purposely conveyed inaccurately. As Tufte (2006, p. 128) succinctly puts it, "Analytical presentations ultimately stand or fall depending on the quality, relevance, and integrity of their content."

3.3.1 Geocollective: Adding 3D visualization to the CSS

With the above principles of geovisualization in mind, a Web-based 3DGeoViz application was added to the geotopics content of the CSS using Esri's JavaScript API Version 4.3. This addition was designed to communicate, as simply as possible, the complexity of the Twitter data from the

City of Toronto, and to present a means to explore evidence of the geotopics inherent in the social media content across the study area. The application integrates 2D and 3D data into single "Web scenes," which are well suited for visualization purposes. An LDA topic-model was trained on the Twitter content intersecting the unit boundaries to allow the classification of new observations into new or existing geotopics as needed.

Selecting a geotopic in the 3DGeoViz application triggers a popup window where users are presented with an interactive LDAViz graph, as shown in Figure 8. This presentation of the topic-model results in a means to reduce the complexity of information contained within one community of interest and allows CSS users to interact with the LDAViz content as needed to explore spatially associated geotopics independently or in comparison.

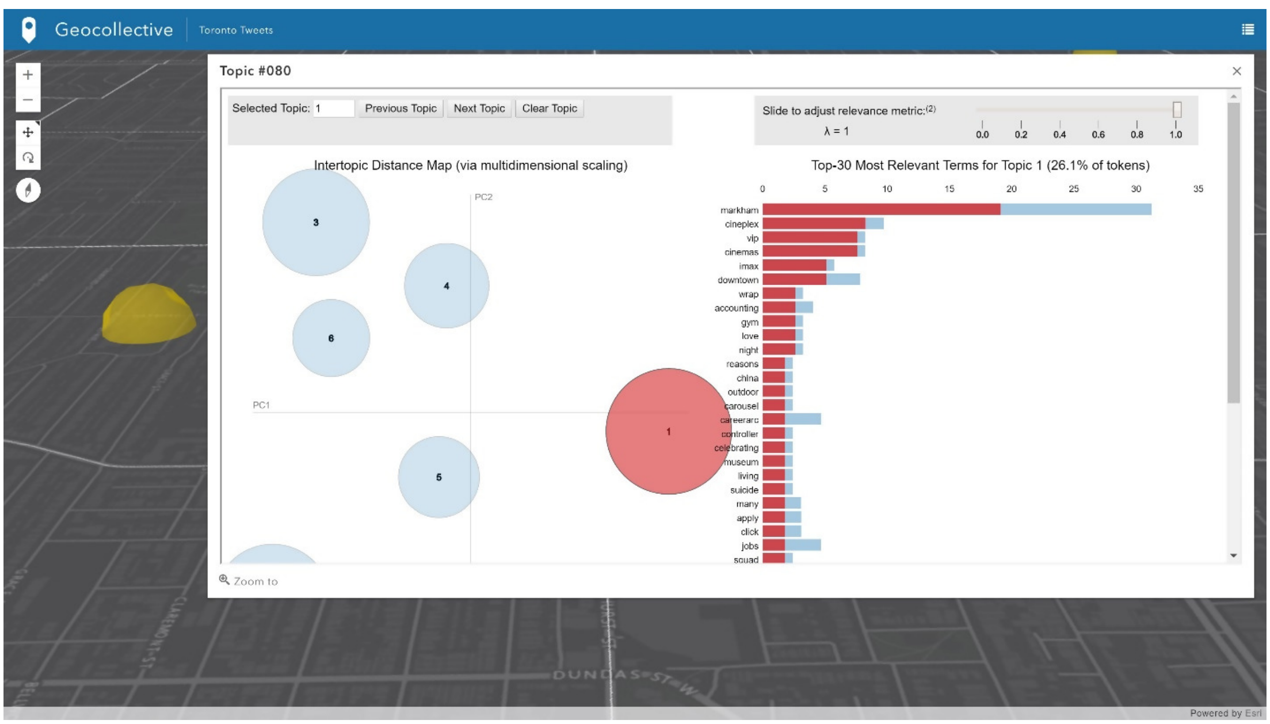

Figure 11 Results of LDA for each geotopic in different windows, with spatially located topics.

3.3.2 Exploring Social Connections and Community Activity

To convey the complexity of contributor social interactions across time and space, a multi-tiered spatially-situated network graph was constructed from the derived 3D geometries. In this graph model, user nodes are positioned at the geographic centres of all their activity areas on the same plane for all on the Z-axis at a set distance above all content nodes. Selecting a ward polygon in the Web scene triggers content Tweets in that area to appear with their corresponding edges. Multiple contributors can be connected to multiple content nodes as determined by their semantic Tweet similarity using the document and content similarity described earlier. This is shown in Figure 12, where the green nodes represent specific Twitter users in subgraph *U*, with salmon content connections to subgraph *C*, and geotopic nodes of the topic graph *T* are seen in yellow at the ground level ward centroids.

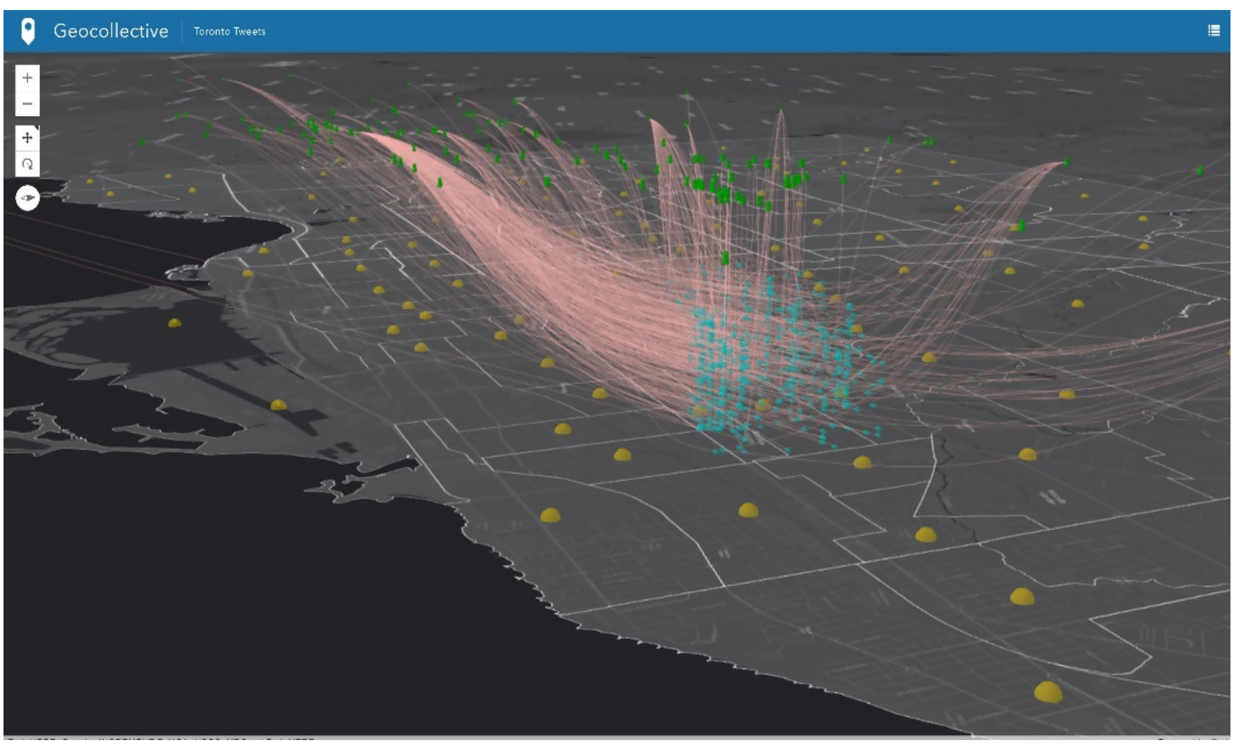

Figure 12 Example of CSS data-structure situated over Toronto. Green nodes (users), blue nodes (content), yellow nodes (geotopics)

The blue content nodes in Figure 13 are arranged according to their creation time on the vertical axis (z-axis), with user nodes being set on the same plane above these. More recent Tweets are located closer to the surface and follow a temporal decay normalized according to the Tweeter's Timeline. Older content is thus put in sequence towards more recent higher z-values. Users of the 3D GeoViz component of the CSS can also select content nodes interactively to trigger a popup that displays its attributes, as shown in Figure 13. Moreover, links from selected content nodes are highlighted to indicate the Tweeter of origin and can be expanded to highlight which other Tweeters form a community of interest through semantically similar content.

Figure 13 Content nodes arranged vertically by time, with interactivity to view content and highlight its originating contributor, embedded content, and connections via topical similarity.

3.3.3 Comparing and Contrasting Complexity

As noted by Tufte (2006, p. 128), and to make meaningful comparisons in the content of Tweets within the CSS, multiple wards in this case in the City of Toronto can provide a visual comparison between a specific Tweeter and his/her content connections, as well as indicate dynamic between-contributor interactions for geotopic comparisons of multiple neighborhoods over space (see Figure 14). Seeing complexity in a 3D visualization application is often important, but to the decision-maker knowing just how complex an area in question is relative to another area is at least equally important. It is often more important to be able to determine how an area differs from its immediate neighbours than how it relates to another area.

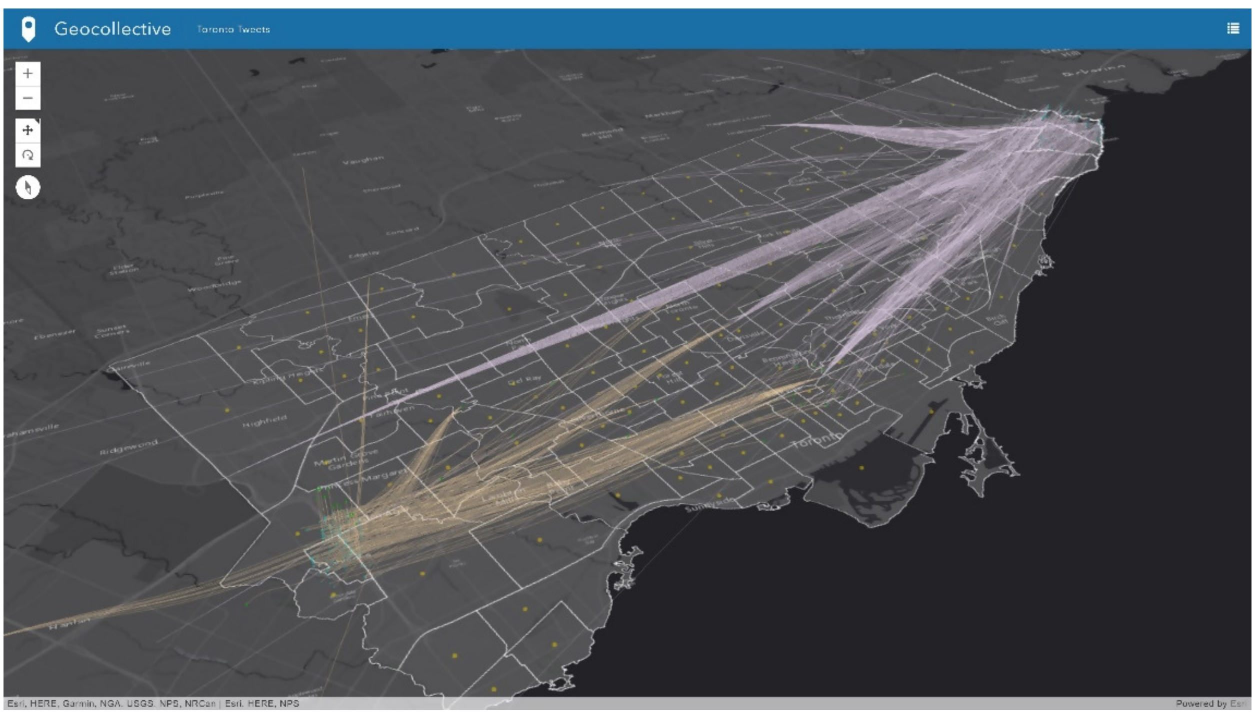

Figure 14 Connections between two neighbourhoods, with edge distinctions (purple, orange). Users highly connected to the two neighbourhoods shown indicate a strong connection to two different geographic spaces.

Understanding human activities and interests within the CSS and its constituent CSN require consideration of the universal diagnostic issues of (1) causality, (2) comparison, and (3) multivariate complexity (Tufte 2006). Including a means to investigate these notions form fundamental principles of analytical design relevant for displays of evidence describing human behaviour (Tufte 2006, p. 131). Hence, based on the interests of the data reviewer, the 3DGeoviz application also allows for tracking interactions and a means to highlight the connections between users of Twitter, space, and information based on Tweet content. For example, Figure 15 shows the interactive ability to highlight Tweet-nodes and content connections between contributors in different wards. Selecting one Twitter contributor highlights his/her connections with contributors in multiple wards according to Tweet content (i.e., contributor 1 is connected to content topic 1, contributor 2 is also connected to content topic 1) Selecting subsequent contributors shows additional connections between them over geographic space. This allows a data reviewer to explore interactively multiple geotopic and theme connections through the revealed social network topic connections.

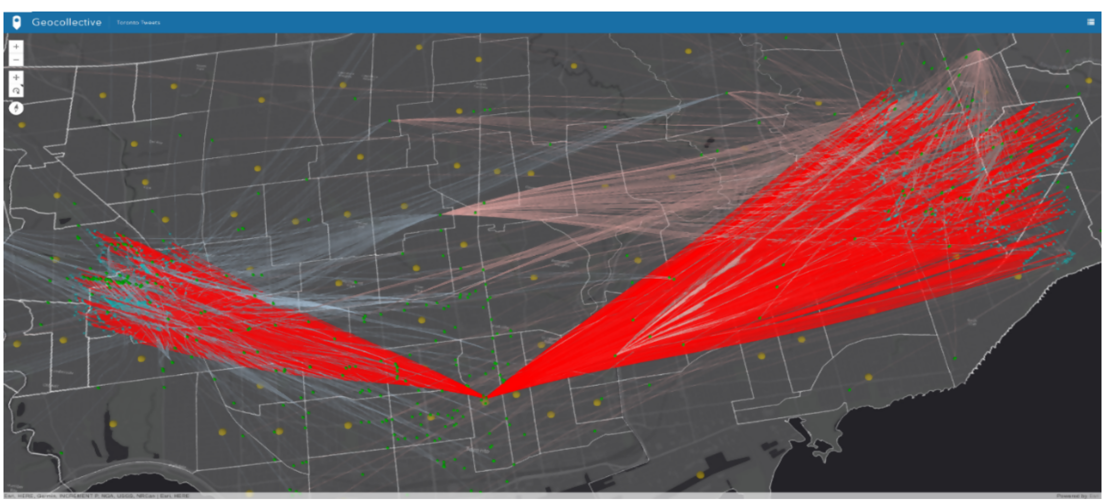

Figure 15 Highlighting contributor influence and graph connections between communities of interest. Highlighted user edges to content (in red) shown between two neighbourhoods.

4. Conclusion and Future Work

The automation of connections via geotopics and themes of common interest among citizens, based on passive social media participation (Cardone et al. 2013), is rendered practical by the CSS presented in this paper. The CSS was applied for demonstration purposes to harvest, analyze and visualize through a spatially-situated social network graph Twitter data collected over a specific time period from local organizations and members of the public in the City of Toronto. The methodology presented examined public opinions and attitudes extracted from geotagged tweets to transform the content embodied in these data into information that can be used to reveal trending citizen attitudes toward municipal governance and other dimensions of urban life. Through the interactive 3DGeoViz Web application, the dynamic, large, and complex CSS database is presented visually and thematically for exploratory purposes and comparative analysis. This aligns with smart city visioning, as the data provide an additional lens on public perceptions of civic affairs and government decision making.

Future enhancements to the research will investigate additional use cases and spatial-network based algorithms as well as further integration of additional social media data sets. The implications of transitioning from conventional means of public participation to a coded form of inputs such as those embodied in the CSS allow trending issues articulated by local residents to be assessed and acted upon. Future CSS enhancements will include interrogating the lack of conventional methods to analyze, conflate, and display complex information on human attitudes and behaviours. The lack of standard methods will be further examined to consolidate and improve spatial analysis (e.g., space-time clustering and geoinferencing techniques) and to adapt to new uncertain data types of location-based social media networks, such as those embedded in the evolving Twitter community of users.

Finally, the authors intend to refine further the methods presented here with an in-depth case-study for municipal use. We intend to engage with city decision-makers to both present them with the potential use-cases for the tools presented above, as well as engage with them to further refine the system. Through the continued improvement, we hope to better address the growing disconnect between big-data methods and civic engagement through meaningful data-driven approaches.

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PREFACE: CHAPTER 4

While newspapers and opportunistic pundits rush to comment on the headlines surrounding the Sidewalk Labs experiment at the Toronto Waterfront—there remain two important considerations concerning this project. First, Sidewalk Labs (a subsidiary of Alphabet Inc./Google) was given a small chunk of real estate to develop a new build smart city in a blighted industrial area of the City of Toronto. To date (almost three years after the award of the contract), there has been little in the way of the actual development of any of the storyboards, post-it notes, sketched renderings of utopian pedestrians in self-driving cars, or the vague narratives provided in the public master plans. Second, this level of control by corporate entities—who push the smart city imaginaries—with their hands on the public coffers is not a new phenomenon (Söderström *et al.* 2014, Viitanen and Kingston 2014, Wiig 2015), especially in the Waterfront district of Toronto. In Chapter 4, we present a case study on the Waterfront area of Toronto that predates the Sidewalk Labs hype, where the same story of data-driven promises under corporate control has been in play for decades. We provide an initial account of a form of coded engagement using data-driven participation methods at the municipal level at the Waterfront through the public funding of corporate players who control public space.

Clearly, we need to look beyond the discourse of technological solutions offered by corporate storytelling (Söderström *et al.* 2014). In addition to issues of privacy, which data-driven approaches to participation will certainly exacerbate, the black box algorithms may do little to address issues of quality surrounding VGI. We should also be concerned that these data-driven approaches will diminish the role of civic participation in municipal operations as they increasingly supplant more active forms of participation. All such concerns with projects predating Sidewalk Labs have now fallen by the wayside as a "new enemy" has come to town.

Meanwhile, the issue remains the same—the problem is not with Sidewalk Labs per se, but rather a problem that pertains to the role of participation in the smart city paradigm. That is, the drive to be smart is taken as a given on the part of the public, regardless of the implications. Engagement, if any, with citizens, is positioned as "terms of service" with an "opt-in" or "opt-out" framing, but is never presented in the context of "do you want to be smart—and all that comes with it, or not?"

Also, there is need to highlight the example provided in Chapter 4 (i.e., the New Blue Edge projects and Waterfront Toronto's *Intelligent Community*, powered by now-defunct IBM smart city partner Element Blue), as a cautionary tale for smart city projects that focus on selling participatory solutions to governments. With the attention now focused on Google's Sidewalk Labs projects, Element Blue's "Citizen Portal" is no longer operational, or mentioned on the Waterfront Toronto's website. In fact, many of the sources used in Chapter 4 have been removed from the webpage, with little or no mention of the project's apparent failure. However, even though the images of the New Blue Intelligent Community are no longer profitable for corporate interests or the focus of government decision-makers—their impact remains. For example, there are sweet-heart infrastructure and land deals that were made with developers and Internet providers such as Beanfield Communications (see Chapter 4), which retains exclusive rights over a section of the Waterfront in keeping with their own objectives (Waterfront Toronto 2019). For the citizen, this could mean that their Internet access at home is still bound by the exclusive data-collection rights (i.e., for a data commodity market) of a single company, without the need for new residents or visitors to ever know about the *intelligent* future once planned, but only partially accomplished.

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Tenney is the primary author responsible for concept development, data collection and analysis, and writing the article for publication. Professor Renee Sieber is a co-author of this chapter and assisted with concept framing and manuscript editing for publication.

CHAPTER 4 - DATA-DRIVEN PARTICIPATION: ALGORITHMS, CITIES, CITIZENS, AND CORPORATE CONTROL

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Abstract

In this paper, we critically explore the interplay of algorithms and civic participation in visions of a city governed by equation, sensor, and tweet. We begin by discussing the rhetoric surrounding techno-enabled paths to participatory democracy. This leads to us interrogating how the city is impacted by a discourse that promises to harness social/human capital through data science. We move to a praxis level and examine the motivations of local planners to adopt and increasingly automate forms of VGI as a form of citizen engagement. We ground theory and praxis with a report on the uneven impacts of algorithmic civic participation underway in the Canadian city of Toronto.

1. Introduction

Governments, from the municipal to national levels, are transitioning from the now "old" to "new" way of administering services to and engaging with their publics (Schmidt and Cohen 2013). Such changes to city planning and policy-formation are driven by big data, which is viewed as the datafication of socio-behavioural observations (Brabham 2009). Many fields of geography and urban planning have shifted to big datasets that are rapidly increasing in availability and being accessed by software solutions with a promised ease-of-use (Graham and Shelton 2013). For this paper, we consider a specific type of big geographic data called volunteered geographic information (VGI). VGI is the "widespread engagement of large numbers of private citizens, often with little formal qualifications in the creation of geographic information" (Goodchild 2007, p.

212). Goodchild (2007) argues that VGI can broaden the numbers and types of people participating due to the ease of contributing. He further asserts that "citizens as sensors" could augment government datasets, datasets once considered the responsibility of expert-collection by the municipal and state governments. Today, VGI acts as "a predominant source of information about scores of geographic features (i.e., cities, towns, national parks, landmarks)" (Hecht and Gergle 2010, p. 229).

Simultaneously, social technologies and digital service providers are fundamentally altering how we go about our daily lives (c.f., Castells 2009). The transformational force of these algorithmically-encoded apps is impacting how we work, interact with one another, and are becoming the digital markers of public opinion (Croitoru *et al.* 2013, Kwan 2016). Indeed, corporate providers of "smart city" solutions like IBM, Facebook, and Cisco offer to bring a suite of monitoring and analytical data-services which furnish insights on the needs of citizens and answer the demands placed on cities (Maillet 2012). Where once urban planners, geographers, and statisticians were responsible for extracting actionable insights from primary-data like national censuses, the heterogeneous nature and massive volumes of VGI has allowed the use of big data analytics like machine learning algorithms and data-driven approaches for knowledge discovery (Kitchin *et al. 2*015). It is important to remember that the collection of VGI is often instrumentally regulated through software and, as we argue, analysis. As Sieber and Haklay (2015, p. 2) note: "there are structural (software coded) mechanisms to dictate what and how information is collected." Issues of assertiveness and accuracy were primary barriers to the use of VGI by planners and policymakers, but these are increasingly being assuaged by hidden "software solutions" (Wiig 2015).

Municipal governments increasingly look to VGI from residents to improve public participation in local government. The combination of location-aware mobile devices and Internet connectivity allow for easy reporting of infrastructure problems or the provision of feedback on events. Elwood (2008b) speaks to the potential of VGI to expand engagement because of the spatial narratives enabled by the heterogeneous platforms. VGI also claims to increase transparency on government decision making via a tractable set of data to “retrace” the inputs of any given decision. These claims have created a “web of expectations” where the democratic process can be extended to everyone (Johnson et al. 2015). Elwood and Lesczynski (2013, p. 559) are less sanguine. If anyone can use the app, then it might be concluded that everyone is using it. If they are not, then people may be blamed instead of structural digital divides or discriminations. Elwood and Lesczynski add that VGI is often presented “as easy or fast, emphasizing how undemanding it will be to participate” (Elwood & Lesczynski 2013, p. 559). Despite VGI being relatively new to both city interests and as a form of participation, it is often situated as a technological solution to the “messiness of democracy” (Baack 2015).

The way in which VGI becomes a form of civic participation differs from the active deliberative sense in which participation was seen in previous approaches like Public Participation Geographic Information Systems (PPGIS). With VGI, participation becomes a largely passive act through automated service of data collection and analysis. VGI also responds to the requirements of active participation (e.g., direct interaction at public hearings or citizen panels) that people seem increasingly unwilling to engage with on a municipal level (Putnam 1995b, Clifford 2013). This passive participation enables cities with on-demand to essentially scrape public opinion from their twitter feeds and interactions with others across the city (MacEachren *et al.* 2011). Contributions thus present the public as data - without the need for "distracting" people from their daily lives to actively engage with political activities (Cardone *et al.* 2013, 2014).

We argue that VGI enacts a form of passive civic participation that is attractive to cities and busy citizens while conveying a host of contradictions. We begin by discussing the rhetoric surrounding digitally-enabled paths to participatory democracy in current and future cities. This leads to us interrogate how the city is impacted by the rhetoric of harnessing civic participation through data science. We move to a praxis level and examine the motivations to develop automated forms of citizen engagement. We ground theory and praxis with a report on the uneven impacts of algorithmic civic participation underway in the Canadian city of Toronto.

2. Civic Participation and the Digital Enablers

Civic participation is considered a cornerstone of democracy (Hoffman 2012). Civic participation has promised to keep "community life vital and public institutions accountable" (Roberts 2015, p. 3), to ensure "the have-not citizens…be deliberately included" in policy formation (Arnstein 1969, p. 216), and to have "citizens as co-producers of public services" (Whitaker 1980, p. 240) Despite these benefits, effective implementation of civic participation remains ambivalent, and the ultimate role it has in city operations remain in a state of ambivalence (Innes and Booher 2004). Many commonly mentioned reasons for ambivalence range from it proving difficult for governments to assure citizens they are being heard (Rowe and Frewer 2005); civic participation rarely appearing to influence decisions of public officials (Chess and Purcell 1999); and civic participation generally failing to capture a sufficiently broad spectrum of the public opinion (Lowndes *et al.* 2001a 2001b). Traditional participatory methods used in cities have been considered to antagonize participants, pitting individuals or interest groups against one another and rendering the duties of city officials more difficult to accomplish (Innes and Booher 1999). Such issues with the implementation of citizen-government engagement have left many institutionalized mechanisms of civic participation, like public hearings and citizen surveys, "to be nothing more than rituals designed to satisfy legal requirements" (Innes and Booher 2004, p. 419).

The purpose of participation is often positioned as a defining aspect of the concept itself. For example, Innes and Booher (2004) identify several purposes for civic participation. First, civic participation provides a mechanism to inform decision-makers, determining public preferences that play a part in decision outcomes. Second, participation seeks to improve decisions by incorporating the "local knowledge" of citizens into decision processes. The third purpose of civic participation is to foster the goals of social equity and justice. This position often manifests through the mechanism of political power dynamics and may require a redistribution of power to achieve those goals. The fourth purpose of participation focuses on legitimizing an outcome from policy or planning decisions. Having the public involved in the process (although not necessarily influencing an outcome) justifies the government's decisions. Finally, participation is often legally mandated, making it "something planners and public officials do because the law requires it" (Innes and Booher 1999, p. 218).

Over the past few decades, local governments have looked to the "use of information and communication technologies (ICT) to foster citizen engagement" (Cegarra-Navarro *et al.* 2014, p. 660). Their pervasiveness and *de rigueur* have caused technologies to evolve from being a tool for mass communication, to be seen as a digital window into the activities and perceptions of urban populations (Kavanaugh *et al.* 2005). To Kingston (2007, p. 138), the opportunities presented by Web 2.0 changed in "how citizens can participate in the delivery and management of everyday services in their neighbourhood." As our lives become more integrated with social technologies, we as citizens inexorably adopt the role of VGI producers. We produce our participation through

VGI by our passive actions and play into the discourse surrounding the "development of e-society as an effect of new technologies development (that) is connected with the accessibility of data concerning planning issues" (Hanzl 2007, p. 291). ICT, including geospatial technologies and location-aware devices, can impact civic participation approaches to adapt to information age demands (Greco and Floridi 2004). Similarities can be found with PPGIS, which concerns the use of spatial technologies to facilitate citizen influence on governance (Sieber 2006). Like claims for other ICT and now with the Web 2.0, PPGIS has often positioned technology as an approach to empower people, while carrying unintended social implications (Sieber 2006). Geographic information systems (GIS) provided a platform for dialogue between the local knowledge of a community and the knowledge of experts and officials, although not always evenly or accurately with all those involved (cf., Pickles 1995). PPGIS processes involve public contributions of geographic information with established goals to map, build, and develop participants' communities. PPGIS is considered a bottom-up approach (Jankowski 2009), even though the implementation of PPGIS is often more "top-down" and serves government interests. Like PPGIS, VGI may be created from "the bottom"; it is increasingly being adopted in "top-down" approaches motivated by corporate interests that complicate the usage of VGI for meaningful public participation (Portugali 2011, Söderström *et al.* 2014).

Carver (2001) provides an early commentary on the transition of PPGIS to online technologies. According to Carver, Evans, Kingston, and Turton (2001, p. 907), traditional means of participation in the planning process require prolonged engagement between city officials and the public. They note numerous barriers like: "It takes time, familiarity, and confidence with bureaucratic procedures, personal contacts in key places, money for campaigns, and private transport in order to attend meetings." Trust in local knowledge, that is the non-expert opinions of citizens, poses critical problems for the PPGIS adoption cycle in official capacities, while there are growing needs to interrogate the many social- barriers and implications born from the GIS (i.e., technology) and participation merger (c.f., Elwood 2006b, Sieber 2006).

3. Data-Driven Participation

Passive civic participation extracted, aggregated and analyzed through algorithms posits a different approach to citizen-government relationships by using indirect interaction methods (i.e., asynchronous, automatic, and repurposed content). Participation becomes the product of harvested public opinion from VGI (e.g., sentiments and topics from the text of a tweet) that they would use within municipal decision-making. Inherent in these methods of participation are techniques that can utilize unstructured data, behaviour-analytical algorithms and distributed computing infrastructures to collect, transform, and extract relevant social signals from massive datasets from a variety of sources.

Predictive algorithms and big data software solutions are strongly associated with the spread of interactive web capabilities and mobile-sensor technologies (Beer 2009). There is presumed suitability of big data like VGI to represent the local knowledge and interests of a community, which is mainly unconfirmed speculation (Lin 2012). A rapidly growing level of availability for VGI datasets continues to propel these claims of access to local knowledge (Tulloch 2014). The localness attributed to VGI is often seen as stemming from the ability to track our day-to-day interactions and movements through distributed sensor areas that are now found everywhere, from the GPS-enabled phones in our pocket to the video cameras adorning cities' transportation corridors, buildings, and streets. Coupled with a seemingly growing stockpile of VGI, the introduction of many "software solutions" has only augmented widespread credence in using VGI as a form of participation in city operations (Lin 2012).

The futurist Duperrin (2014) makes a case for VGI as part of prospective citizen-government interaction models. He argues that a shift to digitally-mediated forms of passive participation both suits the ongoing societal convergence with Internet technologies because citizens prefer these practices:

> "It is not participation that wearies people, nor its lack of sense but its active nature. It requires time (without being sure to get anything in return) and attention. No one denies the advantages of information sharing but employees do not understand why it requires extra work and citizens are happy from the benefits they get from the use of collective data (even unconsciously) but won't spend their life behind their screen to provide a predictive, analyzing and proposition machine with ideas, feedbacks, and experiences." (Duperrin 2014)

An active, engaged citizen is the prescription of the day, but that prescription is increasingly challenging to fill. Four characteristics advance this approach to passive engagement and participation in governance matters through VGI, namely (1) removal of the requirement for deliberation and education on multiple political issues (Albrecht 2006), (2) power of data-driven analysis to abduct relevance and context of inputs from disparate datasets (Provost and Fawcett 2013), (3) ability to offer a qualitative representation of collective public opinion and documentation relative to its formulation, and (4) improvement of transparency in the democratic process by clearly documenting these processes (Anderson 2011, Afzalan and Evans-Cowley 2015).

Enabling users to contribute their content (i.e., VGI) also has altered the concept of an expert. An expert is not necessarily the primary content "producer," nor is the amateur (i.e., public or citizen) merely a passive "user" (Bruns 2008). Part of this "produsage" model allows users (i.e., amateurs) to contribute actively, transform, and even "analyze" all kinds of content for their purpose (Bruns and Schmidt 2011). The pervasiveness of easy-to-use technology is sometimes seen as having effectively removed the need for any form of expert facilitation (Turner 2006). For example, planners, technicians, or scientists in most PPGIS projects retain a level of oversight on the collection to use the spatial data. Seeger (2008, p. 200) notes that most VGI is deemed an ontologically different kind of data collection than that through facilitated public engagement "because of the way in which the collection of volunteered gathered information is shepherded by a facilitator, as part of a pre-established planning or design process." With public participation increasingly seen through VGI, the planner and specialist may eventually have no part in what some consider an entirely user-driven process (Ali and Fahmy 2013). In certain cases, communities have deliberately limited any outsider involvement or purposely regulated the sharing of their collective knowledge with officials who use Web 2.0 technologies. These sorts of "gatekeeper techniques," although not totally unprecedented before the VGI, are increasingly worrying to officials as well as the decreasing influence public participation may have on a decision's outcome (Johnson & Sieber 2013).

Recently, researchers have been investigating similar forms of gatekeeping as the pruning and restriction of information access are increasingly done by coded functions in computer software (i.e., algorithms) (Napoli 2015). In other words, the increasing reliance on data-driven participation, this sort of control (i.e., be it the production of VGI by citizens to how or where city officials use it) is now being delegated to the coding decisions of algorithms and by the available "solutions" a particular software is capable of performing (Bozdag 2013, Winter 2015).

Another major shift with Web 2.0 is that active participation methods hold less influence on a particular engagement method (e.g., random opinion survey cards versus citizen panels). Rather than the level of involvement by citizens, a data-driven model emphasizes numerous participants indicating or justifying that they exert influence over official decision-making (Craglia and Shanley 2015). Many crowdsourcing and citizen-science projects like OpenStreetMap are heralded as examples of an ever-present "crowd" that is always willing and relevant to the needs of a particular city. The public is considered to be an omnipresent crowd and participation is the digital contributions that enable change in social, environmental, and political environments (Vesnic-Alujevic 2012). It is also becoming clear that the level of influence exerted by data-driven participation increasingly will be evaluated in terms of how big a scale it achieves (Sieber and Tenney 2017). This is a scale arguably out of reach for any single municipal department, expert, or community of citizens to process without additional software analytics furnished by private companies (Bucher 2012).

Proponents claim that new civic tools facilitate direct citizen-to-government (C2G) connections, enhance citizen-to-citizen (C2C) interactions, and should eventually lead to an "automated democracy" (e.g., Cardone *et al.* 2013). That is, the ideals of direct-democracy (i.e., civic participation) are merging with data-driven methods of a "fourth paradigm in science" and are ushering in an era of governance by the algorithm (Esty and Rushing 2007). According to Esty & Rushing (2007, p. 14), this era uses:

> Robust data collection and analysis to illuminate problems and enable policymaking that is more nimble, tailored, and experimental. Closes gaps in knowledge by harnessing new technologies to collect, analyze and disseminate key data. Focuses on results by setting quantitative, outcome-focused goals, measuring policy performance, and comparing results among peers. Develop systems to

> ensure that data are used to guide policy priorities and solutions. (Esty & Rushing 2007, p.14)

A common goal in numerous big data projects is to automate aspects of municipal operations (cf., Kitchin 2013) that create a "recommendation system" for choices in governance. This is a form of data-driven participation, where the future of participation promotes an understanding of the city as a complex system. In this system both physical and social operations can: 1) be reduced to the calculation of variables that represent actualities of human existence and lived geographies (Mattern 2015); 2) the system can then be optimized through these derived indicators (i.e., data) and a series of algorithmic tweaks (Hollands 2008); 3) that in turn will inform city officials and policy-formation to better serves its public (Tang 2015). It is not just the power of big data (or VGI) that offers many of these opportunities; the tools (i.e., the algorithms) used to collect, process, and analyze patterns and relationships purportedly inform policymaking.

4. Algorithms, Planning, and Governance

One can simply define an algorithm as a set of procedural steps that solve a particular problem. However, all algorithms must have some form of input and output, "two openings that can be manipulated to help shed light on the algorithm's functioning" (Diakopoulos 2015, p. 405). In practice, algorithms exist in complex realities where they are commonly hidden from sight (c.f., Manovich 2013). These procedures are also interconnected to such an extent that it becomes difficult to determine where one function ends, and another begins. For example, it is rare to find an individual algorithm or procedure that stands alone without being used in tandem with another algorithm (e.g., a function used for the prioritization of some content without the content first undergoing algorithms of categorization and association). Further, many algorithms come with various levels of transparency and control over their parameters. Such cases are exemplified by proprietary and closed-source services when the actual code becomes buried inside larger software packages (e.g., IBM's InfoSphere). In cases of closed-source or proprietary software, it is common to describe the inner-workings (i.e., the algorithms and impacts over their input to garner an output) as black boxes (Diakopoulos 2014).

> Deconstructing the black boxes of Big Data is not easy. Even if they were willing to expose their methods to the public, the modern Internet and banking sectors would pose tough challenges to our understanding of those methods. The conclusions they come to—about the productivity of employees, or the relevance of websites, or the attractiveness of investments—are determined by complex formulas devised by legions of engineers and guarded by a phalanx of lawyers. (Pasquale 2015, p. 6)

Algorithms are realized through computer code and software systems that guide a widening array of public-private spheres, urban mobility, logistics and service systems (Kwan 2016). Kitchin and Dodge (2011, p. 246) argue that algorithms have permeated the seams of nearly every aspect of modern life and have birthed an unintended yet "vital source of social power." This has only recently become a topic of discussion in legal and public policy discourse. That emphasizes adapting government operations to a form of algorithmic governance, which is a digital form of decision-making that relegates duties (and perhaps liability) of governments to computerized processes (Diakopoulos 2016).

Algorithmic usage varies in form and function depending on how the acted-upon data was created, collected, and eventually employed within urban planning contexts. The use of computational or algorithmic methods arose in various areas of city planning through spatial analytical functions of GIS. In the 1970s and 1980s, the use of positivistic techniques of spatial analysis like destination-allocation models relied on rational, objective perspectives on urban dynamics and planning policies (Lake 1993). For example, Balling et al. (2000) developed mathematical optimization functions, rendered through multi-objective genetic algorithms. This plan was thus a product of rules-based and automated heuristics from land-use zoning and policy variables to create the “optimal” layout for a city.

Planning departments mediated their stance by utilizing “stakeholders.” This approach, common throughout the 1990s, envisaged urban form based on “the desired image of a city” amongst a consulted group of the citizenry (Fainstein 2000). As Fainstein (2000) details, this planning perspective stressed direct civic engagement and often would utilize web-based discussion portals or citizen feedback systems. In these cases, an algorithm for decision-making may be within the particular software or technology but was seen as a social process where the “input” to planning processes aimed to co-produce an “output” of a planned-city according to the desires of a citizen. Brown, Kelly, and Whitall (2014, p. 2) reviewed PPGIS methods of engagement with “amateur” citizens and “expert” planners in environmental assessment projects. They find that most of these projects lead to “better results for environmental quality and social objectives.” However, the identification and inclusion (or exclusion) of stakeholders in these PPGIS projects is problematic in many of the areas PPGIS was applied. Brown et al. (2014) describe the issue as a PPGIS sampling bias, which tends to benefit the majority of stakeholders. This further disenfranchises minority groups who are pushed to the periphery of influence or, at times, wholly excluded. Big data (and by proxy VGI) claims to solve these sampling problems by harnessing massive datasets, which are situated as being representative of entire populations (Kitchin 2014a).

VGI and big data algorithms are injected within the current planning era, often called "new urbanism." Fainstein (2000) describes this as the culmination of both the "planned-city" and "desired-city" models that holds a strong emphasis on equity, that is, the "just-city model." As we argue, the primacy of control in this data-driven realm of big data analytics is bestowed onto the algorithms that often act behind the scene, out of sight from both the citizen and the city official.

One vision of data-driven participation relies on the use of large volumes of citizen-contributed data harvested from various sources and sensors, which are integrated through Internet-based services and the physical infrastructure of a city. This VGI stands as the datafication of human activities and social life where our movements, interactions, and opinions become coded through digital services and transubstantiated by an array of algorithmic treatments (Richter and Winter 2011). It is rare that an end-user has total control over a VGI dataset from the collection to its use in any particular capacity (Budd and Adey 2009). Instead, it is often argued the adopting data-driven approaches and computational methods remove the requirement of getting too involved with dealing with the "raw" VGI. According to Diakopoulos (2015, p. 401), the "intrinsic crux of algorithmic power: (is) autonomous decision-making."

> Regardless of an algorithm's function, their application employs a transformative perspective to viewing the world of municipal operations that "problematize(s) public life, including how they necessitate the datafication of the world, create complex feedback loops with social data, or encourage the creation of calculated publics" (Diakopoulos 2015, p. 401)

Many of the algorithms used for big data are seen as being predictive, acting in real-time, and learning from existing observations to better interpret future events (Winter 2015). The decisions being made by software and algorithmic treatments of VGI fundamentally challenge old practices of decision making in urban planning and policy formation by becoming condensed decision points fitting on a computer monitor. These new practices of political regulation become ensconced into the realm of what media mogul Tim O'Reilly has deemed “algorithmic-regulation.” To O’Reilly (2013, p. 300), using data-driven techniques for guiding decision-making at the municipal level delivers four unique advantages over traditional means of engagement. They are: 1) creating a deep understanding of the desired outcome; 2) providing an ability to utilize real-time measurements to determine successes or failures when attempting to accomplish a determined outcome; 3) using “unbiased” algorithms or computer software that can both manage the volumes of real-time data and make needed adjustments based on new scenarios; and 4) utilizing periodic “deeper analyses” to further refine the functioning of these algorithms as a means to ensure they are performing as expected.

Visions of a city that operates on the back of algorithmic policy and planning regulation contradict theories of a city as an assemblage, which emphasizes social-production by human and organizational dynamics. As Chandler (2015, p. 841) warns: “Unfortunately, what works for Google does not work so well for marginal and vulnerable people and communities that desperately need to transform their circumstances.” For Chandler (2015), big data does not empower those most in need social change, but instead can only assist in the management of what already exists — in other words, determining what exists, what becomes interrelated, and what *will occur* depending on the observable properties of available big data. Therefore, the algorithms trained from and unleashed upon the available observation space in VGI datasets do little to identify or benefit those communities that exist on the margins or are entirely excluded (i.e., the uneven digital divide and social inequity).

Another issue regarding the use of or reliance on algorithmic-regulation stems from the control withdrawn from the citizens generating the data and from the city officials wishing to use VGI. The ability to interpret the meaning of VGI datasets is argued as transcending the cognitive capacities of any single human. These beyond-human barriers are seemingly tackled by software solutions that are modelled after (both in terms of our neural processes and trained by our very thoughts, activities, and normative behaviours observed from training datasets) human facilities. For example, the renowned IBM artificial intelligence (AI) software called "Watson AI" already are marketed to and used in municipal operations:

> Watson is a lot like us. Watson can read and understand natural language and can draw conclusions from it. Whether it is twitter feeds, websites, or traditional data sets, Watson can make sense of it and present it in a way that makes sense to you. Through your interactions with Watson, Watson learns, tracking feedback from you about its successes and failures and becoming smarter the more you interact with it. Watson can analyze huge amounts of data and reduce it down to critical decision points. For each conclusion Watson reaches, it provides a confidence level. Watson learns from us. The more we interact with Watson, the "smarter" Watson gets. (element blue, n.d.-a)

Such discourse suggests Watson surpasses our limited human-capacities (the very same it emulates) and enters a plan of infallible clarity for principled decision-making. Paradoxically, Watson is trained on our limited faculties, which means it will always be subject to "learn" from the available collections of knowledge that we contribute or can dataify. A prudent omission regards the fact that what makes Watson and other similar systems "smarter" is the often irrational, illegible, or incorrect data that is represented through uneven access to VGI. This VGI may have limited or no relevance to the conditions of a specific geographic context. Crampton et al. (2013) note that a preoccupation with "location" (i.e., the distinguishing characteristic of VGI from other forms of user-generated content) ignores the complexity of a mediated reality, greatly limits our observation space thus missing the opinions of "others", and ultimately reduces our ability to truly *know* a geographic locality:

> Content is not produced solely by human users but is the product of a complex, more-than-human assemblage, involving a diversity of actors, including automated content producers like Twitter spam robots. (Crampton *et al.* 2013, p. 231)

Early concern surrounding the use of VGI in municipal operations focused on quality aspects of the data and proxy measures like "credibility" and provenance to attest that any given contribution was fit for use. Per Elwood, Goodchild, and Sui (2012b, p. 584), these forms of data "can be said to be asserted, in contrast to the authoritative products of traditional sources that derive their authority from their creation by highly trained experts." In turn, this raises questions about the nature of truth and data quality aspects that VGI can have when used in "official capacities." Stephens (2013) and Haklay (2010b) note divisions between gender, race, and social class representation available in data from the Web 2.0, reinforcing the inequalities of social justice prevalent in modern society. Discrepancies in power, representation, and processes (i.e., in data collection, data quality, and effects of data analysis) found across web-enabled participation methods and crowd-sourced systems remain largely unknown, prompting the need for further research in these areas (Boyd and Crawford 2012). Graham et al. (2014), advise:

> It will now take much more sustained quantitative and qualitative inquiry into locally contingent challenges, barriers, inequalities, and deliberate exclusions for

> us to understand how to work toward more inclusive, more just, and more equitable representations and digital layers of our planet. (Graham et al. 2014, p. 763)

Whereas these aspects of uneven representation have also been longstanding issues in active participation; they are exacerbated by the "uncertainty" of transitioning to a form of data-driven participation (Kwan 2016). This largely due to a limited ability to examine or explore such uneven processes that data undergoes, which are locked behind coded-doors (Diakopoulos 2016). The institutional policy has begun to trust the "ghost in the machine collectively," and it marginalizes concerns regarding the quality of VGI that is instrumentally corrected and cleaned.

> Instruments are a critical source of knowledge. They are seen as more reliable than humans in VGI by relying on GPS signals that provide technological information about the location. The same is true with the embedded coordinate information in the header of digital photos taken by a cellphone. The information is captured automatically by machines, of which uncertainty and precision can be quantified, and therefore, it is trustworthy. (Sieber and Haklay 2015, p. 2)

Algorithmic procedures on VGI presume to act as corrective lenses for our ability to see the contours of the digital divide. Any remaining concerns seem to be negated by the promises of unparalleled insights furnished by the use of big data (boyd and Crawford 2012).

5. Myopic Algorithms Guiding a (Non-)Responsive City in Canada

Frictionless participation, meaning lowering the bar to engage in the decision-making process – often through technology, through technological innovation depends on software and algorithms to make sense of a deluge of social data. By using this data, a city seemingly becomes "smart," or "intelligent," or "responsive" (Hollands 2008). Endless supplies of fuzzy concepts like the "smart city" are rarely used consistently. There is neither a single template for framing the datafication of the city, the types and capacities of data and algorithms running through it nor any examples that can be generalized from current practice (Albino *et al.* 2015). Instead, there is widely uneven reach to the role and implementation of algorithmic-regulation and "smart governance" when it comes to civic participation in municipal operations. There remains a strong connection to century-old cybernetic theories that place public trust in computational systems and mechanical controls of public administration. Goodspeed (2015a, p. 81) describes these machine systems as: "The fundamental unit of cybernetics (that) is the control loop used to monitor and control a specific system. The loop is made up of sensors to detect conditions, actuators that can make changes and an intelligent controller." The fundamental unit of the algorithmically-regulated city thus expands beyond that of this initial control loop. A proprietary shroud of software solutions obfuscates the complexity of these control-loops. Data-driven participation occurs through these algorithms and brings the claims of enabling a city to become genuinely responsive to newly minted *intelligent communities* (the actual name given to these communities by the technology firms responsible for inserting the infrastructure). An example of uneven reaches and control shift in planning practices and citizen engagement is the "Intelligent Community" initiative within Canada's largest city, Toronto. The Waterfront Toronto Corporation is an established public-steward that launched an "Intelligent Community" in 2013. This broad action plan was designed to enhance the lives of those who live and work in Toronto's waterfront communities.

Figure 16 Map of Waterfront Toronto Communities. Source: Waterfront Toronto (n.d.-a).

Facilitating the civic participation efforts of the Intelligent Community initiative is a hybrid system provided and operated by the private company Element Blue LLC. Element Blue operate around the world as an IBM partner to provide various software solutions to government operations. The company's flagship software solution is called CitizenReach, which is described as "a web, mobile, and tablet-enabled public comment platform designed to effectively and efficiently facilitate the dialogue between citizens and government entities" (element blue, n.d.-b) CitizenReach claims to offer citizens an ability to voice their opinions and present an opened window for government entities to hear from them. Underneath the CitizenReach solution (Figure 17), is a system of components and algorithmic functions that can "integrate with unstructured data such as SMS, and major social media sources…(with) complete pre-processing (capture, analysis, validation) to this unstructured and incomplete data before it is forwarded to other systems" (element blue, n.d.-b).

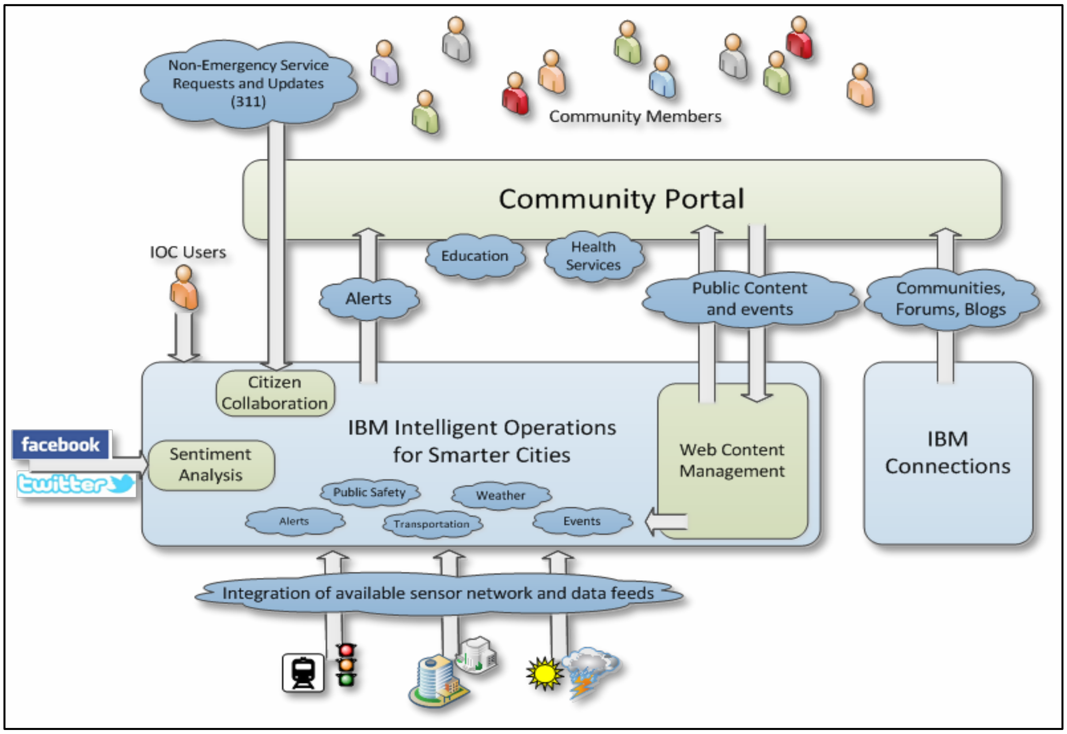

Figure 17 The CitizenReach platform deployed in Waterfront Toronto communities. Source: element blue (n.d.)

The New Blue Edge project started in 2014 and was quickly supported by municipal funding. Despite considerable enthusiasm, the project has yet to reach much further than the development phase. Many citizens living in the Waterfront community are unaware of the multimillion-dollar contract that had been made between these corporate service providers and Waterfront Toronto, let alone informed as to any of the services they provide. The magic of this software is that it can correctly identify the community members and other stakeholders to provide them with a seamless "integration (that) deepens the previously passive web experience into an integrated, geo-aware, and interactive experience." However, the rhetoric has seemingly yet to be practiced.

From the onset of the New Blue Edge project, many Toronto citizens and planning officials were cut out of the loop as most of the project's implementation was delegated to corporate control (Lorinc 2013). After several years and over 1.2 billion dollars of public investment into the Waterfront Toronto initiatives, many of the proposed intelligent enablers have yet to leave the "development phase" (Starr 2014, Verner 2015). Much of the New Blue Edge community portal remains inoperable, and it remains unclear whether companies are already harvesting VGI data to both citizens and planning officials that do not have access to the "behind the scenes." This lack of control by citizens and municipalities over the data-driven participation efforts erodes the very notions of empowerment, transparency, and efficiency the project is argued to provide. Further, the abdication of already limited public resources through investment in private companies to collect and manipulate potentially-sensitive datasets being harvested could be perceived as encroaching on the privacy rights of citizens. It also limits the role of local planners and governments and fuels a multibillion-dollar data-commodity market that aims to resell this valuable data to other private interests (Campbell and Carlson 2002, Medway and Warnaby 2014)

6. Conclusion

We argue that data-driven forms of civic participation increasingly become the modern approach for municipalities to engage with citizens. Data-driven participation relies on the use of large volumes of data (i.e., VGI) that are handled through complex assemblages of computer software and algorithmic treatments. The promised capabilities of these tools include: (1) remove key aspects of deliberation and education that often seen as imperative to more active forms of civic participation, (2) bring the power of data-driven analysis to extract hidden insights from unruly datasets, (3) condense the complexity of urban life to consumable graphics on a screen, and (4) provide greater transparency in the democratic process via clear documentation.

As mentioned above, the purpose of civic participation is often conflated with its ontological definition. In the case of VGI, large amounts of citizen-contributed data are algorithmically harvested and repurposed, which render citizen-government relationships into passive forms of indirect interaction (i.e., asynchronous, automatic, and repurposed content). It has been further argued that the suitability of both VGI and big data analytics becomes a matter of concern because VGI "does not work so well for marginal and vulnerable people and communities that desperately need to transform their circumstances" (Chandler 2015, p. 841). Data-driven participation consequently shifts from its primary purposes in cases such as PPGIS and active deliberation methods that seek to empower citizens and influence government decision-making. Instead, datafication of participation via VGI propels the integral process of democracy into data-market economies that are largely driven by corporate interests outside those held by government officials and citizens. Further, much of the "how" and "what" behind data-driven participation remains hidden in proprietary black boxes. Diminished access to the data constituting participation not only negates the promises of transparency commonly attached to the use of Internet technologies but also obfuscates who retains control and responsibility for outcomes of such approaches (i.e., removed from the citizens producing the data and planners wishing to use it and placed into the hands of private companies).

Motivations for data-driven participation seek to harness the participatory aspects of governance with data produced by this ubiquitous technology. However, the sheer volume of data suggests VGI can be harnessed only through the "intrinsic crux of algorithmic power" that will effectuate "autonomous decision-making" (Diakopoulos 2015, p. 401). In addition to streamlining the participation process in cities, algorithmic procedures carried out on VGI supposedly assuage any concerns and generate a corrective lens to see the contours of the digital divide. Any remaining concerns are negated by the promises of unparalleled insights furnished by the use of big data (Boyd and Crawford 2012) There are ample opportunities for VGI to operate in participatory capacities within cities. Restraint should be practiced in adopting a technological solution to the "messiness of democracy" that operates behind *coded-doors*.

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PREFACE: CHAPTER 5

Chapter 5 continues the case study approach started in the previous chapter. In Chapter 5, we extend the work done in Chapter 4 by diving deeper behind the *coded doors* of Toronto's City Hall in an effort to flesh out the values and implications of coded engagement. Through direct participant observation, formal interviews (i.e., survey instrument found in Appendix B for formal interviews and data reported in Appendix C) a robust understanding of the internal institutional dynamics, the perspective of the citizen in the "smart city," and operational disconnects in governance, policy, and practices were observed. As a consequence of the previous efforts, interviews, and contacts arising from this research project, in Summer 2017, I accepted a position with the City of Toronto to establish the new "Data Analytics and Visualization Team" (DAV). The DAV has the primary mission of undertaking research and development tasks related to effective methods for leveraging data for evidence-based decision making. The empirical observations included in this chapter have extended the direct formal interviews conducted for the research by providing a detailed understanding of city operations across multiple divisions and sectors of work. Furthermore, the role has allowed for the influencing of policies and projects, and engagements with the public in furtherance of a responsible form of a data-driven smart city that focuses on effectiveness instead of fetishizing efficiency.

This chapter was invited for submission to a special issue of *The Canadian Geographer*, titled: "*Smart citizens creating smart cities: Locating citizen participation in the Smart City*." The manuscript, a redacted version of this chapter, has been submitted for peer-review in May 2019 and is currently under review for publication. Matthew Tenney was the primary author responsible for concept development, data collection and analysis, as well as writing the article for submission to the journal. Ryan Garnett, a co-author, is Director of the Open Data Project, as well as DAV at the City of Toronto. Ryan provided invaluable access to staff, materials, and assisted in the editing of the article for publication. Bianca Wylie, also a co-author of this chapter, is a community activist and consultant in the Toronto area, who has focused on grassroots engagement on the topics of Open Data, Smart Cities, and more recently, has been an outspoken adversary of the Sidewalk Labs project proposed for the Waterfront of Toronto. Bianca provided insights on community perceptions, material related to advocacy groups within the open data/smart city sectors and assisted in editing the manuscript for publication.

CHAPTER 5 - A THEATER OF MACHINES[4]: AUTOMATA CIRCUSES AND DIGITAL BREAD IN THE SMART CITY OF TORONTO

Matthew Tenney (primary author), Ryan Garnett, and Bianca Wylie

Abstract

In this paper, the policies, projects, and promises of "smart" initiatives at the City of Toronto are evaluated, as they manifest through a technological convergence between local-government services and an increased focus on citizen services through data-driven mediums. Our case study on the City of Toronto provides a focused account on how and from where these "smart" motivations for increasing a data-driven engagement with the public have arisen over the past several years. We further our analysis with an account of there being multiple versions for the image of the smart-city held simultaneously within one organization, which itself contributes to the uneven impact and implementation of what the smart-city may entail in the Canadian context. In doing so, we identify key characteristics that both enable and hinder the actually-existing smart city in the forms of access to open data, the use of increased computational methods, and the engagement of public services through digital-space as requirements for the future of participatory governance that utilizes this form of "coded engagement."

Keywords: Citizen Participation, Smart City, Governance, Big Data, Open Data

1. Introduction

Cities are buying, building, and deploying information and communications technologies (ICTs) to become "smarter." (Caragliu and Del Bo 2019) They are said to become smart as a result of

[4] The title for this paper is adapted from the book, "A Theatre of Machines" by A.G. Keller, published in 1964

their collective human intelligence, collected, for example through passive sensing via mobile phones traversing the space-time of the city (Coletta and Kitchin 2017, Kummitha and Crutzen 2017, Rathore *et al.* 2017, Caragliu and Bo 2018, Han and Hawken 2018, Kitchin 2018). Instead, cities more likely reflect a distributed machine intelligence-driven by data collected through citizens-as-sensors, big data algorithms, and latent practices or outdated policies (Regalia *et al.* 2016, Rathore *et al.* 2017, Conti and Passarella 2018, Silva *et al.* 2018, Andreani *et al.* 2019, Kensicki 2019, Osman 2019). These intelligent-machines are integrated as part of the physical and social structure of living within the city (Kitchin *et al.* 2017, Yeh 2017, Shelton and Lodato 2018). Smart cities are material-hybrids, assembled through physical infrastructures and social actions mediated through the multiplicity of hardware, software, people, policy, and data (Batty 2001, p. 479). In this way, the people who live, work, and play within the "smart city" are transformed to data-producing actors who participate within the governance of the city through their passive engagement through apps, sensors, and digital services (Shen *et al.* 2017, Costa *et al.* 2018, Lupton 2018, Cai *et al.* 2019). In other words, smart cities look to use a form of *coded engagement* to involve citizens by proxy of their digital data for municipal operations (Tenney and Sieber 2016). It is the goal of this paper to interrogate the policies, projects, and promises of "smart" initiatives underway within the City of Toronto, as they are part of a political vision brought on by a myriad of forces, overstated promises and, at times, duplicitous purposes.

The promises of a smart future for the city rarely meets the actual implementation of plans, policies, or practices of the day-to-day activities in municipal services (Shelton and Lodato 2018, Kensicki 2019). The process of *becoming smart* is one of the genuine efforts in the use of technologies (and data) to be smarter about serving citizens (Batty 2018, Han and Hawken 2018, Desdemoustier *et al.* 2019, Trencher 2019). This pursuit of leveraging *smarter* ways to do things can be seen with the City of Toronto's official statement on the role and urgency to become a "smart city":

> A smart city uses technology and data to optimize resources and enhance the quality and performance of urban services, increase economic competitiveness, and engage citizens more effectively. A smarter city develops and implements innovative policies and technologies to ensure these benefits are realized in a manner unique and consistent with its core values of economic, social, cultural and environmental vitality. (City of Toronto 2018a)

To be smart is to grow, develop, and modernize city services through data-driven approaches and digital-technology based solutions (Tenney and Sieber 2016). A circus of actors is rushing in to rebrand and layer such innovations for smart city operations for the sake of economic prosperity (McNeill 2015 2015, van den Buuse and Kolk 2019). Prosperity in this context deals with city operations that focus on citizen-centric solutions, through data-driven approaches (Anthopoulos 2017). It is by disentangling the discrepancies between actors and their respective agendas that offer an empirical account of how *actually existing* as a "smart city" in Toronto is materializing, as well as detailing the consequences to the citizen and their means of participating in this vision of a smart city.

The remaining portions of this section set the scene for how the historical context of governance within the City of Toronto has evolved into a dissociative form of automated policymaking by private interests (Section 1.1). With these mechanisms already in place, with the focus and priorities of economic development, the public seal of approval has been seemingly given to the promises of smart city imaginaries reviewed in Section 1.2. These "citizen-centric" services of a smart city promise are the bread to ensure adoption of a circus of technological "solutions" (Section 1.3). Implanting these circuses follows the washing-effect of approaching "smart," "inclusive," and "open" concepts through a governance structure that typically follows either a *libre* or *gratis* model that is either to the benefit or detriment of setting up a surveillance state within the urban fabric in Section 1.4. Section 2 details the methodology and Section 3 presents high-level results from these surveys, from direct personal interviews, participant observations, and direct involvement with many of the examples and views presented within Section 4, the case study on the City of Toronto. A series of pertinent examples are provided to highlight how the mechanisms for the adoption of "smart solutions" are well entrenched within the City of Toronto's governance structure; all branded to provide automated citizen-centric services without the prerequisites of permission or at least assumed consent for this imaginary of coded engagement.

1.1 On the Yellow Brick Road to Becoming a Smart City

In the name of economic opportunity and capitalist visions of what it means to be a smart city have largely altered the means in which citizens are engaged within municipal affairs. Smart cities are projected to be a 1.5 trillion-dollar market by 2025 and have garnered the attention of a global roster of commercial players looking to implement their promised solutions for city problems (Singh 2014). The "promise of development" has become a depoliticized program with the assumed consent of the public to be pro-economic growth as early as the 1980's real-estate crisis (Keil 2002). The economic growth following deregulation and furthering the reaches of private entities to control the public resources through third-party commissions gave way to the pacification of public participation in many of these land-development deals (Keil 2002, Jackson 2009, Viswanathan 2009, Kelly 2013, Rankin and McLean 2015, Rosen and Walks 2015, Webber and Hernandez 2016). Throughout the 1990s into the early 2000s, Toronto privatized many of its public services, deregulated market interests for the sake of economic growth, and set up "independent" planning commissions that would handle much of the development around the city that fit the interests of the social elite (Keil and Boudreau 2005). Desfor et al. (2006, p. 132) retraces how several of these mechanisms for the privatization of public interest occurred in regional plans implemented in the Greater Toronto Area, which further distanced power from elected and accountable power to decide the direction of city development, and even more so out of reach from the public:

> …to the rather undefined regions of governance by an elite citizen committee. This depoliticization of planning has long been part of Ontario urban policy. Important examples are the Royal Commission on the Future of the Toronto Waterfront, the Sewell Commission on Planning Reform, the Golden Commission on the Future of the Greater Toronto Area, and David Crombie's "Who Does What Panel," which, between the early and late 1990s, recommended far-reaching changes to the governance and planning of growth in the region.

Keil (1998, p. 155) points out that: "the political regime in Toronto experienced a bifurcation into a discourse on democracy and civicness on the one hand and a discourse (or rather non-discourse) that was pro-development and growth on the other." The formation of a *dissociated governance*, where decisions are not necessarily directly made by elected and accountable powers, the City of Toronto has put the decision-making power of urban policies mainly in the hands of private industry and out of reach from public influence (Keil 2002). Fast-forwarding to the 21st-century "data-markets," this dissociative governance model has grown from the real-space of physical land-development into the virtual space of the city through technological territorialization of corporate interests with control of public data and data driven-methods for engagement (Kreiss 2015).

These digital services of the smart city become the digital bread, a tokenistic form of civic engagement, whereby the technological agenda of being a smart city succumbs to the appeal of unchecked economic growth. As Arnstein (1969, p. 216) muses, “The idea of participation is like spinach: no one is against it in principle because it is good for you.” Thus, it becomes “good for you” to be a “smart” city; in principle, it better serves the public, makes government operations more efficient, and brings together the will of the public with the decision-making process (Caragliu and Del Bo 2019). It is these smart citizen-services that become the bread that ensures citizen sign-off and retain the presumed public stamp of approval in smart city procurement practices (Castelnovo 2016, Lee *et al.* 2017, Spil *et al.* 2017b, Pérez-delHoyo *et al.* 2018). As local activist and leader of the “Community Tech Reset” movement in Toronto, Bianca Wylie notes regarding this neoliberal agenda on “individual services” through personalization and automation:

> Focus on the individual is one of the fundamental hallmarks of neoliberal thinking. Much of the current discussion about digital reduces technology to a user/government interaction. This is not a framework for reimagining social policy. This is a framework for entrenching neoliberalism. (Wylie 2017a)

Smart development is thus a means to embrace the modern world through the advancement of technological-service markets through personalized services (Pan *et al.* 2016, Cai *et al.* 2019, Desdemoustier *et al.* 2019, Nummi 2019). These “citizen-centric” services are promised to be delivered through the procurement of smart city technologies; effectively giving them the public stamp of approval by adapting the dissociation of the decision-making process that happens through real-estate and public-service privatization, the concept of a smart city uses rhetoric to place participation as a "virtual" promise in the process of smart governance (Zandbergen 2017, Cardullo and Kitchin 2019, Kensicki 2019). Said another way, the citizen is obligated to either "opt-in" or "opt-out" of the terms-of-surveillance a smart city provides, while never actually being able to turn down the situation altogether. Removing the role of "participation" in democratic decision-making in the choice to become a smart city, but instead how a citizen will be observed within one, which we call *coded engagement*.

In this form of *coded engagement*, promises of efficiency to stakeholders' (especially citizens') in engagement are tied to decision-making processes and promises of increased access to various public or social services (Kreiss 2015; Tenney and Sieber 2016; Shelton and Lodato 2018). Thus, the smart-city brings a form of governance that occurs only after the control of the digital commons is relinquished to the actors within the smart city circus, this so-called "e-governance, is key to enabling the smart city by bringing citizens to a smart city initiative and keeping the decision and implementation process transparent." (Nam and Pardo 2011, p. 287) Governance in the smart city itself brings many challenges tied to lacking policy formulation, poorly developed strategic planning, and misguided implementation (c.f., Anand and Navío-Marco 2018, Fernandez-Anez *et al.* 2018, Yigitcanlar *et al.* 2018).

With the popularity of the smart cities' paradigm, comes the over-promised expectations by city leaders to be able to frame citizen participation, and government services to the public in general, within the rhetoric of *smartness* (Fredericks *et al.* 2018, Andreani *et al.* 2019, Cardullo and Kitchin 2019). Increasingly, these "smart" framings are carried out without appropriate strategic planning and follow the urge to jump on the first pilot opportunities for using smart technologies to solve the real problems – no matter how trivial they matter to the citizens (Anand

and Navío-Marco 2018, p. 795). Legacy investments and approaches rooted in past policies or regulations are also reported as contributing to vast over-investments in projects, which inevitably fail with little to no outcomes in the short- or medium-term time frames (Lai 2016, Borsekova and Nijkamp 2018, Lu *et al.* 2019, Michalec *et al.* 2019). Therefore, as we argue in this paper, the importance of instituting fitting policies and engaging citizens to co-design and participate within the planning stages is imperative to any smart city that seeks to be seen as *inclusive*, *modern*, and *open* – let alone *smart*.

1.2 The Automata City: The Many Imaginaries of the Smart Circus

Many definitions of smart cities exist that range from visions of sensors driving infrastructural resources to encourage creative economies and using evidence-based policymaking (Nilssen 2019). With all definitions of what it means to be a *smart city,* the role of technology is an essential ingredient, however increasingly the scope of what is included in the smart city concept reached beyond just information-technologies:

> …to a clever blend of policy innovation, leadership and building collaborations. While technology remains a necessary but underlying common ground, it is the creation of space for innovation and citizen participation in solving urban problems that real successes in cities such as Amsterdam, Barcelona and New York appear to lie. (Anand and Navío-Marco 2018, p. 795).

A range of conceptual variants of the smart city is often obtained by replacing "smart" with a variety of other euphemistic adjectives, for example, "intelligent," "inclusive," "innovative," or "modern." (Ching and Ferreira 2015, Nilssen 2019) The label "smart city" is a fuzzy concept and is used in ways that are not always consistent within one organization, as the City of Toronto (Nam and Pardo 2011, p. 283). There is neither a single framing for a smart city nor a one-size-fits-all definition of what is so *smart* about this modern conceptualization of the city (Albino *et al.* 2015, p. 287). The history of the intelligent city, virtual city, digital city, and information city reach back to the theories of cybernetics popularized in the early twentieth century, which refer to science-organized systems and the mechanical control of communications (Wiener 1989, Mattern 2015, Zook 2017). Thus, to understand the role of current vision of a smart city one must investigate more than just the types and uses of technology so to include the social and political impacts they have on democratic processes of participation within the city and rights of the citizen.

The fundamental unit of the smart city is greatly expanded beyond the concept of controlling basic infrastructural processes to include a multiplicity of factors and forces of people and processes of policy (Borsekova and Nijkamp 2018, Andreani *et al.* 2019, Kondepudi and Kondepudi 2019, Nilssen 2019). In this context, Couclelis (2004, p. 7) states, “the idea of the digital city is a product of several of the broad factors that define our postindustrial age.” Extending this view, the most notable factor from the rise of the truly digital city is “the technological convergence of computers, telecommunications, and mass media” (*ibid.*). In a broader context,

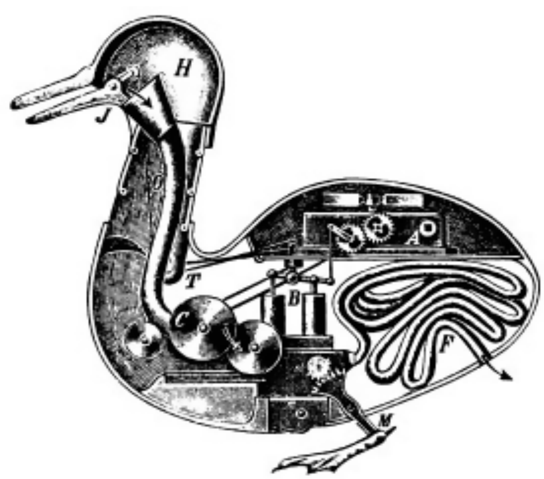

Figure 18 American artist (mistaken) interpretation of Jacques de Vaucanson’s Canard Digérateur was inspired by Descartes' principle of the mechanistic universe to create a mechanical animal. The Canard Digérateur was said to have the ability to eat grain, digest it naturally, and defecate waste. (Image adapted from Wikicommons)

the idea can be extended to include the smart city's impact on socio-economic and cultural developments (Shapiro 2006).

Motivating a smart city, relative to other kinds of imaginaries[5] of cities, is the use of ICTs to become more efficient in serving its citizens (Albino *et al.* 2015, p. 6). Furthermore, a smart city is positioned as being more user-friendly, with customized services tailored to the individual citizen's needs. This efficiency and personalization become the promised bread and circuses[6] to public demands whereby the smart city adapts itself to the user needs (i.e., citizens) in real-time and provides customized interfaces that deliver city-services through a circus of apps, sensors, and algorithms (Costa *et al.* 2018, Gardner and Hespanhol 2018, Witanto *et al.* 2018, Cai *et al.* 2019, Osman 2019).

The ease and seamlessness of interacting with a smart city through these citizen-centric services come to form an automaton of civic-engagement. These automata promise a form of *coded engagement* where interactions between government representatives and citizens are mediated through surveillance ICTs (Green 1999, Albrechtslund and Lauritsen 2013, Tenney and Sieber 2016). Meaning you, the citizen, are participating in the decision-making by having your digital-footprints consumed by big-data algorithms, and out from the automatic circus of technologies come actionable-insights from public feedback.

[5] Imaginaries (or social imaginary) is a sociological concept indicating the values, institutions, laws, and symbols being held to a particular social group and the corresponding society through which people imagine their social whole.

[6] A palliative offered especially to avert potential discontent - Merriam Webster. Originating as a term to referencing techniques to keep the Roman populace happy by distributing free food and staging huge spectacles.

This form of *coded engagement* in the smart city becomes framed as a circus of technological automata (various citizen-centric digital services and data collecting sensor arrays operating automatically to replace traditional democratic processes), such as Vaucanson's *Canard Digérateur* (see: Figure 18). Vaucanson's automatic digesting-duck presented itself as the mechanical emulation of the eating, digesting, and defecating biological version. Just as the duck could not digest food - the food is collected into a hidden drawer, and the pre-processed feces were "produced" from a second compartment - the automata-participation of a smart city cannot replace democratic participation. Herein lay the reality of many smart city imaginaries for creating a user-experience integrated and fueled by the simple living of daily life that is promised by many of the citizen-centric services. Sensors harvest the digital fields of citizen data, then process it through a series of database-handshakes and algorithmic treatments. No matter the quality of data entering the algorithms of the data-driven city, out come the promises of actionable insights for government operations and increased citizen engagement (Shelton 2017, Madsen 2018, Cardullo and Kitchin 2019, Hong *et al.* 2019, Torabi Asr and Taboada 2019).

By living, working, and playing in the automata city, citizen behaviour becomes the ingredients of the *coded engagement* for a smart city's participatory democracy. At least that is the expectation: citizen behaviour provides the digital bread-crumbs (i.e., the datafication of participation and e-government services), and a circus of technology promises to solve the democratic messiness of participatory governance in the smart city (Baack 2015).

1.3 Fed the Bread of Data-Driven Solutions for Coded Engagement

The efficiencies of citizen-centric digital services in smart cities rest on the premise that, with so much data (big data), planners, governments and researchers can better understand cities as complex systems and make better decisions about how they are managed (Anthopoulos 2017).

Big data promises the potential for cities to obtain valuable insights from a large amount of data collected through disparate sources. The Internet of Things (IoT) allows the integration of sensors, cameras, and Bluetooth in the real-world environment using networked services. Through these assemblages of technology (Zook 2017, Carter 2018), the crumbs of data that we leave behind become the ingredients used algorithms to retrace our opinions, desires, and offer a digital bread for the means of public engagement within the smart city (Anthopoulos 2017). However, it is increasingly difficult to make sense of the mounds of crumbs left by decontextualized data, compounded uncertainty through algorithmic treatments in proprietary software, and determining where the actual "solutions" being offered by *smart* city technologies meet reality instead of being mere hyperbole; let alone their actual impacts on citizen engagement.

The difficulty in harnessing or providing a frictionless means of engagement for participatory democracies, have led cities to be the "new laboratory" of innovation for modern governance (Bonis and Trapani 2017). Through automation and the use of algorithms, municipalities can leverage data analytics in an effort to solve some of the more wicked urban problems that municipalities face (Goodspeed 2015b). Problems like ensuring that public opinions are being "heard" and appropriate city-services are being delivered. However, there is an ultimate applicability issue with "off-the-shelf" data analytical platforms being sold under the different terminology of business-intelligence, data science, and data analytics *solutions* (Chatfield and Reddick 2018b):

> At a closer look, however, "analytics" proves to be a slippery object of inquiry. Analytics "use case" is more than an algorithm; it is a constellation of mathematical methods, technology capital, personnel skills, process design, and policy implementation. Transferring one is not so much a simple matter of sharing code

> as it is a process of adapting a sociotechnical system to a new context. (Campbell 2019b, pp. 7–8)

For example, Tenney et al. (2019) present a novel approach to how municipalities might attempt harvesting public opinion through the analysis of social media data. They demonstrate a methodology that could be used to emulate emergent topics in public opinion and identify communities of interest and practice within local contexts for the exploration by local stakeholders. Their approach allows *passively* contributed social media-based opinions, along with different variables, such as time, location, social interaction, service usage, and human activities to be examined and used to identify trending views and influential citizens. However, the uncertainty and variability of big data make it entirely evident that there is no silver-bullet solution through analytics for a one-to-one city fit. Instead, this sort of analytical method requires domain-specific knowledge about a locality for their adaptation and understanding of their feasibility for use in a particular geographic context and tailored to both the unique characteristics of available data as well as the goals or expectations of the application at hand. By themselves, data-driven methodologies do not automatically engage citizens and deliver them efficient government services to their door-step (Thrift 2014, Pink *et al.* 2018, Smith 2018, Lehtiniemi and Ruckenstein 2019). Often off-the-shelf solutions are aimed at addressing trivial problems or fail to be able to address the actual problems experienced in local contexts (Campbell 2019b):

> a "common understanding" of what smart city is a "smart utopia" - that is, the outcome of the "wedding" of vendors and local governments - drives the above efforts and leaves out real community problems. (Anthopoulos 2017)

Rather, data-driven methods need to be strategically implemented within appropriate contexts, engage domain and local experts, as well as be supported through policy and good practices (Zook 2017, Madsen 2018, Moses *et al.* 2018, Redden 2018).

1.4 A City of "Free Beer" or "Free Speech": The Gratis vs. Libre Model of the Smart City

No matter how smart the tools of a city become, there is still a framework of policies controlling these operations and deciding which of the technologies or services to implement. The type of governance structure deployed in many smart cities can be framed in the context of offering public resources to third-party vendors under the *gratis* or *libre* models to develop these citizen-centric services in the smart city. For example, Larson (2018), details how the promises of democratic participation are supplanted in Chinese government surveillance policies under a *gratis* model of SCG - where leaders have pushed forward with efforts to capture public sentiment while ensuring government authorities are not questioned or accountable for these actions. In order to do so, much of the Internet, social media platforms, and public realm data are monitored by contracted firms to harvest citizen behaviours and opinions for the furthering of authoritarian interests. Conversely, Graham (2018) provides a report of reclaiming of the public commons through technological sovereignty under a *libre* model in Barcelona where the drive toward co-creation and transparency opened up rapid developments in the SCG model being practiced. In many respects, it is which of the *gratis* or *libre* models of SCG being used in becoming a smart city that determines the role, the rights, and the consequences citizens face in their smart future.

The smart city governance (SCG) model deals with how smart cities implement and manage policies to regulate themselves and the processes or technologies that make them smart. In this way, SCG includes the regulation of "the social and technical platforms which include data, algorithms, skills, infrastructure, and knowledge." (Lauriault *et al.* 2018a, p. 36).

SCG is one that is neither holistic nor integrated within the city governance model as a whole (Anand and Navío-Marco 2018). Instead, SCG is often an ad-hoc series of policies and processes layered on top of one another from one procurement to another vendor-provided solution. In either case, the notion of public involvement in the process of governance is increasingly an afterthought or even absent in many operationalized SCG models (Tenney and Sieber 2016, Webster and Leleux 2018, Kensicki 2019). In a survey of 13 other Canadian municipalities, researchers Lauriault et al. 2018, highlight the primary issue with smart city governance models currently underway across the country:

> […] even when driven in Canada by good intentions and best practices in terms of digital strategies, has its shortcomings, namely that it remains a form of innovation and efficient, driven technological solutionism that is not necessarily integrated with urban plans, with little or no public engagement and little to no relation to contemporary open data, open-source, open science or open government practices. (Lauriault *et al.* 2018a, p. 33)

Ruhlandt (2018) performed a systematic review of SCG models. The review stressed the importance of having a structured, comprehensive, and pragmatic governance structure for actually-existing smart cities. However, the author claims to find no definitive definition of SCG in their scan of empirical examples. It is this lack of a cross-applicable SCG model that constitutes one of the most forbidding barriers for a city's transformation into being smart (Ruhlandt 2018, p. 1). As Castelnovo et al. (2016) highlight that if the smart city is to fulfill one of its more salient promises, improving citizen engagement and harnessing public participation, then the SCG must encourage the incorporation of codesign (i.e., involving citizens in the design process of what technologies are included in the smart city) and co-production (i.e., citizens are aware and in agreement to participate in providing the data to fuel smart city services) (Mueller *et al.* 2018).

Fundamentally, governance at the municipal level should include a variety of mechanisms in which the citizen is engaged within the decision-making process, as well as providing a means to make municipal operations transparent and accountable (Castelnovo 2016, Scassa 2018). Currently, most SCG models focus on setting limits on smart city technology and routinely lack a mechanism to provide an oversight role to the citizen (through formal engagement processes) which would engage them in deciding which technologies to procure and deploy and for what purposes (Lauriault *et al.* 2018a). Instead, many SCG models provide private industry public resources under the *gratis* model (i.e., free to use resources like data, infrastructure, or "experimental space") that allows participants (e.g., private companies, citizen-tech groups) to pilot, develop, and further solicit their products with lower financial risk environments. A SCG model that incorporates citizen-centric processes in the implementation and regulation of the smart city prior to the implementation, instead of the promise to be included in a more automata version of public engagement after the fact, befitting the notion of an Open Smart City and the *libre* model of SCG (i.e., free to access resources):

> An Open Smart City is where residents, civil society, academics, and the private sector collaborate with public officials to mobilize data and technologies when warranted in an ethical, accountable and transparent way to govern the city as a fair, viable and liveable commons and balance economic development, social progress and environmental responsibility. (Lauriault *et al.* 2018b, p. 6)

As we argue in the second half of this paper, there is no "clear distinction" of a total encompassing fit of either the *gratis* or *libre* models of an SCG model within Toronto. As the city is a large and complex organization with many different actors, practices, and policies. Both models exist, layered in the palimpsest of existing structures and processes, fragmented across the city as a whole.

One attempt at an *open*-SCG model is that of the City of Barcelona, and it is the second iteration of their SCG. The first model started in 2011 when the City Council of Barcelona launched a new IT strategy to encompass a transformational plan aimed at introducing the use of innovative new technologies to improve the overall operation and management of the city. This SCG model focused on fostering economic growth and strengthening citizens' welfare (March and Ribera-Fumaz 2016). The lessons learned from allowing too many private interests to entirely control the visions of this Smart Barcelona program took the second and current governance model, developed under Mayor Ada Colau, in a different direction - the open-SCG. Barcelona's second and current smart city strategy is about moving towards a model for technological sovereignty that focuses on the use of non-proprietary standards (i.e., *libre* model) for all digital services; using free software and the reuse of existing resources; establishing a new relationship model with vendors and open source communities; and a developing flexible intellectual property policy. Instead of wiping the slate from the first model, Barcelona integrated the newer and open SCG principals into new projects iteratively and over time. Furthermore, the city used this gradual transition to smartness to invest in building dedicated in-house resources, create a supportive infrastructure, and acquire the competencies to facilitate these goals into the future (March and Ribera-Fumaz 2018).

According to the literature and examples provided reviewed above, it is clear that the public is offered the bread of promises for citizen-centric services by the adoption of their participation within the smart city assemblages through data-driven methods. Increasingly, these layers of technologies, policies, and practices are a mixed bag of hyperbolic rhetoric and imaginary ideals driven by private entities within still lacking governance model. This is particularly the case for the City of Toronto, where governance power has been removed from elected officials and public oversight for the past several decades. In the following section, empirical examples have been collected on Toronto's open data program, smart city imaginaries, and representative project with regards to the *gratis* vs. *libre* model of SCG as they involve the role of the citizen participating in the smart future of Toronto. Moreover, we examine how these ideas of what the promises of a smart city can bring are encapsulated in rhetoric or concepts to have a washing effect on the potential barriers for the arrival of automata services and circuses of vendors to set smart city values.

2. Methodology

2.1 Study Area

Occupying 636 km^2 the City of Toronto is a collection of six boroughs that amalgamated in 1998, with a population of approximately 2.92 million residents, Toronto is the largest city in Canada, by population, and the fourth largest in North America. Governed by a Mayor and 25 city councillors, the city is comprised of 44 divisions and 12 service agencies, employing 35,000+ full-time employees year-round and up to 55,000 people, depending on the seasonal workforce.

2.2 Data Collection

There were several methods of collecting data for this chapter, including 1) formal interviews with relevant actors in the smart city and participatory space around the Greater Toronto Area; 2) secondary data collection from documents regarding the topics and projects discussed; as well as 3) direct participant observation. Several of the co-authors are daily engaged in city operations at the City of Toronto with a direct role in the development of smart city projects across multiple divisions. The third co-author is a vocal community leader on civic rights in technology and open data policies within the Toronto area. These roles affect the positionality of views held and presented within this chapter.

2.2.1 Formal Interviews

Formal interviews (n=38) were conducted in locations chosen by informants (i.e., at the City of Toronto offices, or, in several cases, over telecommunication platforms like Skype). All interviews were conducted over two-years from 2017 to 2018 following an opportunistic scheduling timeline set by the informants. Formal interviews were conducted using a standard interview protocol consisting of a combination of 56 questions, ten of which multiple choice and scale-based questions were, with 46 open-ended responses. The interview protocol focused on four primary areas including 1) perceptions on public participation, 2) perceptions on data-driven methods for smart cities and public participation, 3) a review of a recent project using "smart" approaches to deliver citizen-centric services, and 4) basic demographic and experience information from the respondents. The survey instrument used in these interviews can be found in Appendix B of this dissertation. Follow-up probing questions were used to learn more about informants' relationships to the organization, smart city practices, further details and context surrounding their initial responses, and views regarding participation in the City of Toronto. Informants were encouraged to express personal perspectives and to elaborate on how their behaviours, interactions, and what they had observed in the areas of interest related to this research. Each informant was also consulted, as needed, throughout the study for additional insights and clarification. It was required, as is common with this form of fieldwork (Marshall and Rossman 1999), to do contextual revisions of the interview questions because of non-applicable lines of questions and as data suggested.

2.2.2 Secondary Documents

Substantiating evidence for the propositions raised during formal interviews and participant observations – were derived from various public documents including Toronto City Council meetings minutes, internal documents, external documents (i.e., news releases, city web page), presentations and public consultation events from city officials. Related documents to the projects used as examples in Section 4 were also collected to assist in filling in details not held by individual informers. Data was collected from council meeting minutes back to 2006, local news and community publications, as well as public forums that resulted in over 325+ relevant documents in support of the topics within Section 4. The documents covered the topics of data governance, smart technologies, public participation, and data analytics within the Greater Toronto Area. Only a selection of these documents is presented in this work so to highlight key projects, policies, and examples relevant to the theories developed from this research.

2.2.3 Participant Observations

The final and most robust data collection technique used in this research was that of being an active participant-observer as a "full member" within the City of Toronto. Exposure to internal meetings, discussions, and staff viewpoints on policies, projects, and processes regarding smart cities, citizen participation, and the direction of these factors for the future were enlightening data points within this work. Furthermore, this internal role allowed for the observations to take place over time and be augmented by formal interviews of relevant staff that offered the most background and positioning on the themes of smart cities and citizen engagement. Observations took place from November of 2017 to ongoing. These observations took place during normal job-duties as the Lead Data Scientist within the city, Director of the Open Data project and Geospatial Competency Centre, and as a community activist involved with citizen interest groups focused on the use of technology within the City of Toronto. These shared perspectives were integrated into the accounts provided within Section 4 and the conclusion of this chapter.

2.3 Data Analysis

Interpretation of the data for a fuller investigation is on-going. The coding of qualitative data requires a dialectic thinking process (Bennett and Elman 2006, Brown 2010), in which interviews and field notes are read several times to develop a coherent sense of the whole body of data and generate as many categories as possible. For each of the data sources listed, emergent themes were clustered to provide an understanding of shared meanings across actors and actions within the City of Toronto. Finally, these themes and the emerging theoretical framework are related to literature, as suggested by the data.

2.3.1 Formal Interviews

A grounded theory approach was used, through both inductive and deductive reasoning, on survey results to code them into open themes by salient topics (i.e., categories) (Annells 1996, Urquhart *et al.* 2010). The interviews were divided into four themes: 1) perceptions on public participation, 2) perceptions on data-driven methods for smart cities and public participation, 3) a review of a recent project using "smart" approaches to deliver citizen-centric services, and 4) basic demographic and experience information from the respondents. The summarization and tabulations of multiple-choice and scale-based questions were cross-compared by informant role and responsibilities. Open question replies were documented through note-taking that were then condensed and coded within the four themes above. The identification of codes was to find anchors that allow the key points of the data to be gathered related to the emergent concepts within the literature and focus of this research. The terms concepts in grounded theory are collections of codes of similar content that allows the data to be grouped and themed into the theories presented below. This process and framework of coding was continued with secondary documents and participant observations.

2.3.2 Secondary Documents and Participant Observations

Content analysis was performed on sources of data collected, as identified in Section 2.2. Analyzing these texts included the coding documents into manageable categories for analysis (i.e. "codes"), fitting to those determined by formal interviews and themes of this research (Altheide 1987). Once the text was coded into categories, "code categories" were further summarized into key concepts to identify emergent themes (Scott 1955, Elo and Kyngäs 2008) that assisted in developing the perspective presented in Section 4. The same process was done with notes from participant observations and daily activity logs regarding the themes of participation, smart cities, and data-driven methods for the above.

3. Results of Coded Themes for Smart Toronto Visions

The results for the survey and coded content from secondary documents, as well as participant observations, are provided in the tables below. Table 1 contains the breakdown of informants; Table 2 presents the coded themes from open-ended interview questions, content analysis results, and observations from participant observations. Codes are keyword groupings under four categories as they related to the focus of the research and design of the interview sections. Table 3 presents the results from scale and multiple-choice questions from the survey.

Survey Informants:		Informant by Tenure:	
Total Participants	38	Average Years in Position	7.2
Total - City of Toronto	12	Median Years in Position	4
Level of Education:		**Informant by Sex:**	
Undergraduate	25	Male	21
Masters	13	Female	17

Table 1 Demographic and work experience results from formal interviews

The formal interviews covered 38 participants from the Greater Toronto Area (GTA), with a majority of the informants being employees from the City of Toronto (n=32). There were 21 males and 17 females in the survey pool with roles relevant to the topics of interest in positions that ranged from the staff-level to middle and executive management. The average number of years informants had in their current position was 7.2 years, with a median tenure of 4 years. All respondents had an undergraduate degree, with 13 obtaining Masters level of education in their respective fields (see: Table 1)

Lack of Access	Not required for most projects	Consultants, “Vendor knows best.”	Efficiency
Vendor-controlled	Vendor-controlled	Strong Focus	Big Initiative/Focus
Quality	Mandatory for Council/Public Work and Planning Projects	Lack of resources; Lack of skills;	Technology providing citizen services; vendor controlled
Quantity	Unknown Influence	Good Idea	Vendor-controlled
Knowledge	No set Methods	Dashboards, business intelligence, GIS, excel	Buzzwords “Inclusiveness"
Lack of Timeliness	Unrepresentative, Notification Difficult,	Not sure where to start	IoT, AI/Machine Learning; Data Mining
Siloed	Burden on Public	BI-Dashboards	Privacy
Privacy	Hard to do	“We have been data-driven.”	“We have been a smart city.”

Table 2 Category Themes from coded content analysis

Figure 19 Years of Experience Survey Responses

Responses to survey questions in Theme 1, regarding the role of data, were dominated by a focus on lack of access, third-party control and concerns regarding the quality of available data to city staff. A majority of the respondents referred to the Open Data program at the City of Toronto and effort to share data between divisions was difficult. Perspectives on "data" held by informants (Theme 1) primarily focused on the use of data to make evidence-based decisions and provide improvements to city services. Data-driven efforts from survey questions provided further details regarding current practices with software and analytics platforms. While the responses were mixed in terms of knowledge and ability, there was a shared interest in pursuing and developing more data-driven capacities in the City of Toronto (see: Figure 20). These included aspirations (and some current limited role) of using advanced analytics (e.g., Machine Learning and Artificial Intelligence) with big data to provide business and citizen services better.

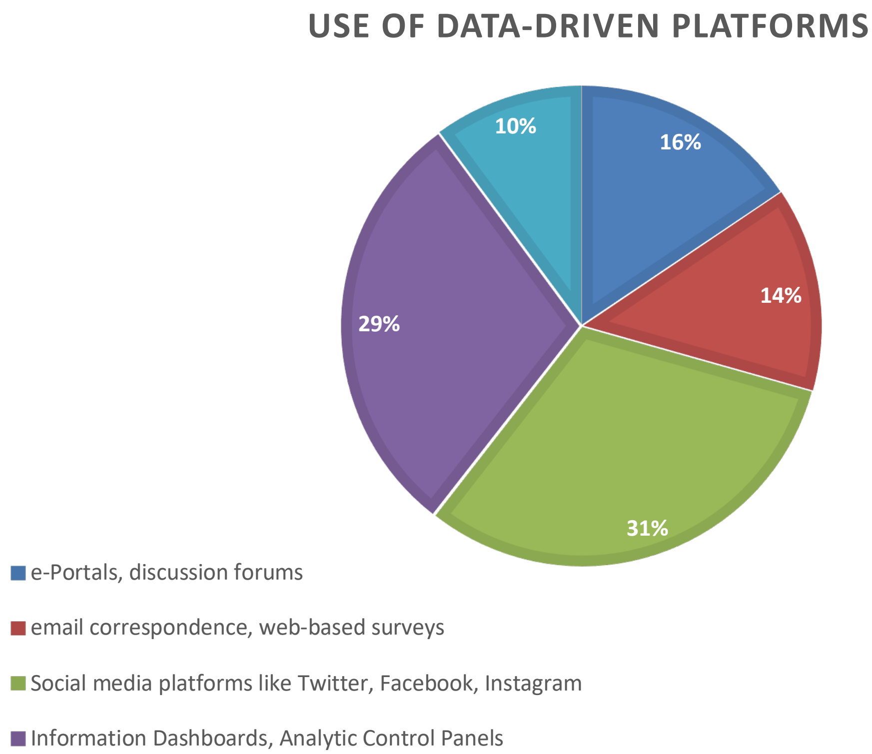

Figure 20 Distribution of data analytics platforms currently used by total survey responses.

The internal perceptions of public participation and the ability of public servants to engage with citizens were coded into Theme 2. While public participation was unanimously held as being an essential and needed process within municipal operations, city staff had conflicting perspectives on its role, utilization, and future. However, respondents still rank their ability to engage with the public, measure their level of engagement, and think the perceived satisfaction with the public role in participatory roles as being relatively low (see: Figure 21).

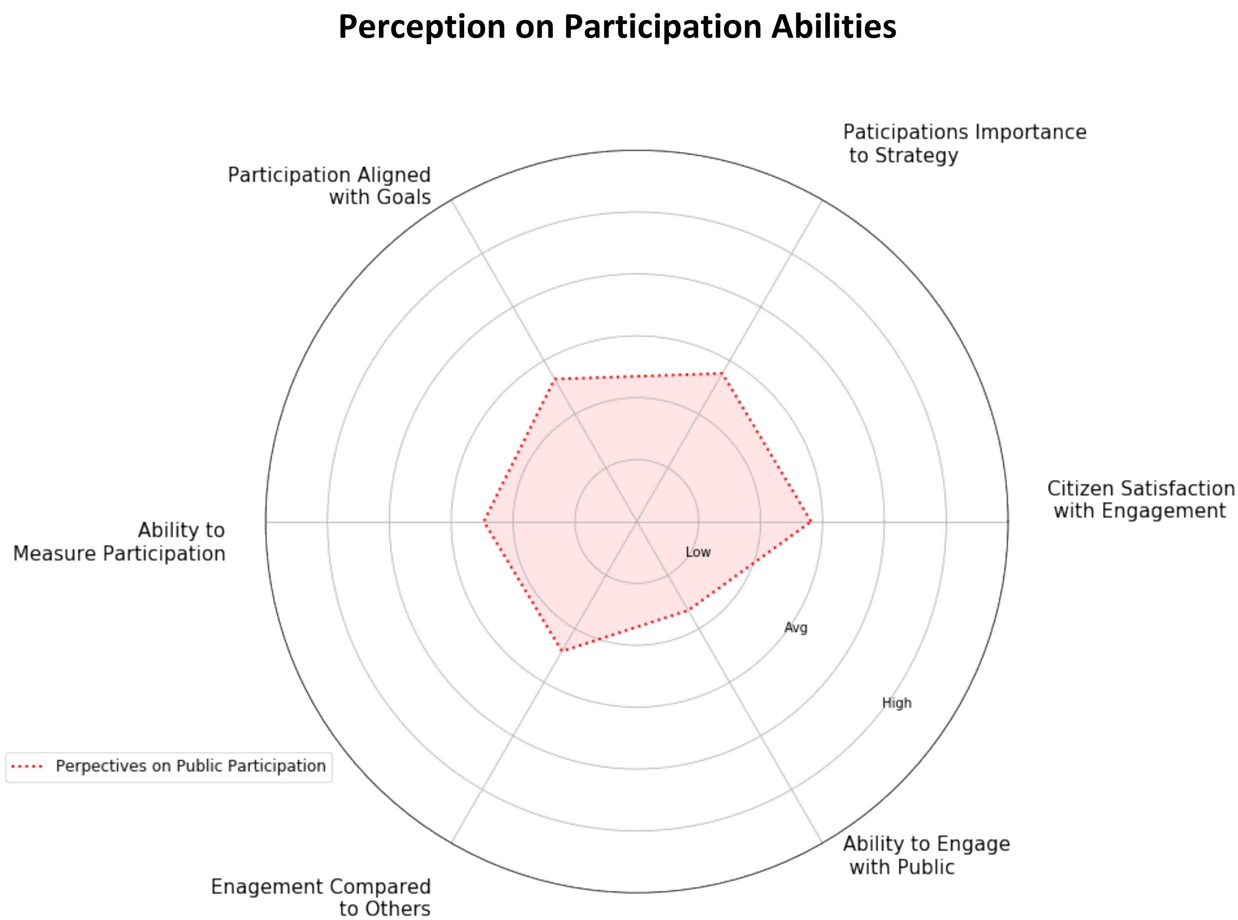

Figure 21 Public participation perceived ability by survey respondents

Forms of traditional engagement methods (e.g., see Figure 22) were still the most prevalent means of involving public participation within the City of Toronto. According to the respondents, Town Hall and open public meetings were most common, but there were several accounts of using online surveys and social-media advertising campaigns. Seven informants had internal roles as analysts with job duties that never required them to engage with the informal public settings. Citizen juries and community panels were reported to be less used, but upon further inquiry "citizen" and neighbourhood panels were often noted as being business-owner associations for local areas across the City of Toronto who take over consultation and policy review for administrative areas known as Business Improvement Areas (BIAs). BIAs are a consortium of local property and business owners within local districts across the City of Toronto. Increasing the role of public participation through traditional means was indicated as being a priority to City of Toronto's strategic aims and included in master plans for city initiatives, which can be seen in Figure 23 (note 7 respondents answered not applicable – NA).

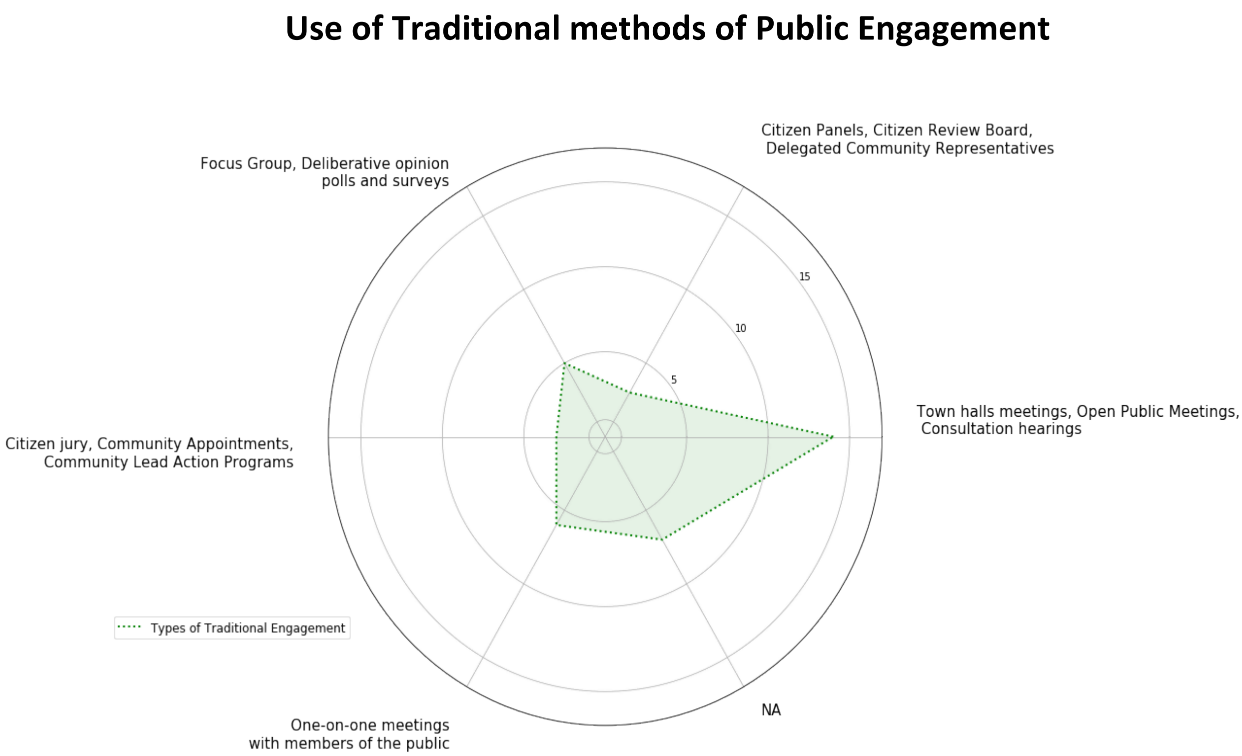

Figure 22 Use of "Traditional" Forms of Public Participation

There is interest both within city departments, as well as with citizen constituents (as reported to informants) for the city to utilize more “smart” technologies in order to engage with citizens, collect urban data relevant to city decision-making, as well as pursue narratives present within the “Smart City” agendas being developed within the City of Toronto. Several teams within the City of Toronto are pursuing more e-government forms of participatory feedback through active-engagement methods like citizen forums and social media campaigns (i.e., for targeted survey responses). However, there is also increased use of sensors and “big data” to understand public opinion and better utilize city resources. The areas identified for increasing use of “smart” technologies for increasing public participation generally mirrored those areas for increasing traditional methods of engagement with the stark exception of protective services (note no informants were associated with protective services – i.e., Police Department) where concerns of privacy were raised (see: Figure 23). There were also concerns raised for using sensing technologies more generally when it relates to smart city initiatives, primarily raised by respondents at senior levels.

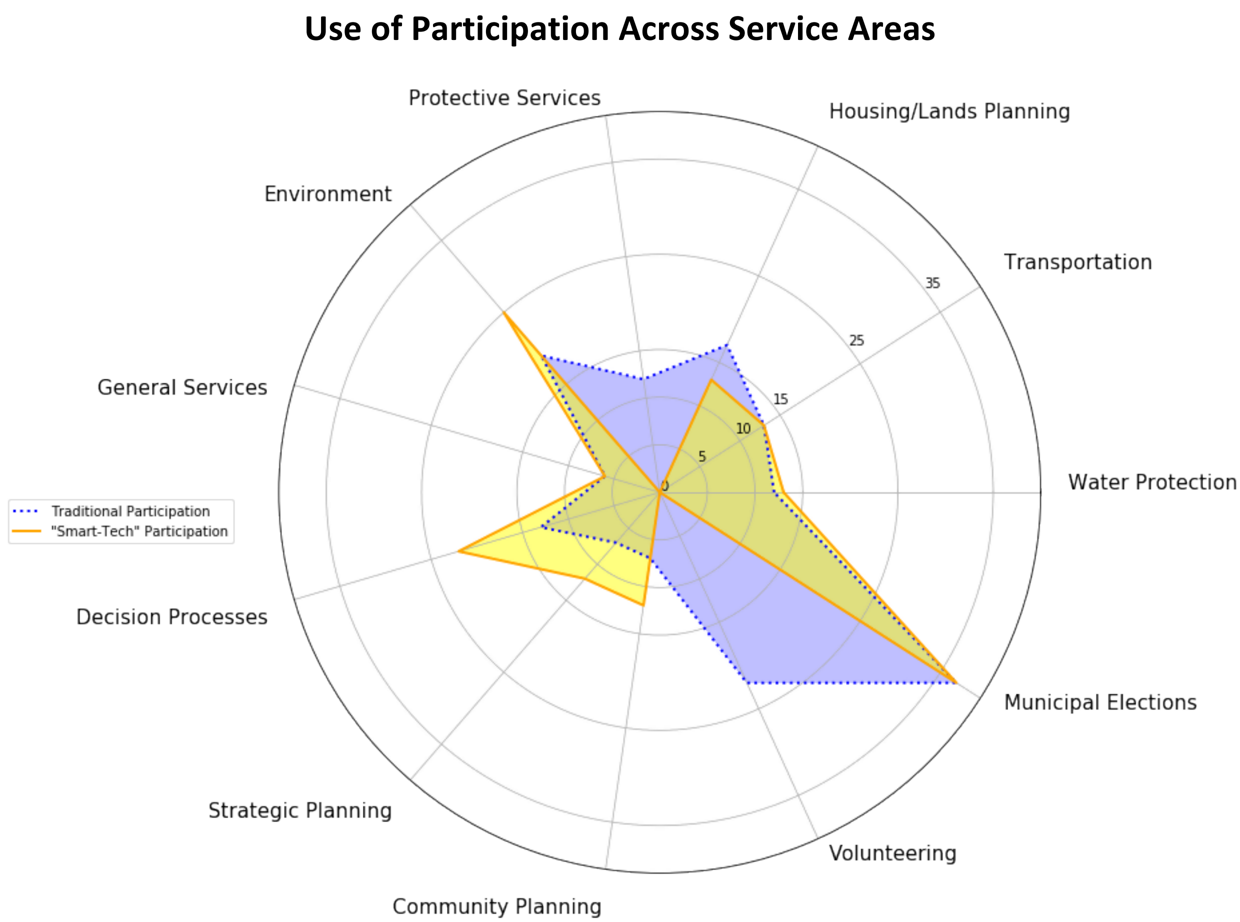

Figure 23 Areas of focus for increasing the role of public participation through both “traditional” and “smart” city initiatives.

There was a divide in consistency between responses from City of Toronto staff that mirrored the level of their role in the organization. For example, senior management (e.g., Manager, Directors, and executive leaders) shared a much more uniform narrative and response to survey questions that aligned with material in strategy plans outlined for their respective divisions and initiatives. However, all respondents indicated the most prominent method for public engagement was through voting in municipal elections.

4. Wizard of Toronto: "Pay No Attention to that Man Behind the Curtain"[7]

Like many cities around the world, Toronto has instituted several multi-year plans that outline a conceptual guide for future growth and development. However, the sparse details available in the yet-to-be-released smart city plan for Toronto are seemingly unknown to the primary decision-makers, city staff members, or members of the public. This is largely because of the behind-the-scenes agendas of corporate technology vendors who not only have a clear interest in having their "solutions" be part of a smart Toronto procurement strategy but are also largely commissioned to define what this smart city plan entails from the onset. Master planning makes the connection between urban infrastructure, public needs, and their surrounding environments. A master plan will often include concrete recommendations and proposals for a city's economy, housing, transportation, community facilities, and land use policies (Brody *et al.* 2003, Blecic *et al.* 2011, Swartz and Zegras 2013, Kahila-Tani *et al.* 2016). However, in the case of the city, many of these plans result in only sparsely filled slides of colour-coordinated bullet points and do little to identify actual pathways or mechanisms to make the smart city.

[7] Section title is based on quote from "The Wizard of Oz" – 1939 – where the Wizard of Oz was being controlled by a hidden figure behind a curtain.

4.1 Quacks Like a Duck: Focus on the Promises, not the Processes

The message set by those designing the values and agendas for Toronto's "smart future" is clearly stated in the mission statement used as a guiding principle for City development and so is the rhetorical technique commonly used to distract the focus from the "how" or "what" behind actually creating a smart city to the intangible promises being offered:

> The City can use the concepts of smart cities to achieve civic aims; ***the point is not the technology, but the outcomes technology can deliver.*** With strategic planning, those outcomes can be far-reaching. This is an aspiration towards a smarter Toronto. (Smart Cities Working Group and City of Toronto 2017 - emphasis added)

One such example is the recent case of Sidewalk Labs (a subsidiary of Alphabet Inc. - i.e., Google), there has been accelerated demand, to design policies and frameworks to support the needs of Sidewalk Labs' engineers. Sidewalk Labs' had been awarded a contract by a semi-governmental commission in charge of Toronto's Waterfront development to develop a vacant portion of land into a modern "smart city" model to be emulated around the world (McKinnon 2017). The pressures of "supporting" new smart city infrastructures, in the larger context of the City of Toronto, have permeated city boardrooms and summoned the salesmen of these new products and services to offer solutions to modernize city policies in order to handle Sidewalk Labs proposal. Deputy City Manager Tracey Cook released a public staff report detailing the requirements for the City to evaluate a master innovation and development plan (MIDP) from Sidewalk Labs later in the year of 2019 would cost over $800,000 for the city to review (City of Toronto - Cook 2019). According to both the staff report and accounts from reporters at the Toronto Star newspaper, much of these costs would be allocated to:

> […] payment for external consultants who would be retained to oversee a public and stakeholder engagement process that will centre on the master plan for its Quayside "beta site" project, a mixed-use development on Toronto's waterfront that the firm [Sidewalk Labs] says will feature sensors and data-driven technology aimed at making life for thousands of new residents, workers and visitors to the district more efficient. (Vincent 2019)

The priorities set in the staff report are again aimed at ensuring inclusiveness and integration into city frameworks while acknowledging the current policies are not able to address these "smart city needs." Again, the commentary provided by community activist leader, Bianca Wylie, regarding the insertion of corporate control over public services in Toronto, using the rhetoric of "smart" and "inclusive":

> In Toronto, our long-term strategic plan is not the playbook we are all following. Our supposed values and ideals—are we using technology for them? Alternatively, are we asking the private sector to step in, and to effectively step over both the residents of this city and its immensely skilled bureaucracy, to help us think about what we need in a smart city and why? I'd wager, based on history, that it is the latter. (Wylie 2017b)

The city has become an apparatus of strategic planning for the insertion of technology on behalf of economic development, but citizens are urged not to focus on the technology itself, rather the circus of promised outcomes (Alizadeh 2017). At the forefront of these promises are economic development and technological solutionism. It is clear to see how the SCG model emboldens the ethos of Silicon Valley, where technology is a solution to urban problems and those who should control these technologies are the tech-giants themselves. As said by the former CEO of Google, Eric Schmidt, regarding the role of governments regulating technology in the smart city future: "The problem is [that] if you write a rule, inevitably, you fix the solution on a specific solution [technology], but the technology moves so quickly,[...]It's generally better to let the tech companies do these things." (as quoted in Zahn and Serwer 2019) Thereby demonstrating the perspective that technology vendors behind the smart city circuses should be allowed to self-regulate as they move to provide the next phase of democracy through coded engagement. This perspective is commonly held amongst city executives, within IT, as reported by survey results.

4.1.1 Smart City Working Group

In 2016, Toronto City Council requested that the Chief Information Officer (CIO) "continue to work and establish relationships with industry partners to support the commercialization of smart city technology and identify the potential uptake by City divisions" (City of Toronto - Smart City Initiatives 2016a). Following the council motion, city staff, private industry partners, and the Toronto Region Board of Trade formed the Smart City Working Group (SCWG) to pursue their aspirations of being a smarter Toronto. The SCWG is comprised of 26 (out of 35 total members) private industry executives. The remaining members are academic and government officials from five city divisions (5 out of 44 in total) and three local universities (City of Toronto 2017a). The SCWG has been tasked with outlining the strategic plan for the "smart" City of Toronto and formed critical recommendations on how to "modernize" and "innovate" city services and operations. It is also a primary function of the SCWG to generate discussions about policy issues, including open government data and broadband infrastructure, which could impact the economic vitality of the GTA. However, no public engagement or citizen participation has been included to this point. To this end, the SCWG has repeatedly encouraged the adoption of wholesale corporate development and data collection as the Chair of the board, Brian Kelsey, reported to City council during a discussion on the Sidewalk Labs project. Kelsey was clearly in support of Sidewalk Labs investment with special focus on the collection of citizen data as the source of economic potential (euphemistically termed "public realm data" by the SCWG):

> [The Toronto Board of Trade] released a report calling attention to the data regulation issues around so-called public realm data, what sidewalk labs refer to as urban data. We support the regulation of that data. We introduce that had report as our first step into that debate because we wanted to make it clear not only that we believe that that issue should be regulated, but we believe that with proactive work by this council and other governments which is already taking place, we believe that data can be regulated in time for sidewalk labs to proceed, and even if the sidewalk labs deal fails there are still other examples in this city all right underway where public realm data could be collected or could be collected. So, let us remove that issue as quickly as we can. (Toronto City Council 2019)

4.1.2 Masters of Technology: Providers of Plans

Having technology companies write the plans and policies for how primary services are provided to citizens is not an uncommon story in municipal government. There are multiple accounts from city divisions (i.e., city executives, program directors, service managers) where not only are the policies and programs designed by the procurement of third-party vendors within the City, but these same vendors are also responsible for conducting the public consultation and engagement processes often statutorily mandated (City of Toronto - Various engineering firms for 'Vision Zero 1.0/2.0' Coleman 2017, Open North for the 'Open Data Master Plan' Garnett 2017, Esri for the 'Enterprise Geospatial Strategy' McGhie 2017a, Carr 2018). On June 6th, 2019 Toronto city council was approached by three community leaders to raise their concerns regarding the ongoing work of Sidewalk Labs on the Quayside project. In response to the issue being raised of allowing the vendor of record control the consultation process in a project they are developing as a conflict of interest, councillor Pasternak replied:

> I got the point. Are you aware that when a developer comes and does a public consultation, mostly statutory consultation, across the city whether it be homes or condos or what have you, much of that presentation and much of those events are run by the applicant [contract awardee]. That is our system. (City of Toronto - Toronto City Council 2019)

Illustrating a commonly held perspective reported by city staff, "the vendor knows best," which was a common theme found in the interviews conducted for this research. This is also reflected in the creation of many other guiding IT policies, strategies, and master plans through the City of Toronto.

In June of 2018, representatives from the international consulting firm Ernst & Young LLP (EY) presented to city council "...the story of how technology, data, connected citizens, digital literacy and our tech ecosystem will help Toronto become the smartest, most inclusive, thriving, healthy and happy society of the future" (City of Toronto - Smart Cities Working Group and City of Toronto 2017). Consequently, EY now leads the development of Toronto's Smart City Master Plan that will guide the taxpayer's investment in pursuing the City's aspirations of being a smarter Toronto (City of Toronto - Smart Cities Initiatives 2018). Similarly, the international geospatial technology company Esri Inc., who effectively controls a non-federated system of geographic information systems (GIS) and spatial technologies, was contracted to design the "Enterprise Geospatial Strategy" (EGS) for the city. The EGS outlines the future steps *required* in geospatial technology development for the entire city as the city pursues a "smart city status" (City of Toronto

2016b). Gartner Inc. has been contracted by the CIO to carry out a comprehensive plan for the *modernization* of information technologies and suggest new procurement models allow for more *innovative* technological solutions within the City (City of Toronto - Information and Technology Initiatives 2018). All of the plans mentioned above occur within the City's Corporate IT division and have been outsourced to outside providers. In many cases, these vendors are already large service providers in city operations, where they have a direct stake in further developing the technology markets they were representing (City of Toronto - IT Strategy & Portfolio Management 2017).

Behind the scenes, various third-party actors were developing development roadmaps for those overseeing city operations that include their interests. Often, the technology providers for city operations are also the same vendors that are commissioned to write multi-year plans and strategies dictating the future *needs* of the city (multiple accounts from city staff). While there is no explicitly nefarious agenda or "bad-actor" network trying to subvert democratic principles and derail civic-services, the city is nonetheless following paths similar to the dissociative governance models from the 1990s (Skok 2019). The belief of "vendors know best" and an endless desire for "development," which prioritizes *efficiency* over *effectiveness* in public services (Bel *et al.* 2013). These narratives are strongest amongst senior leadership and often combine the multifaceted efforts of engaging with public participation in the decision-making process.

4.2 Walks Like a Duck: Talking About New Policy, Reverting to Tried Practices

A common problem for projects to get beyond the desks of city staff is not the lack of innovative ideas; instead, it is the means to implement novel approaches to city services so to replace "the way it has always been done" according to the Director of the Geospatial Competency Centre (McGhie 2017). It is the account of several city staff across multiple divisions that for many smart city-billed projects they are destined for failure due to implementation problems rooted in dissonant connections between internal policies and operating practices (informer accounts from Coleman 2017, Fusca 2017, Garnett 2017, McKinnon 2017b, Meikle 2017, Carr 2018). Despite directives and plans that claim that the city has achieved becoming "smart," "modern," and "innovative," there is little in the way of operationalizing these visions into city-wide policy or practice. Internal staff must generally "make do" with limited resources while being beholden to external vendors for support or access to now privatized resources - one such resource too commonly cited as being scarce is access to data (as reported by Open Data Team and 26 out of 38 formal interviewees). However, without access to relevant, shared, and reliable data between "smart" solutions in the city – there is little chance of actually delivering any of the touted promises attached to a smarter future.

4.2.1 Libre Data: Supporting Businesses, Supporting City Services.

Data is a quintessential element in delivering digital services and developing evidence-based policy within the smart city. Without data, few of the promised citizen-centric services, as envisioned in the smart city, are possible. Despite this, the capacity to access relevant, current, appropriate and reliable information can be a highly challenging endeavour within government organizations. The history of Toronto's governmental organization has created a system of siloed data holdings that prevent employees from different divisions and in some cases, sections within the same division, from accessing data from another group or project. A significant portion of the "stockpiles" of data within the internal divisions at the City of Toronto are secondary dataset procured from other sources (often third-party providers) (City of Toronto - Data Governance and Smart Cities 2019). Many of these siloed and vendor-controlled systems rely on collecting data about or from a citizen in order for them to participate in city projects.

Like many other municipal governments, the City of Toronto is adopting and investing in open data programs with the intent of improving transparency, data literacy and providing economic opportunity and growth, which can be seen in their "Open Data Master Plan" (c.f., City of Toronto 2018a). In late 2009, the City of Toronto committed to an open data program, making the city an early adopter to the open data movement. Following the announcement, the city developed an open data policy, open data license, and an online open data catalogue, which was made publicly available in 2010. Between 2010 and 2017, the program operated with the primary goal of convincing City divisions to agree to release datasets publicly on the City's open data catalogue, a mission that resulted in 150+ open datasets. Toronto considers the open data program to be one of the three primary pillars in its open governance model strategy. They have directly paired the need for open data sharing policies with their smart city development.

As part of the Open Data program at the City of Toronto, five years of email requests were analyzed to understand the use of open data posted to the city web portal in conjunction with the Open Data Team. The results indicated that over 50 percent of all open data requests came from city staff looking to access city information that was stored outside their division or working group. The goal of this exercise was to "understand who was using the data, and while we found a lot of it was going to external businesses – a good portion of city staff rely on the open data program to support their jobs too" (Carr 2018). This confirms an additional benefit to open data programs, beyond their ability to support citizen engagement, participation, and oversight, is to make data more discoverable and useable for city staff. The portal is a centralized location that allows all users, including city employees, to easily search and download authoritative data without the roadblocks typically associated with accessing enterprise information. According to the Director of the Open Data Program: "We are a department with no teeth, without the mandate for city divisions to share data there is not much we can do to force them to do so" (Garnett 2017). Unfortunately, to date, the open data project, the Open Data Master Plan, and the authority of a city-wide policy to mandate cross-divisional data-sharing is still not in place (City of Toronto 2018b), which means that data within the city is "open by default" but only voluntarily.

Beyond the civic engagement and operational benefits, open data programs also provide valuable resources for many companies to develop commercial services (Barns 2016). The promises of economic development brought on by Toronto's Open Data program have been reinforced on several occasions. For example, the local start-up "Think Data Works," have based their business model around acting as a data consulting firm that leverages a variety of open data resources by re-packaging them into a conflated dataset for use in their proprietary business intelligence platform. Because of this business model, Think Data Works was able to grow from six employees into more than 30 in less than a year as a direct result from Toronto's Open Data Program (Wynne-Jones 2018). Another company, MioVision (their slogan is - "Smart Cities Start Here") also directly expressed their support for Toronto's investment in open data on a separate occasion to Toronto's City Council, where their CEO Kurtis McBride made the financial prospects of open data clear:

> Artificial intelligence [AI] has changed the way the world values data. Data was once an outcome of IP [Intellectual Property], but now with the proliferation of deep learning, it represents training data for AI – and ultimately, the creation of IP. This means that innovative solutions can be developed faster than ever before. Data will be the fuel for innovation[...] Cities have spent billions of dollars generating data that has been largely inaccessible due to vendor lock-in. In these situations, vendors control the data, often even preventing the cities themselves from accessing

it. Data is the key to innovation, and without access to it, public entities miss out on a massive economic opportunity to monetize the data generated from their infrastructure assets. (McBride 2018 - CEO of MioVision)

4.2.2 When the Circus Comes to Town: Locked-In to Piloting Smart Innovation

King Street is a major arterial road traversing the urban core of Toronto and one of the busiest surface travel routes for daily commuters with over 65,000 trips per day. In 2017 the City decided to, according to the Project Manager for the Kind Street Pilot, "take's modern approach" to solving transportation issues on King Street with a pilot study to restrict automobile traffic to only single blocks of travel The idea was to encourage the idea of King Street as a more community and pedestrian-friendly zone (City of Toronto 2017b). To highlight the city's more modern, smart-*er*, approach to tackle traffic congestion and use citizen-sensed data to provide better public services, an evaluation and monitoring program was designed to gauge the impact of the pilot. At the core of this study was MioVision's real-time monitoring devices that data created by pedestrians, shoppers, and commuters travelling King Street using Bluetooth and video technology (City of Toronto 2017c).

While the use of Bluetooth sensors and traffic cameras used in the King Street Pilot are not hidden from citizens, they are not well-publicized to those commuting past these sensor monitoring zones either. These devices are used to observe citizen travel patterns and leverage these data resources as citizen participation within the outcome of the King Street Pilot. Furthermore, these devices are not directly governed or controlled by city-staff but are provided by the smart city vendor MioVision, who also apply their proprietary computer vision algorithms to track multimodal traffic for the study. As reported by several staff members in the Transportation Services divisions, Parsons Corporation, who is under contract to the City of Toronto for the provision of Transportation Operations Centre (TOC) operation services at the City's Traffic Management Centre (TMC) found a smart solution to this technical issue and the data-sharing (Coleman 2017). That solution was to subcontract the hanging of entirely separate cameras in the same locations as those operated by the King Street Pilot team. However, these second cameras were entirely run and operated by a third-party vendor, specifically for Pearson's Corporation work and were not to be shared outside of this operations domain. However, now, citizens can be monitored by multiple companies at once, for the same purpose of alleviating their commuting tribulations.

4.3 Swims Like a Duck: Pellets of Hope from Out the Other-End

In 2018, several city divisions started another pilot project with a targeted purpose to use open-source IoT environmental sensors (IoTES) and approach the traditional IT procurement process another way. That is, a more collaborative and grass-roots approach to the procurement and development of smart city solutions that are directly informed by multifaceted participatory processes from start to finish. The multipurpose sensor was built with Raspberry Pi open hardware and explicitly designed to address some known operational needs and data-gaps being encounter within the Transportation and Urban Forestry divisions in the city. The goal of the IoTES pilot is to observe the devices during a four-month proof of concept study to gauge the effectiveness of the sensors across different environments (Coop 2018). Compared to other IoT sensor arrays at the city, IoTES devices stand in stark contrast to both how they are being designed and implemented, but also how they are also explicitly aimed to engage the public and leverage citizen participation in the development of smart city initiatives.

A key design aspect of IoTES was to allow citizens, organizations and other municipalities to utilize the architecture so that they can be reused, allowing for shared data collection and reducing the costs to develop. Internal city staff behind the design and operation of these devices are publicly posting design schematics, source code, and a public repository for a citizen to build their device(s) crowdsource the effort. Furthermore, since they will be placed in public spaces (e.g., street-trees and public furniture), the IoTES devices will not aim to blend seamlessly into the background and go unnoticed by the passing citizen. Each device will adorn a scannable QR-code and message explaining the project, purpose, and providing educational materials to those who choose to inquire. While it is unclear what type of interest the initiative will garner among the public, there was a conscious and deliberate effort to provide the option for engagement by the public using the *libre* model for smart cities according to the design team of the project.

5. Definitely Not a Duck: A City of Diverse and Ingenious Machines[8]

Some smart city technologies, such as apps or enhanced web experiences, aim to offer solutions to individual problems that the state has often created itself through under-funding or cuts to public resources. As several city staff highlighted failed attempts of using advance programs or analytical approaches to solve actual problems but found that without the necessary domain knowledge within city operations these programs ultimately failed (c.f., City of Toronto 2013). Dissatisfaction with the quality of experience when engaging with local governments is now said to be solved with improved technical capabilities of smart city technologies. Furthermore, cities are unendingly expected to "do more, with less" in terms of dwindling financial support for operational projects, limited-term funding for one-off projects, and outsourcing of resources, knowledge, and ultimately control of how the city operates. The perceived solution to these, along with a myriad of other urban problems, are promised to public servants and the public through the bread of commercial

[8] The title of this section is adapted from Agostino Ramelli's work 'Diverse et Artificiose Machine' published in 1588 (translated from the original Italian and French versions).

off-the-shelf technologies in the smart city era. These solutions harness public participation through sensor technologies and engaging with the public through data-driven solutions.

The *gratis* model of smart city governance prioritizes economic-development for issues that hover at the surface of government-2-citizen interaction (communications, administrative) and do nothing for deep collective issues related to the availability of housing, transit, or well-maintained infrastructure. By providing open doors to corporate interests for a smart-*er* government, cities increase the distance between public servants and citizens. As multiple acrobats from corporate vendors drain the city coffer to fund their automata circus, the public is locked-in to proprietary surveillance. Eventually, the surmounting cost to the tax-payer by subsidizing the development of uncertain technologies in hopes of their promises to materialize will outweigh the tokens of bread and amazement for the circus of technologies taking over the city operations.

Promises of open models of smart cities and grassroots efforts show budding hope to make the shift to *libre* governance and technologies that fill the urban streets. The ability for citizens collaboratively design the kinds of and limits of *smart solutions* being offered in their city poses an empowering opportunity for defining the role of participation in local-government decision-making. However, for the citizen, the actuality of existing in the smart city is a highly contextualized and challenging position to hold. The very means in which they are to engage in democratic processes are being taken away through algorithmic solutions, passive surveillance, and technological mediation that removes their right to participatory actions, their right to the city. A primary fight for the right to the smart city is on combating how forms of *coded engagement* supplant traditional means of public participation in the smart city future.

The modern rhetoric of the smart city offers a washing effect by using words like *inclusion*, *innovation*, and *modernization* in democratic processes. Because a majority of smart city developments arise from technocratic values and are “top-down,” or from executive-level policies as opposed to grassroots-driven movements, these so-called smart-initiatives are imposed on citizens without being consulted about their deployment. Washing the rhetoric of the smart city development is to position initiatives as "citizen-centric", and act as a marketing strategy “designed to silence detractors or bring them into the fold while not altering the technocratic workings, profit-driven orientation, or ethos of stewardship (for citizens) and civic paternalism (deciding what is best for citizens) of smart city schemes.” (Kitchin 2019)

Navigating the web of legal and governance issues of how the future of smart city governance plays out will mark for a lasting line of inquiry for further research because there is a seemingly endless number of permutations on how the imaginaries of smart city rhetoric (Watkins 2015). The circus of the smart city is beset with the falsities of hyperbole, where every techno-solution to urban issues can be easily procured with off-the-shelf products. As Toronto embarks on emerging in the smart city space, tech companies have instilled grand visions of what a Smart Toronto *could be* while urging city officials and citizens to look the other way on *how to do it*. Promises of assuaging urban issues with seamless digital-ease, and creating an entire ecosystem for urban innovation, is the bread bringing city executives to the table. Unfortunately, there are still no details on the full menu being served.

The reality of a smart city fitting neatly under one definition or governance model is likely an impossible ambition and just as there is not one voice to be heard in a democracy, nor should there be just one means of engaging in decisions with your city (Thorne and Griffiths 2014). There prove to be few cross-applicable forms of smart city technologies that can go from "off the shelf" to "on the streets" from one geographic locality to another. However, unlike a travelling circus, the diverse and ingenious machines of the smart city do not just leave town once the show ends, or the promises prove to be the hubris of dissociative aspiration. There are certain to be legacy impacts on the residents of these smart-city "guinea pigs" who are first to procure uncertain "technological solutions" to the problems they may not even have (Sauter 2018). As the monetization of our behaviours fuels further markets for even more self-serving machines, the role of the citizen will be further marginalized in their inclusion within these smart economies as inclusion is rebranded as surveilled (Chandler 2015)

Furthermore, unlike the effects of feeding actual bread to the public, the digital promises of citizen-centric services do little to feed the public with meaningful engagement and access to the services they depend upon (e.g., food banks, homeless shelters). While a focus is seemingly being set on "new ways" to solve "old problems" there are often many disparities between the footing the costs of developing new *innovative* methods, when more fitting allocations of these resources are present (e.g., providing better funding to social-support programs). The reliance on *gratis* data and infrastructure needed to stimulate the promised tech-industry for a thriving smart city comes at the cost of the tax-payer, who has to be resold their data of speculative quality through the forms of digital-services and reduced municipal resources (Kitchin 2019). While the promises of the smart city may Quack, Walk, and Swim like a democratic city seeking meaningful ways to reduce the barriers to civic engagement, there is little more than complex marketing schemes and algorithmic functions churning urban data into profit. One thing remains similar to Vaucanson's *Digesting Duck*: you can feed the *gratis* model of the smart city all the data it requires, but out the other end, you are still stuck with the same results.

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CHAPTER 6 - CONCLUSION

1. Contributions to Original Knowledge

The first research question presented in Chapter 1, *"How does traditional public participation differ from emergent practices of coded engagement in the context of cities who are looking to become "smart"?"* was addressed in several chapters of this dissertation. In Chapter 3, we present a novel methodology developed to use computational approached in capturing emergent topics in the local context for the purposes of *coded engagement* by using social media data and advanced analytical methods to make sense of public opinion found on Web 2.0. Relevant to operationalizing concepts surrounding participation in local decision making and communities of interest (Abbott 2013). The use of computational methods to identify these social groups was done through the creation of a novel data model capable of integrating multiple dimensions of user-generated content and presented in a queryable application for evidence-based decision making. In Chapter 4, a case-study highlights the divergent efforts of actually implementing *coded engagement* within the Waterfront area in the City of Toronto. Where the implications of being a citizen actually existing in the smart city are framed as a form of *coded engagement*, Chapter 5 ties the notion of monitoring citizens-behaviour in the smart city while they go about living, working, and playing to forms of smart city governance and presents a case study on the City of Toronto. While much of the promises for *coded engagement* are surrounded by the notion of being able to solve the democratic messiness of participatory governance in the smart city, rarely do these implementations work. I further deconstruct these values and degrees of dissociative values regarding democratic and open governance in the context of sensing the citizen.

The second research question addressed within this dissertation: "*How does coded engagement rely on the ability of various algorithmic treatments (the data handling and analysis techniques)* *to being understood as a form of public participation*?” was done through contributions in various chapters to better understand how data-driven approaches can affect the outcomes of *coded engagement*. Specifically, using case studies and examples, Chapter 3 explored the use of computational techniques to make sense of big data and extract meaningful insights into the ends of facilitating public engagement. Notably, in Chapter 3 we design and implement just such a data-driven approach to extract meaning from the duplicitous big-data world of Twitter, using novel spatially-situated social networks to identify communities of interest and practices within local geographic contexts. In Chapters 4 and 5, I use case studies in the City of Toronto to highlight the limitations of data-driven approaches to replace or emulate traditional forms of public engagement within government affairs.

It is clear that there are a variety of issues with the data-driven approach, including the availability of data, the quality of data, the black-box of many proprietary algorithms used in smart-city solutions, and the replicability of results across different use-cases and geographic contexts.

2. Research Summary

Chapter 1 gives the context in which this research was undertaken and provided the justification for its timeliness. Namely, cities around the world are pursuing the title “smart,” and their utilization of big data to tame the difficulties of public participation is a quintessential part of the data-driven promises. Chapter 2 traces the concept of *coded engagement*, i.e., the technologically mediated form of passive participation, through the literature of the past several decades in a North American context. Framing the progression, issues, and multiplicative perspectives on public participation and the role of citizen engagement within democratic governments there is a clear impetus for the will to accept promises of big data, smart cities, and data science in alleviating these concerns; despite the obvious limitations with the data, methods, and motivations on which these promises are themselves based.

Chapter 3 attempted to extract the algorithms from the black box of *coded engagement* by presenting a novel crowd-sensing methodology to extract public opinion, communities of interest and practice from the big data of Twitter and using natural language processing, social affinity, and spatially situated network analysis. This new data-model and spatial-analytical approach attempts to harness 'passively' contributed social media-based opinions, along with different variables, such as time, location, social interaction, service usage, and human activities to be examined and used to identify trending views and influential citizens. The data model and CSS are used for demonstration purposes to identify geotopics and community interests relevant to municipal affairs in the City of Toronto, Canada. Also, the methodology of a Geovisualization tool was developed for a 3-D web-mapping to perform exploratory data analysis on the complex and uncertain big dataset found from social-media silos. The empirical evaluation of this methodology is yet to be undertaken but is planned, as discussed in the following section regarding future work.

Chapter 4 uses the Toronto Waterfront as a case study to further explore the concept of *coded engagement* as it actually exists in implementation. This chapter highlights the disconnects between the imaginaries of the smart city and the discontents of the role of the citizen-sensor within these visions. The Waterfront has become the global stage for corporate actors to take control of democratic practices and offer promises of technological solutions to urban-issues that often fail to live up to expectations. In addition to issues of privacy, which data-driven approaches to participation will certainly exacerbate, the black box algorithms may do little to address issues of quality surrounding big data. A further concern highlighted in this chapter is that these data-driven approaches will diminish the role of civic participation in municipal operations as they increasingly supplant more active forms of participation.

Chapter 5 extends the case study on the City of Toronto with empirical examples of how concepts of open data, governance, and smart cities are conflated into the assemblages of *coded engagement* within modern cities. The role and dependency on open data is an essential resource to the corporate actors in Toronto who are setting the policies and priorities of smart city governance. While the promises of smart cities include the inclusion of every citizen, the reality of actually existing in the smart city is more an offering of bread and circuses to the public (Madsen 2018, 2018, Cardullo and Kitchin 2019, Hong *et al.* 2019). That is to say, the grand solutions being proffered are meant to distract citizens who are the material of driving smart city markets through being surveilled in the name of *coded engagement*. Framed in the context of Victorian-era fetishism with automaton machines, the efforts of implementing technological solutionism within city operations are not so much a matter of malice or ill-intent, but a fascination with a city filled with diverse and ingenious machines to assuage urban issues. Thus, the smart city and *coded engagement* resemble the Digesting Duck depicted in Figure 18 American artist (mistaken) interpretation of Jacques de Vaucanson's Canard Digérateur was inspired by Descartes' principle of the mechanistic universe to create a mechanical animal. The Canard Digérateur was said to have the ability to eat grain, digest it naturally, and defecate waste. In many ways, it resembles the actuality of participation within democratic governance, given that in the end, you are still left with refuse out the other algorithmic-end that has little utility in terms of actually solving city problems.

3. Limitations and Challenges

There were several challenges encountered during this research and ultimately, several aspects of the work were limited in scope to accommodate these realities. Namely, without internal access to City offices, boardrooms, and the ability to observe daily operations of municipal decision-making, the ability to discern between intentions, rhetoric, and their disconnects in policy or practices is challenging to ascertain. For this reason, being a "participant-observer" within the City of Toronto provided invaluable context and background that would have been omitted from an outsider perspective that relied on just the survey protocol developed in Appendix B. That said, the use of qualitative methods such as formal interviews had its challenges that could be expected at institutions as large as the municipal government of the City of Toronto (i.e., Chapters 4 and 5 case-studies). Specifically, finding the "right" participants were often left referrals and cold-calling names from a directory to find that the topic matter of interest was outside of their work duties or that there was a variable disconnect between the answers given and the actual practices in daily operations. Furthermore, for participants at the "executive" level – there was often a common script or institutional narrative that was followed without much deviation. It was only in informal contexts that divergence was observed with these individuals. However, at the less-senior roles, it seemed a more representative account was provided.

In terms of citizen engagement practices used within the City of Toronto, traditional methods (e.g., town-halls, public oversight committees, and consultation surveys) are still the primary methods of engagement. The desire to pursue "smart" forms of *coded engagement* is stimulated by the fact that turn-out to formal meetings are often cited as being homogenous populations (i.e., numerous accountants of participants being White, Male, age 50+, and landowners (see Appendix C for results of survey) while accessing the marginalized and minority communities often most impacted by policy changes and program developments left out of the conversation (Fusca 2017).

Furthermore, a vast majority of "stakeholders" identified as being members of the public in the City of Toronto are representatives from the local population.

Chapter 3 is also limited in scope and presents unique challenges to the role of data-driven methodologies for creating *coded engagement*. The smart city claims to offer a panoptic view over the city by "sensing, capturing, collection and processing of real-time data from billions of connected devices serving many applications including environmental monitoring, industrial applications, business, and human-centric pervasive applications" (Zaslavsky *et al.* 2012, p. 1). However, the generality surrounding the term "analytics" proves to be a difficult object of inquiry, because in most contexts, the "use case" is more than an algorithm—"it is a constellation of mathematical methods, technology capital, personnel skills, process design, and policy implementation." Making the ability to replicate "use cases" a more challenging matter than just sharing source code and marks the need for adopting a sociotechnical system to a new context. (Campbell 2019, pp. 7–8)

With respect to Chapters 4 and 5, challenges were encountered when attempting to accesses the internal culture of an institution the size of the City of Toronto (e.g., +35,000 employees and 44 divisions) from the perspective of an "outsider." There were sampling limitations as conducting formal interviews to compile meaningful data proved difficult since many contacts were unaware or unwilling to diverge from a conventional narrative regarding public participation and the role of *smart technologies* in improving city operations. It was not until further observations were collected through participant observation (i.e., being hired to develop a data-science team within the City of Toronto in part because of these interviews) that a more clarion representation unfolded regarding *coded engagement*. That is to say, how the disconnect between the image of the smart city was represented through corporate rhetoric, conflicting policies, and divergent practices behind city doors.

4. Future Work

There remain many unexplored avenues of research and unanswered questions in the area of smart cities, big data, and public participation. The field of smart cities is full of ever-changing actors, and the endlessly emerging events change the dynamics and technologies that are at play in this research domain.

Future enhancements to work in Chapter 2 include extending the literature review for publication and framing the context in a more general, global context as divergent threads of work has been underway since the start of the research project. For example, tracing the parallels between the role of "new build" cities like the events unfolding in the Toronto Waterfront with Sidewalk Labs versus the new sought Technological Sovereignty movement with Barcelona's initiatives to embrace open source, and shun major corporate interests from exploiting the public of their money and data would be an appropriate case study to review opposing views in smart city literature.

Chapter 3 will be extended to investigate additional use cases and spatial-network based algorithms as well as further integration of additional social media data sets. Plans are already underway for early 2020 to purchase complete historical datasets from Twitter and design an experimental protocol to evaluate both the quality of output from the data, as well as the perceived utility to city staff in relevant positions. The implications of transitioning from conventional means of public participation to a coded form of inputs such as those embodied in the CSS allow trending issues articulated by local residents to be assessed and acted upon. Future CSS enhancements will include interrogating the lack of conventional methods to analyze, conflate, and display complex information on human attitudes and behaviours. The lack of standard methods will be further examined to consolidate and improve spatial analysis (e.g., space-time clustering and geoinferencing techniques) and to adapt to new uncertain data types of location-based social media networks, such as those embedded in the evolving Twitter community of users. Furthermore, a directed study on the "perceived utility" of the platform "Geocollective" will be evaluated with additional data with city staff in the City of Toronto.

Chapters 4 and 5 provide a backdrop of context for the dissociative governance practices that run much of the policy formations within the City of Toronto. However, with the ongoing saga of the Sidewalk Labs development proposals for the Toronto Waterfront, it will be a moment of confirmation for corporate control or a movement of change toward open governance models depending on the way this project progresses. While many pundits are quick to critique or lambast actors in the news for quick publicity, fieldwork (i.e., including engagement with Sidewalk Labs staff) has already been started to conduct an empirical study on the internal drivers within the Sidewalk Toronto's offices, as they relate to those of the citizens and public servants of Toronto (Skok 2019).

While the apparent utility of alleviating inefficiencies in municipal operations are enticing to local leaders, the corporate storytelling and uncertainty that imbue many big data sets require a deliberate set of actions and clear goals to be set before embarking on these endeavours (Aradau and Blanke 2015, Williamson 2015, Burrell 2016, Ashton *et al.* 2017, Madsen 2018, Cardullo and Kitchin 2019). As the urge to become *smart* subsumes the ability citizen to participate in democratic practices with the increased transitions to forms of *coded engagement*, there lay more at risk than to be gained with the current understandings and capabilities available to most city staff. Cities should focus on developing co-design policies for the governance of data and smart infrastructure that does not forfeit the control of these resources to private entities and remove the citizen from the decision-making process. The choice to "opt-in" or "opt-out" is not the choice that needs to be made; it is whether to have or not have smart technologies embedded in the urban context.

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Appendix A - Oral and Email Scripts for Recruitment

Hello {Participants Name},

Thank you for taking the time to consider being a participant in my research project, which is focused on harvesting local social media to see if we can simulate civic public participation. My focus is on Canadian municipalities. This is part of my Ph.D. research in the Department of Geography at McGill University, Montreal, QC. You have been identified as someone who has a role relevant to incorporating public participation within city operations. My research compares the use of public participation in a traditional manner (e.g., city council meetings) to participation through digital technologies. My study does not aim to evaluate your techniques or your experiences. Rather, I am trying to learn more about how local governments view the role of public participation, methods used to engage citizens, and insights on any experiences where public input is gathered on civic matters.

Please let me know if you are interested and able to participate in my study, which would require you to engage in a single interview (estimated to last one hour) with me at your convenience. If you have any more questions or concerns before deciding or at any point during or after your participation, please feel free to contact me directly or my academic supervisor Prof. Renee Sieber. Our contact information is provided below for your convenience.

Thank you for your time.

Cheers,

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Appendix B - Interview Instrument

City Employee Interview Protocol

City: ____

Office: ____

Position: ____

Interviewee: ____

Interviewer: ____

Other Topics Discussed: ____

____

Documents Obtained: ____

____

Post Interview Comments or Leads:

____

Introductory Statement

Thank you for agreeing to participate in my research. Before we begin, could you please sign the release form? To help my note-taking, I would like to audio tape our conversations today. For your information, only researchers on the project will have access to the tapes which will be eventually destroyed after they are transcribed. In addition, you must sign a form devised to meet our human subject requirements. Essentially, this form states that all information will be held confidential, your participation is voluntary, and you may stop at any time.

We have planned this interview to last approximately one hour. During this time, we have several questions that we would like to cover. If time begins to run short, I may ask to push ahead and complete the questionnaire.

Subject Introduction

You have been selected to speak with us today because you have been identified as someone who has a role relevant to incorporating public participation within city operations. Our research project as a whole focus on the use of public participation in a traditional manner (i.e., finding out how you use it here) to what has been described as being possible through digital technologies in the future. Our study does not aim to evaluate your techniques or experiences. Rather, we are trying to learn more about how local-governments view the role of public participation, methods used to engage with citizens, and insights on any experiences where public input was gathered on non-electoral matters.

Perspectives on Traditional Public Participation

These questions will provide an understanding of the types of levels of public participation activities, as well as related goals, measure , and technologies

1. What strategies do you employ during citizen engagement within decision-making processes? Please check all that apply.

   ____ Town halls meetings, Open Public Meetings, Consultation hearings
   ____ Citizen Panels, Citizen Review Board, Delegated Community Representatives
   ____ Focus Group, Deliberative opinion polls and surveys
   ____ Citizens' jury, Community Appointments, Community Lead Action Programs
   ____ One-on-one meetings with members of the public
   ____ Other (please specify):____

2. Can you please briefly describe the primary benefits of having traditional forms of public participation (e.g., like those mentioned above) in your department's decision-making processes?

   ____
   ____
   ____
   ____

3. Can you please briefly describe the primary challenges of having traditional forms of public participation (e.g., like those mentioned above) in your department's decision-making processes?

   ____
   ____
   ____

4. Have you encountered any biases utilizing any of the strategies you use?

   ____
   ____
   ____

5. How would you rank your current ability to engage with a citizen?

(Low) 1	2	3	4	5 (High)
○	○	○	○	○

6. If your rating for the above was not "optimal" (5), list behaviors you would like to see increase or decrease:____

____

7. Rate the following areas related to public participation and citizen engagement.

	(Low) 1	2	3	4	5 (High)
Rate your citizens' level of involvement overall in providing "Customer satisfaction" feedback (low to high).	○	○	○	○	○
Rate the importance of public participation according to your municipality's strategic plan	○	○	○	○	○
Rate how well your municipality's public participation goals link to your municipal strategic plan	○	○	○	○	○
Rate how well your municipality measures citizen engagement or participation.	○	○	○	○	○
Rate your citizens' level of civic engagement *compared* to other similar municipalities. ("3" is average.)	○	○	○	○	○

8. Do you have a public participation policy manual?

Yes	In Development	Non
○	○	○

9. Do you have a formal public participation plan?

Yes	In Development	Non
○	○	○

10. Do you have a public participation officer or similar?

Yes	In Development	Non
○	○	○

a. Please specify position title of the officer if applicable (optional) :____

11. Do you have a public participation report?

○ Yes

○ No

Describe if "yes"

____

____

12. Please indicate the *frequency* of public participation reporting (check any that apply)

○ as events occur

○ weekly

○ monthly

○ quarterly

○ annually

○ Other (Please specify)____

13. Please describe the object of the report (check any that apply):

○ individual report for each event

○ events by department, service or program

○ report on public participation goals

○ Other (please explain)____

14. Please indicate the report contents & measures

- List or description of events, including date, purpose, outcomes
- Number of participants
- Progress toward strategic goals for period
- Other (please explain) :______________________________

List the top 3 barriers to improving public participation.

____
____
____

15. Where would you like to see more public participation?

- ☐ Water Protection
- ☐ Transportation
- ☐ Housing/Lands planning
- ☐ Protective services
- ☐ Environment
- ☐ General services
- ☐ Decision processes
- ☐ Strategic Planning
- ☐ Community planning
- ☐ Volunteering
- ☐ Municipal elections
- ☐ Other (please specify)

____
____
____

16. Please comment on how the municipality could facilitate more public participation.

Perspectives on Digital Public Participation

17. Where would you like to see more ITenabled public participation (indicate by type of IT.

Select any).

	Smart Technologies	Web	Other IT	N/A	
Water protection	○	○	○	○	○
Transportation	○	○	○	○	○
Housing/Lands planning	○	○	○	○	○
Protective services	○	○	○	○	○
Environment	○	○	○	○	○
General services	○	○	○	○	○
Decision processes	○	○	○	○	○
Strategic Planning	○	○	○	○	○
Community planning	○	○	○	○	○
Volunteering	○	○	○	○	○
Municipal elections	○	○	○	○	○
Other (please specify)	○	○	○	○	○

18. What *digital* strategies do you employ during citizen engagement within the decisions making the process? Please check all that apply.
    - ☐ e-Portals, discussion forums
    - ☐ email correspondence, web-based surveys

- ☐ Social media platforms like Twitter, Facebook, Instagram (i.e., we have an account, we show information on these and respond to questions via…)
- ☐ Information Dashboards, Analytic Control Panels
- ☐ Aided/facilitated computer/software data-collection or feedback (e.g., PPGIS)

19. Is there anything that I missed in the question above that you commonly use?

____
____
____
____
____
____

20. Can you please briefly describe the primary benefits of having digital forms of public participation (e.g., like those listed above) in your decision-making processes?

____
____
____
____
____
____

21. Can you please briefly describe the primary challenges of having digital forms of public participation (e.g., like those listed above) in your decision-making processes?

____
____
____
____
____
____

22. Have you encountered any biases utilizing any of the strategies you use?

____
____
____
____
____

Perspectives on Automated and Data-driven Public Participation

23. What *automated* strategies do you employ during citizen engagement within the decisions making the process? Please check all that apply. Please refer to the slides and examples provided.

____ "Decision-support" software and visualization tools
____ Data Analytics software that harvests web-content (e.g., from social media)
____ "Smart city" software monitoring "real-time" urban sensors
____ Data-driven analysis for policy formation

24. Is there anything that I missed in the question above that you commonly use?

____
____
____

25. Can you please briefly describe the primary benefits of having automated forms of public participation in your decision-making processes?

____
____
____

26. Can you please briefly describe the primary challenges of having automated forms of public participation in your decision-making processes?

____
____
____
____

27. Have you encountered any biases utilizing any of the strategies you use?

____

____

____

Recent Public Participation Project

All the remaining survey questions ask about one specific project, the project you most recently completed.
Think about **the most recent project** you completed which used open government data. By completed, you may have finished the project and decided to quit working on it. If there is no project that you have completed, then you can describe your **most recent project**.
If you saved your work in an online repository (e.g. GitHub), created a website for the project, or written up your work (e.g. biog post) please share links to these resources to help us understand the project better.

28. How long did you work on the project?

    ____

29. Did the Project have a title?

    ____

30. What was the overall goal of the project? (check all that apply)

    - ☐ To make sense of the data
    - ☐ To build a tool someone else could use to understand the data
    - ☐ To build a tool to make predictions
    - ☐ To build a tool to identify outliers in the data
    - ☐ To learn a programing language, data mining technique or statistical technique
    - ☐ To test a hypothesis or prediction about the data
    - ☐ To improve or provide a public service
    - ☐ To build a tool for another application
    - ☐ To support a political position
    - ☐ To publish a report about an interesting finding
    - ☐ To identify government misconduct

☐ To promote public awareness

31. Which of the following stages did you reach over the course of your project? (Check all that apply)

- ☐ Created a mock-up or a plan to analyze the data
- ☐ Created a working prototype or preliminary data analysis
- ☐ Created a final working product and/or finalized data analysis
- ☐ Released the software product and/or wrote a report describing the data analysis
- ☐ Others outside the group used the software product and/or read the report
- ☐ Measured the impact of the software product and/or report (e.g. gathering feedback, tracking how many people viewed it)

32. Please indicate the degree to which you agree or disagree with the following statements about the project outcomes.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
The project outcome(s) and/or results will be useful to society.	○	○	○	○	○	○	○
I am personally satisfied with the project outcome(s).	○	○	○	○	○	○	○
I enjoyed working with others during the project.	○	○	○	○	○	○	○

33. How many other people provided feedback, guidance, advice and/or worked on your project not including yourself?

____

____

____

____

34. How did you meet your collaborators? (check all that apply)

- ☐ Through work
- ☐ Through a friend, acquaintance, or friend of a friend

- [ ] Through an in-person meeting of an organization (e.g. Code for America) or an event (e.g. hackathon)
- [ ] Through an online community, forum, or code repository (e.g. Github, email listserv)
- [ ] Via direct contact discovered from your or their public profile (e.g. blog, website, Twitter, Facebook etc.)
- [ ] Other (please specify)

35. How frequently did other people ...

	Never	Rarely	Occasionally	Frequently	Constantly
Join your project after it was started?	○	○	○	○	○
Leave the project before it was finished?	○	○	○	○	○

36. What best describes how often you communicated with your collaborators when working on the project?

○ Almost any time one of us worked on the project

○ Regularly

○ Semi-regularly

○ Infrequently and/or only during one phase of the project

○ Only once or twice

37. What best describes how you communicated with your collaborators?

○ Mostly in-person communication (e.g. hackathon, face-to-face)

○ Mostly remote communication using asynchronous communication tools (e.g. email, slack, Github)

○ Mostly remote communication using synchronous communication tools (e.g. a phone call, video call, instant messenger)

○ Substantial mix of remote and in-person communication

38. Which tools did you use for communication between collaborators? (choose all that apply)

- ☐ Social media (e.g. Facebook, Twitter)
- ☐ Shared project management tools (e.g. Trello, Asana, Jira, Zoho projects)
- ☐ Collaborative content creation tools (e.g. Google Docs, etherpad, hackpads, team blog)
- ☐ TheVideo call (e.g. skype, google hangouts)
- ☐ Email
- ☐ PC or Mobile messengers (e.g. IRC, Telegram, Whats App, Google Hangouts chat)
- ☐ Code, data, or visualization repository (e.g. Github, Tableau, Bitbucket)
- ☐ Online team communication tools (e.g. Slack, google groups, online discussion forums)
- ☐ Audio call (e.g. phone, or voice only video call)
- ☐ Other (please specify)

39. The following questions ask about how you worked together. For each statement indicate whether you agree or disagree with the statement.

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
We worked as a team—not a collection of individuals with their own tasks to perform.	○	○	○	○	○
We often had to share materials and ideas to get our work done.	○	○	○	○	○
I often had to talk to other people in my group in order to do my part well.	○	○	○	○	○

40. To what extent did people in your project team (include yourself, people you worked with, and people you consulted with) have **similar backgrounds**, expertise or knowledge?

- Not at all similar
- A little similar
- Somewhat similar
- Very Similar
- Extremely similar

41. To what extent did people in your project team (include yourself, people you worked with, and people you consulted with) have **different backgrounds**, expertise, or knowledge?

- Not at all different
- A little different
- Somewhat different
- Very different
- Extremely different

42. How would you rate the skills of the OTHERS you consulted with or worked with. Consider the people in the group with the most skills in the given area. Please indicate their level of skill in the following area and estimate if you have to. (If no one had expertise in a given area, mark no experience.)

	No experience	Beginner (less than a year)	Intermediate (1 to 3 years)	Advanced	(3 to 5 years)	Expert (+ 5 years)
Data exploration (e.g. Excel, visualization)	○	○	○	○	○	○
Inferential or Bayesian statistics	○	○	○	○	○	○
Machine Learning and Data mining	○	○	○	○	○	○
Software Development	○	○	○	○	○	○

43. How long have OTHERS that you consulted with worked or volunteered in the following sectors? Consider the people in the group who have worked or volunteered the longest in the given sector. Please indicate for each sector whether they have worked or volunteered within that sector and for how long. (If no one had experience in a given sector, mark no experience.)

	No experience	Less than a year experience	1 to 3 years of experience	3 to 5 years of experience	More than five years of experience
Government	○	○	○	○	○
Journalism	○	○	○	○	○
Activism	○	○	○	○	○
Social Services and Non-Profits	○	○	○	○	○
Academic Research	○	○	○	○	○

44. To what extent were the following open and available to anyone in the general public?

	Not at all open	A little open	Somewhat open	Mostly open	Completely open
Contributing to the project	○	○	○	○	○
Project data, code, and materials	○	○	○	○	○
End products of the project	○	○	○	○	○

45. When you were designing the project whom did you plan on making use of the resulting software and/or insights? If there were more than one intended recipient mark the one that was primary.

- Yourself
- A project requester (or client)
- Other people working on the project (not the project requester or client)
- Citizens of a specific region (e.g. local, state, or national)
- A specific group of citizens (e.g. homeless)
- A non-profit organization
- Journalists
- Government officials and employees
- There was no intended recipient
- Other (please specify)

46. Think back to when you first conceived of this project. How did it start?

- I do not know and/or remember
- A hypothesis, prediction, or expectation that you wanted to confirm.
- A set of data you wanted to analyze.
- A societal or personal problem that you wanted to solve.
- Other (please specify)
- A statistical, data mining, or visualization technique you wanted to implement.

47. Were you or other team members being paid for doing the project?

- Yes
- No

48. Would you have liked to have any additional collaborators? If so, please describe what type of collaborators would have helped you improve the project.

49. Is there anything else you think we should know about the project?

50. Do you have any additional comments you'd like to make relevant to this survey or research project?

____

____

____

____

Personal Background

51. Below are four of areas of data analysis in which YOU may or may not have experience and skills. Please indicate your level of skill in each area. This section is optional.

	No experience	Beginner (less than a year)	Intermediate (1 to 3 years)	Advanced (3 to 5 years)	Expert (+ 5 years)
Data Exploration (e.g. summary tables, visualizations, means, bar charts)	○	○	○	○	○
Inferential or Bayesian Statistics (e.g. t-tests, ANOVA, regression)	○	○	○	○	○
Machine Learning and Data Mining (e.g. clustering, classification, anomaly detection)	○	○	○	○	○
Software Development and Programming (e.g. databases, distributed computing, APIs, data scraping	○	○	○	○	○

52. Below are five sectors that are sometimes involved with open government data. Please indicate for each sector whether YOU have worked or volunteered within that sector and for how long. This section is optional.

	No experience	Less than a year experience	1 to 3 years of experience	3 to 5 years of experience	more than five years experience
Government	○	○	○	○	○
Journalism	○	○	○	○	○
Activism	○	○	○	○	○
Social Services and Non-Profits	○	○	○	○	○
Academic Research	○	○	○	○	○

53. What is your sex?

○ Male

○ Female

54. What is your age?____

55. What is the highest level of education you have attained?

○ High school

○ Some college

○ Undergraduate level degree

○ Masters level degree

○ Doctoral degree

56. What was your degree in?__ ____

Appendix C – Survey Results

1	*What strategies do you employ during citizen engagement within decision-making processes? Please check all that apply.*						
		Town halls meetings, Open Public Meetings, Consultation hearings	Citizen Panels, Citizen Review Board, Delegated Community Representatives	Focus Group, Deliberative opinion polls and surveys	Citizens' jury, Community Appointments, Community Lead Action Programs	One-on-one meetings with members of the public	NA
		14	3	5	3	6	7
5	*How would you rank your current ability to engage with a citizen?*						
		Low- 1	2	3	4	High - 5	NA
		4	9	7	5	0	13
7	*Rate the following areas related to public participation and citizen engagement.*						
		Low- 1	2	3	4	High - 5	NA
	Rate your citizens' level of involvement overall in providing "Customer satisfaction" feedback (low to high).	6	14	2	13	3	0
	Rate the importance of public participation according to your municipality's strategic plan	7	8	13	7	3	0
	Rate how well your municipality's public participation goals link to your municipal strategic plan	8	9	12	6	3	0
	Rate how well your municipality measures citizen engagement or participation.	8	12	13	2	3	0
	Rate your citizens' level of civic engagement *compared* to other similar municipalities.	8	6	11	6	3	4
8	*Do you have a public participation policy manual?*						
		Yes	Dev	No	NA		
		2	2	24	12		
9	*Do you have a formal public participation plan?*						
		Yes	Dev	No	NA		
		2	2	24	12		
10	*Do you have a public participation officer or similar?*						
		Yes	Dev	No	NA		
		2	2	24	12		

12	*Please indicate the *frequency* of public participation reporting (check any that apply)*	
	As Needed	NA
	24	14

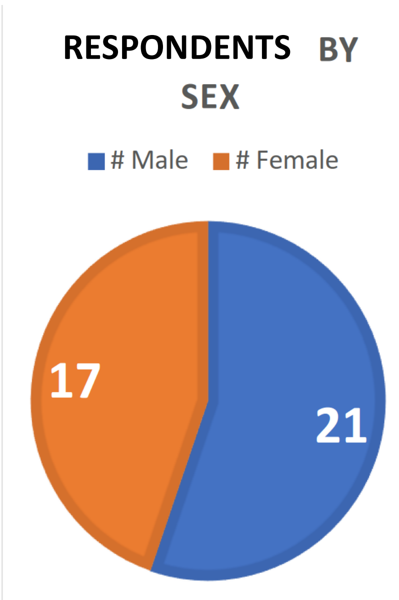
15	*Where would you like to see more public participation?*										
	Water protection	Transportation	Housing/Lands planning	Protective services	Environment	General services	Decision processes	Strategic Planning	Community planning	Volunteering	Municipal elections
	12	13	17	12	19	6	23	7	7	22	37

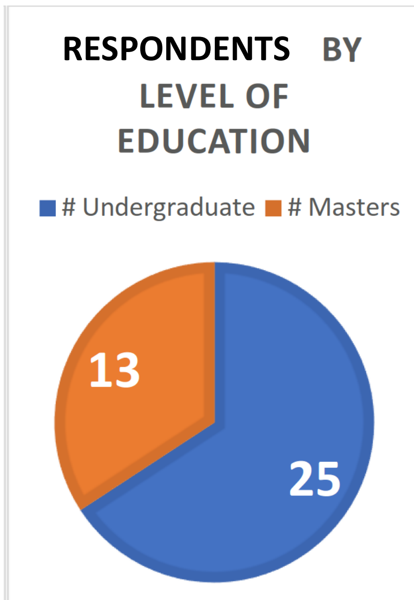
17	*Where would you like to see more ITenabled public participation (indicate by type of IT.*										
	Water protection	Transportation	Housing/Lands planning	Protective services	Environment	General service s	Decision processes	Strategic Planning	Communit y planning	Volunteering	Municipal elections
Smart Tech	12	13	17	12	19	6	23	7	7	22	37

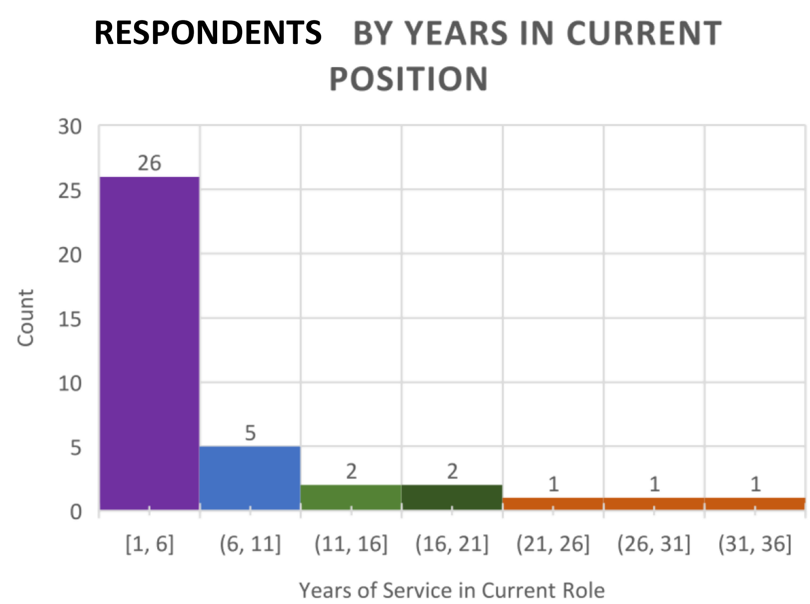
18	*What digital strategies do you employ during citizen engagement within the decisions making the process? Please check all that apply.*				
	e-Portals, discussion forums	email correspondence, web-based surveys	Social media platforms like Twitter, Facebook, Instagram	Information Dashboards, Analytic Control Panels	Aided facilitated computer software data-collection or feedback
	17	15	34	32	11

23	*What automated strategies do you employ during citizen engagement within the decisions making the process? Please check all that apply.*			
	"Decision-support" software and visualization tools	Data Analytics software that harvests web-content (e.g., from social media)	"Smart city" software monitoring "real-time" urban sensors	Data-driven analysis for policy formation
	35	14	26	25

Total Participants	38	Average Years in Position	7.2
Total Organizations/Divisions	12	Median Years In Position	4
Total - City of Toronto	32		
Undergraduate	25	Male	21
Masters	13	Female	17







Respondent Level of Experience from Survey Results

Primary Survey - Coded Themes: 46 Open-Ended Questions, Content Analysis, and Field Notes. Coded into 4-themes by topical matter.

Theme 1: Data	Theme 2: Participation	Theme 3: Data-Driven	Theme 4: "Smart" City
Lack of Access	Not required for most projects	Consultants, "Vendor knows best"	Efficiency
Vendor licencing	Often Vendor Run	Strong Focus	Big Initiative/Focus
Quality	Mandatory for Council/Public Work and Planning Projects	Lack of resources; Lack of skills;	Technology providing **citizen** services; vendor controlled
Quantity	Unknown Influence	Good Idea	Inclusiveness
Knowledge	Ad-hoc Methods	Dashboards, business intelligence, GIS, excel	Buzzword
Lack of Timeliness	Unrepresentative, Notification Difficult,	Not sure where to start	IoT,AI/Machine Learning; Data Mining
Siloed	Burden on Public	BI-Dashboards	privacy
Privacy	Hard to do	"We've been data-driven"	"We've been a smart city"

Appendix D - Consent Form

Participant Consent Form

Researchers: Matthew Tenney, Ph.D. Candidate, Department of Geography, McGill University, matthew.tenney@mail.mcgill.ca,

Supervisor: Renee Sieber, Department of Geography, McGill University, renee.sieber@mcgill.ca

Title of Project: Coded Engagement: Data-Driven Participation in the Smart City

Sponsor(s): This project is partially supported by a Social Science and Humanities Research Council Grant #895-2012-1023 and Mitacs Accelerate Ph.D. Fellowship with Esri Canada Inc.

Purpose of the Study: You have been identified as someone who has a role relevant to incorporating public participation within city operations. This research project compares the use of public participation in a traditional manner (i.e., finding out how you use it and when) to what is possible from the digital harvesting and algorithmic treatment of public comments. I am a Ph.D. student who is trying to learn more about how local governments view the role of public participation, which methods are used to engage with citizens, and what your impressions are of online forms of participation.

Study Procedures: Your participation in this study will consist of an initial interview where you will be asked questions regarding 1) Policies and procedures carried out as part of your employment duties relevant to engagement with members of the public, 2) Your personal assessment of these methods and efforts carried out at an institutional level, and 3) any additional information or material you'd like to provide regarding our efforts to study the way public participation is approached within your organization. This initial interview will be recorded with your consent, take place at a time and location of your convenience, and should last no more than an hour.

Voluntary Participation: Your participation is totally voluntary and may refuse to participate in part of the study, may decline to answer any question, and may withdraw from the study at any time, for any reason. If you decide you would not like to participate all information regarding your engagement will be deleted, and no records will be kept other than an entry that you would not like to be contacted or take part in any further part of this project.

Potential Risks: There are no anticipated risks to you by participating in this research.

Potential Benefits: The primary goal of this research is to inventory the multiple perspectives and approaches to public engagement as they currently exist and how they might be transformed with a collection of online data. Our intent is to improve approaches to public participation, methods used to engage with citizens, and insights on any experiences where public input was gathered on non-electoral matters.

Compensation: There is no compensation being offered or implied with your participation in this study.

Confidentiality: Most of the information we will gather from you will pertain to the organizational practices being undertaken at your workplace concerning public engagement. Some personal information like your name, job title, and personal opinions will also be collected. All information will be stored in password-protected files and further be de-identified from you by random assignment of participant identification numbers. All notes, recordings, or other collected material in physical form collected as part of your participation will be secured in a file safe where only the approved researcher may have access to, or, immediately destroyed if they can be digitized (e.g., written notes during the interview or physical documents you may provide). Your information with not be shared with other interview subjects or people aside from the primary researcher of this project, but you can request copies of your own files to use as you wish.

In most cases, it would be helpful for us to record the interview that will be transcribed at a latter point. The original audio file will be deleted and the transcripts of our interaction securely stored as stated above. You, of course, can refuse to answer any question, have any information documented, or be recorded during any part of this interview.

You consent to be interviewed

Yes:☐ No: ☐

You consent to be audio recorded

Yes: ☐ No: ☐

You consent to be identified by name in reports.

Yes: ☐ No: ☐

You consent to have your organization's name used.

Yes: ☐ No: ☐

Questions: If you have any question regarding this study, please feel free to contact the primary researcher, Matthew Tenney, directly at ------- or -------

If you have any ethical concerns or complaints about your participation in this study and want to speak with soameone not on the research team, please contact the McGill Ethics Manager at 514-398-6831 or lynda.mcneil@mcgill.ca.

Please sign below if you have read the above information and consent to participate in this study.

Agreeing on toparticipate in this study does not waive any of your rights or release the researchers from their responsibilities.

A copy of this consent form will be given to you, and the researcher will keep a copy.

Participant's Name: (please print) ____

Participant's Signature: ________________________________Date: __________

[If applicable, include copyright permission for previously published material. Remove any personal information from appendices and forms, such as emails, phone numbers, signatures, etc.]