PORTALS FOR PLANNERS:

CURRENT STATE OF OPEN LAND DEVELOPMENT DATA IN CANADA

by

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ABSTRACT

As municipalities struggle to keep up with the rising amount of development applications and population growth, open data has been overlooked as a solution to improve the development review process. This paper explores the current role of open data portals in providing land development data in five large urban centres in Canada, assessing the issue of availability. A set of 10 land development datasets, from an urban planning perspective, was investigated, as well as a case-study analysis on the respective municipalities open data history and initiatives. It was found that land development data is more prevalent in larger populated cities; simple geographic location points are common; and there is inconsistency within each municipality on how information is released publicly. Through these findings, recommendations were made for various municipal staff members to address the challenges in opening essential land development data.

Key words: open data; open data portal; open government; urban development

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A. Introduction

In July 2019 Toronto was announced to have the most active cranes in all of North America, with 120 in the city and 246 in the Greater Toronto Area (Gismondi, 2019). Like Toronto, urban centres across Canada are responding to population growth through intensification in the built environment. For quarter four in 2019, the Canadian Mortgage and Housing Corporation (CMHC) calculated over 274,000 residential units under construction in Canada - 73% of these were apartments or other unit types (Statistics Canada, 2020a). Municipalities across the nation are challenged to keep up as staff are strained with development applications, sometimes taking months or years to complete the approval process (Green & Filipowicz, 2017; KPMG, 2019). Yet, a recent study by KPMG (2019), *End-to-End Review of the Development Review Process* for the City of Toronto, found 31 municipal systemic challenges that have caused delays in the approval process. One of these challenges was the lack of available development review-related information, or "land development data", which has caused poor application quality and delays. It was found that the essential information required for development applications were either not online, partially online, don't exist or are currently under development (KPMG, 2019).

Simultaneously, municipalities across the nation are implementing "smart city" initiatives, where interlinked systems, technology and big data are key in creating a better urban life. In November 2017, the Government of Canada launched its "Smart Cities Challenge", provoking municipalities, local or regional governments, and Indigenous communities to think "bold and ambitious ideas to improve the lives of their residents using data and connected technology" (Government of Canada, n.d.). With over 200 submissions from communities of all sizes, over

100 projects proposed to advance their open data initiatives as their smart city initiative(Government of Canada, n.d.). Nevertheless, 61 municipalities in Canada do have existing open data portals, yet there seems a great need to improve these systems to encourage better livelihoods for their residents (Government of Canada, 2019).

However, some municipalities are not taking full advantage of their open data platforms and its ability to publicly release information. As mentioned, land development data could be inaccessible and unavailable to those who require it. There is an opportunity to use the recent ambition to improve open data portals as a way to "open" land development data. This paper examines the current state of the distribution of land development data provided by large municipalities across Canada. From a planning perspective on the development review process, a fixed set of data has been searched for its availability across five open data portals, including the City of Toronto, City of Montréal, City of Edmonton, City of Vancouver and City of Ottawa. Therefore, the primary question guiding this research is: what is the current state of Canadian municipal open data portals in providing land development data? As many municipalities are looking to improve their open data platforms, observations of the experience in navigating these portals are also shared in this research. Thus, answering the secondary question: How can municipalities improve their open data platforms for users looking for land development data?

The research is from an urban planning perspective and primarily focuses on policy or land use data needed to build a planning rationale for a development application. However, there is other development-review information such as water main locations or transit capacity models, which

require further expertise and software to interpret. Additionally, this research has an emphasis on geospatial datasets that can be used in a Geographic Information System (GIS) software. Maps and other spatial analyses have been useful in supporting planning rationales, by visually representing land uses and relationships (Klosterman, 2015).

B. Literature Review

Though the results are the foundation of this paper, literary research highlights the underlying context of the open data movement and its involvement in the urban development industry, and more specifically in urban planning. The use of data and technology in urban planning is not a new phenomenon, rather it has progressed over time through various trials and errors. The first portion of this literature review introduces this history, emphasizing the ongoing emergence of smart cities. However, outside of urban planning, open data and open data portals have grown tremendously in the last 10 years. Thus the second portion takes a deeper look into this growth and the progression of open data platforms. More recently, open data has contributed to more entrepreneurial technological solutions including public transit apps. However, there is also a discrete emergence of urban development technologies, like PropTech (property technology) that can greatly benefit from open data, given its relevance and quality. The final portion of this literature review establishes the gap between open data and its role in supporting new and innovative urban development technologies.

B.1 Data and Urban Planning

In the 1960s urban planning went through a paradigm shift from a design focus to an applied science with the goal to make unbiased decisions using quantitative methods (Klosterman, 2015). Melvin Webber (1965) sparked the notion of intelligent centres in urban planning which would support scientific morality in urban affairs. These intelligent centres would create "rational developmental decisions" through a system of interlinked data and improved inventories and forecasts (Webber, 1965). Shortly after in the 1970s, planners' trust in computer technology failed with the unsuccessful attempts with large-scale urban models, due to the lack of data, software and high expectations (Klosterman, 2015). It wasn't until the 1980s when planners regained faith in computer technology with better access to systems due to the development of microcomputers (Klosterman, 1997). Yet in the 1990s, another shift occurred as GIS became more widely available (Klosterman, 1997). This shift was of particular interest to planners as it provided a platform to conduct spatial analysis. (Kitchin, 2014).

As the access to information and technology progresses throughout the years, the urban development community, including governmental bodies, urban planners, private developers and residents, are exploring the power and potential of data and its role in making cities more fruitful and resilient. This growing interest has led to the development of smart cities. A smart city has been defined as a city that embraces information and communication technologies (ICTs), such as sensors to create an interlinked network of data (typically big data) as a means for a better urban life (Pembleton, Ahmed, Lauriault, Landry, & Planchenault, 2019). However, Kitchin (2014), argues that are two distinct understandings of the smart city. On one hand, ICTs are to be

built into the urban fabric as a means to collect, monitor and manage data on city living and therefore creating the ability to generate interconnection and improved decisions (Kitchin, 2014). On the other hand, smart city refers to how ICTs can support human and social capital to make the city smarter, through innovation and creativity (Kitchin, 2014). The focus of this research is based on the latter, acknowledging the role of open data platforms in mobilizing new ideas and perspectives on urban life.

B.2 Growth of Open Data Platforms in Canada

The evolution of open data has radically shifted the previous conceptions of information and data as inaccessible, exclusive and essentially "closed" to the public. Though inconsistently defined across literature, open data at the core embodies "openness, participation and collaboration" or in other words the power of transparency to leverage social engagement and knowledge (Kitchin, 2014). The International Open Data Charter characterizes open data as "digital data that is made available with the technical and legal characteristics necessary for it to be freely used, reused, and redistributed by anyone, anytime, anywhere" (Open Data Charter, 2015). However, open data's breakthrough is rooted in civic activism, which challenged government bodies to no longer hoard valuable data as this information may impact social, political and economic development and decisions (Davies, Walker, Rubinstein, & Perini, 2019). Public sectors are the largest collector and producer of data including information regarding traffic, business and weather, or what can be called 'open government data' (Janssen, Charalabidis, & Zuiderwijk, 2012; Davies, Walker, Rubinstein, & Perini, 2019). Therefore, public institutions have been

particularly reactive in releasing data, some under the ideology that by doing so, will give a perception of 'open government' (Janssen, Charalabidis, & Zuiderwijk, 2012).

Open data portals act as a solution for governments to provide a web-based system in which the public can search and access data upon demand (Máchová & Lnénicka, 2017). Yet, the effectiveness of this interaction between open data and the public (and private sector), is dependent on the government's intention and objective. Sieber & Johnson (2015), found four models of open data provision which include: data over the wall (government publishing of open data); code exchange (government as open data activist); civic issue tracker (data from citizen to government); and participatory open data (open data as open government). Each provision has its pros and cons, and essentially may conflict with one another, but raises a question on the economic or ethical positioning a government may take in delivering open data (Sieber & Johnson, 2015). However studies have shown that open data portals are the most effective when it engages the user and retains consistent feedback (Máchová & Lnénicka, 2017; Zhu & Freeman, 2019). On the other hand, the direct and indirect costs of open data, specifically GIS data, also need to be considered when delivering open data (Johnson et al., 2017). Today, hundreds of municipalities across the world host open data portals in their own unique way with different magnitudes of engagement.

B.3 Open Data and the Emergence of Entrepreneurship

Open data has a tremendous economic value which is attractive to start-ups and entrepreneurs as they find creative and innovative ways to fully embrace this free resource. McKinsey Global

Institute (2013) found that open data can potentially create $3 -5 trillion USD yearly, across only seven sectors alone. Therefore it is no surprise that Open Data 500 (n.d.), identified over 150 companies in Canada that are using open data to launch new products or to improve their operations and research (Open Data 500, n.d.). Governmental sectors across the globe have been hosting open data hackathons, in search of the next big inventive idea. Therefore, open data is more than just releasing data, as it also serves as an opportunity to solve ongoing challenges and issues (Kitsios & Kamariotou, 2018). Various industries have leveraged this opportunity to create new software that does just that, including apps that share real-time public transit locations (i.e. Rocketman), waste management and pick-up times (i.e. Recycle Wizard, Garbage Day) or even swimming conditions in local lakes (i.e. Beachify) (City of Toronto, n.d.a).

Despite this great opportunity, urban planning has yet to take full advantage of open data and its ability to provide solutions for urban issues. Kitchin, Dawkins & Young, argue urban planning is too complex and political to "be simply reduced into data and rules and run via computational, technocratic procedures" (Porter et al., 2019). However, PropTech has emerged as an interesting entry point for planners to explore how data and technology can improve their work. PropTech has the potential to increase the amount of recorded information about land and property, support data digitization and unite actors in the urban development industry (Porter et al., 2019). Though commonly used for real estate, PropTech's functional application is extensive including mapping and site potential (Phillips, 2019). Companies like Ratio.City[1] has joined urban planning data such as zoning and official plan policies with 3D modelling, reporting and analysis (Ratio.City,

[1]In the spirit of transparency, this research emerged from the author's experience as an intern at Ratio.City in the summer of 2019. As a current employee of this company, the author recognizes that there are ongoing challenges that need to be explored and examined.

n.d.). Nevertheless, urban planners need to consider how such technologies should fit within their work or how it may impact planning systems (Porter et al., 2019)

All in all, the improved access and quality of information, or what Kitchin (2014) calls the 'data revolution', has a great impact on the urban development industry and more specifically urban planners. Planners are beginning to embrace data but seem wary of its ability to make big decisions about complex urban cities. Yet, with the ongoing development in ICTs and open data platforms, access to critical data is becoming more readily available. But is it enough to push for new solutions? This paper puts data availability to the test, by exploring how well Canadian, urban municipalities are doing in open land development data.

C. Methodology

This paper uses a case study analysis that employs primary qualitative research, examining the availability of 10 planning related land development datasets across five large Canadian municipalities' open data portals, answering the question: what is the current state of Canadian municipal open data portals in providing land development data? Using a cross-sectional research approach, which is a snapshot of the findings at a single point of time, all open data portals were investigated on January 13th, 2020 (Neuman, 2014, p. 44). A case study approach was used to link micro-level geographies (individual large-cities) findings to make a general understanding of the macro-level geography (all large-cities) (Neuman, 2014, pp. 42-43). However, the case study analysis approach was used to compare the results between cities to identify similarities and differences, supporting the discussion of the findings.

In reference to the secondary question, an observational approach was taken in answering the question: how can municipalities improve their open data platforms for users looking for land development data? As each open data platform was investigated for land development data, the experience of navigating each system was tracked and noted. The strengths and weaknesses of each portal have been highlighted and were based on personal individual evaluation. Statistics Canada defines large urban population centres as census metropolitan areas (CMAs) that have a minimum population of 100,000 and a density of 400 persons per km^2 (Statistics Canada, 2017). The population counts of the large urban population centres, in order form big to small, included Toronto, Montréal, Vancouver, Calgary, Edmonton and Ottawa-Gatineau (Statistics Canada, 2017). To demonstrate provincial differences among municipalities aside from Ontario, Calgary was omitted from this research. Edmonton was chosen over Calgary due to its known leadership and excellence in open data services in Canada. Therefore, the final selection was the municipal governments of the core subdivisions of the large urban population centres including, the City of Toronto, City of Montréal (Ville de Montréal), City of Vancouver, City of Edmonton and City of Ottawa.

C.2 Land Development Data

To maintain neutrality, the same set of datasets was investigated for each municipal open data portal. Though each municipality may have various interpretations of the defined dataset, sound judgement was used to reason if a dataset was available or not. Each dataset was searched in the respective municipality's open data portal and then exported as a comma-separated value (CSV),

shapefile (SHP) or another geospatial data type (i.e GeoJSON or KML). Consequently, if a dataset was found on the open data portal, had the ability to be downloaded and could be visualized, it was deemed “available”. If a dataset did not meet all three requirements above it was not marked as available.

The development process and planning frameworks differ between municipalities based on their respective government structure, natural environment (such as protected views of mountains), scale of the project and the various planning policies and initiatives. Therefore, land development data required to form a planning rationale/justification for a given proposed development will fluctuate between municipalities. However, based on the case studies, there was a general high-level consistent theme where each studied development application or the requirements for, included the following datasets in some form.

#	Dataset	Definition
1	Property Boundaries	The legal geographical confinement of a given site. AKA: Parcels
2	3D Massing	General shape, form and size of existing buildings or structures, with the ability to be seen in a 3D format. AKA: Building footprints with heights.
3	Heritage Locations	Locations that have significant historical or cultural; heritage significance, with a conservation strategy in place.
4	City-wide Land Use Plan	General city-wide map of designated land uses with supportive policies.
5	Large-Area Plans	General policies for a large area of continuous sites. Typically secondary in nature.
6	Small - Area Plans	General policies for a single site and/or a small set of continuous sites. Typically tertiary in nature.
7	Zoning By-law - Categories	Regulated permitted land uses for each site.
8	Major Development Applications	Listing of all development applications that have a significant impact (i.e. new high-rise building) with statuses. May also have an amendment to existing policies and/or by-laws.
9	High-order Transit	Geographic points of existing transit that have its own right-of-way (i.e. subway, LRT).
10	Active Planning Studies	Municipally led city projects which may have an impact on current policies or by-laws.

Table 1: Planning-related land development datasets that were investigated.

C.2.1 Property Boundaries

Property boundaries or in some cases known as parcels are the geographical confinements and extension of a specific site. At the base of any specific development application, a site needs to be known and identified, whether this is single or multiple parcels. Beyond the planning justification benefit, data on property boundaries may provide information on land ownership and registry.

C.2.2 3D Massing

It is common for planning justifications to demonstrate how the proposed development is in context with the surrounding community, in terms of height, structure and scale. Typically, a projected massing is extruded in a 3D format among other existing buildings in order to showcase its suitability. Therefore, a preferred data type for this dataset would be a 3D Massing file that has the geographic confinements of each building. Another acceptable dataset is a building footprint geographic file that contains a field of height values, which then can be extruded in a given software program.

C.2.3 Heritage Sites

Another crucial piece of information for the development application is identifying any heritage protected sites on or around the study area. Typically large cities have a list or registry of all buildings and sites that have a significant historical or cultural importance, and thus may be limited to construction or have protected viewpoints. Though the details regarding the constraints of each heritage site are significant, in the pre-consultation phase, the location of these sites shed importance. Therefore a point shapefile data format is sufficient, given it is accompanied by the respective heritage file number to follow-up on future research. However, a CSV could be of use as well, given it provides readable addresses or longitude and latitude coordinates that can be geocoded. The later dataset format does, however, adds an extra step in accessing the data, and the former is preferred.

C.2.4 City-wide Land Use Plan

For most large municipalities in Canada, an Official Plan or a city-wide plan sets out a general vision of where certain land uses ought to be. Future development is expected to follow this vision or at times, apply for an amendment if the proposal does not comply. A geographical map of the land uses across the city, will assist the user to detect the land use that impacts their site and also other potential areas for growth.

C.2.5 Large-Area Plans

Certain neighbourhoods or communities have specific development guidelines that vary from the city-wide plan. These are typically secondary in nature (i.e. Secondary Plans) and consist of continuous blocks of properties. Though the understanding of "large-area" may not be consistent between municipalities, it is common to think of these areas as communities. The ideal dataset of large-area plans, would include a set of maps with all of its respectives guidelines (land use, character areas, etc.). However, the confinements of each large-area plan area could be efficient as it would let the planner know if a given site has more specific considerations.
This indication could be demonstrated in a shapefile that has names, any policy numbers and accurate boundaries of each large-area in the respective city.

C.2.6 Small-Area Plans

Like large-area plans, small-areas such as blocks or specific sites (i.e. Site and Area Specific Policies) may also have added regulations on how development should take place. The size of such plans is also not consistent among municipalities, but it can be argued that these areas are

geographically smaller than large-area plans. Boundaries of these areas, distinguishing where such plans exist can help the planner prepare any future investigation.

C.2.7 Zoning By-law Categories

Nearly every large city in Canada has a zoning by-law of some sort, which provides a more detailed prescription of land uses. Zoning by-laws tend to act as the rulebook for any future development outlining what exactly can be built here, how tall, and what scale. These can be very specific to a certain address, but also tend to have a general categorization of building types such as residential, institutional or employment. Therefore it is key for the planner to know what zoning category a given property belongs to, as this will guide any future development requirements or if any amendments to the by-law are required. A map with all zones and their respective categorization, zoning codes or identification numbers may be sufficient to help the planner conduct research.

C.2.8 Major Development Applications

Though the 3D Massing of buildings may provide precedence of existing buildings, knowledge on upcoming or refused buildings can provide the planner information on what is typically approved in a given area. Though this information may be updated frequently as decisions on developments may occur daily, data should be able to be downloaded and used for analysis. The ideal dataset would have locations, file numbers, application dates, status (i.e approved, declined, appealed etc.) and some information about the development (i.e. height). Therefore a point file may be best suited for this dataset.

C.2.9 High-Order Transit

High-order transit or even sometimes referred to as rapid transit is public transit that has its own right-of-way and functions on a frequent basis. For various reasons, developments close to high-order transit can have many implications including, increased land value, support for sustainability, or attractiveness for potential tenants. In some cases, areas surrounding large transit stops or stations are deemed as areas with future growth (such as Major Transit Station Areas in Ontario's Growth Plan). Thus a point file identifying where high-order transit stops/stations are located across the city may provide enough information for the planner to identify how far their respective study site is to transit. The location of stops is widely publicized and often found on Google Maps. However, the benefit of being able to download and use this information is to conduct spatial analysis queries, such as creating catchment areas of walking distance. High-order transit stops can be pulled from a General Transit Feed Specification (GTFS) file or be provided in a point shapefile.

C.2.10 Active Planning Projects

At times, municipalities themselves initiate or/and endorse significant planning studies that can create a large change in planning policies or urban development, including new large-area plans, new heritage site designation or new transportation strategies. Since this may impact the nature of future development, this is of importance to the planner. Boundaries of such areas that are going through significant changes would be the ideal dataset.

C.3 Case Study Methodology

The findings have been organized by each municipality in the following order: City of Toronto, City of Montréal, City of Edmonton, City of Vancouver and City of Ottawa. Each municipal section includes five subsections: (1) Overview of Urban Growth, (2) Background on Open Data Initiatives, (3) Open Data Portal Observations, (4) Development Application Requirements and (5) Land Development Data Availability. The overview of urban growth introduces the municipality's population and development trends and statistics, which was collected through secondary research. The second subsection, background on open data initiatives, was also supported by secondary research, underlining the municipality's open data progression and history. The open data portal observations subsection shares the personal experience of maneuvering each portal, identifying the pros and cons of the platform. The fourth section introduces the general development review process respective to the municipality. Planning rationales and/or development application documents were sampled randomly to provide a glimpse of recent work. This sampling used development application platforms hosted by the municipalities and selected at random three active applications in three different areas of the respective city. The final subsection is the results of the availability of the 10 land development datasets in the respective municipal open data platform, shared along with any known limitations and/or identified missed opportunities.

D. Results

D.1 City of Toronto

D.1.1 Overview of Urban Growth in Toronto

For the year 2019, the Toronto census subdivision is home to an estimated 2,965,713 people, however, the Toronto CMA has an estimated count of 6,471,850 people - resulting in a growth of 5.97% and 7.06%, respectively, from 2015 (Statistics Canada, 2020; Statistics Canada, 2020a). In one year (August 1st, 2017 – July 31st, 2018), the City of Toronto grew an additional 77,435 people, the highest in all of Canada and the United States (Clayton & Shi, 2019). Known for its technological innovation, robust economy and home of many neighbourhoods, net international migration is the main driver of population growth in the city (Clayton & Shi, 2019). With a limited space of 630.2 km^2, the City of Toronto is increasingly compact with a density rate of 4,705 people per km^2 (Statistics Canada, 2017a).

To meet the needs of this growing population the City of Toronto has one of the highest development activities in North America. As mentioned, in the summer of 2019 Toronto had the most active cranes in all of North America, with 120 in the city and 246 in the Greater Toronto Area, (Gismondi, 2019). CMHC (2019) *Housing Starts, Completions and Units Under Construction* publication for quarter 4 of 2019, found that the Toronto CMA had 7,225 housing starts, 4,767 completions and 74,451 residential units under construction. This has an evident pressure on city staff as they've approved the construction of more than 220,000 residential units and 7.4 million squares of non-residential space, in the last 10 years (KPMG, 2019). Therefore

the city contracted KPMG, to conduct an end-to-end review of the City's development review process. In this review, KPMG found 31 large systematic challenges that impact the timeliness, efficiency and transparency of the development review process (KPMG, 2019). One of these challenges, item number 5.3, poor data availability has been recognized as a major issue and causing poor application quality (KPMG, 2019, p. 32).

D.1.2 Background on Open Data in Toronto

In the early 2000s, the City Council established an Auditor General and an Integrity Commissioner roles, both with the intention to hold staff accountable for meeting the needs of local taxpayers (Kleinman, 2016). One major problem for the City was the siloed structure of staff, in which information would "belong" to a particular department, causing some data to be incompatible across the system (Kleinman, 2016). It was in April 2009 at a Mesh Conference, when former mayor David Miller announced that the city will initiate an open data website within six months (Woo, 2009). As promised, by November 2009, the city launched the open data website at the Toronto Open Data Lab where community members and those interested in civic data had an opportunity to engage with this new release (Kuznicki, 2009). Since then the City has issued its Open Data Policy and now hosts over 300 datasets on the Open Data Portal (City of Toronto, 2013; City of Toronto, 2011).

D.1.3 Open Data Portal Observations

The City of Toronto open data portal homepage welcomes the visitor to a search box, allowing the user to immediately start typing in their interested data. The home screen also displays the

five most recently added datasets and top stories/publications from the Open Data Team. Once an item is searched, there is a preview of each relevant dataset providing a brief description, refresh date, publisher, data format, civic issues tags and topic categories. On the left panel, there are 15 topics that act as a categorical system, grouping relevant data together including City Government, Development and Infrastructure, Locations and Mapping and Transportation. Additionally, there was another categorical system of Civic Issues which had five categories including Mobility, Poverty Reduction, Affordable Housing, Climate Change and Fiscal Responsibility. Another filtration option was the publisher of the open data, which seemed to replicate the departments of the City of Toronto. Furthermore, when a dataset is selected the user is able to retrieve more information such as any external links, known limitations regarding the data, a data preview option and the ability to explore the data.

One of the greatest strengths of the City of Toronto's open data portal is its new "Data Quality Score". Even without going to the metrics of the scoring system, seeing a gold, silver or bronze icon helps notify the user of the quality of the data and possible limitations. The system uses five weighted quality dimensions including usability (38%), metadata (25%), freshness (18%), completeness (12%) and accessibility (7%) (Hernandez, 2020). Another strength is the knowledge centre which hosts tools and training tips to help users of different skill levels understand and adequately use the open data portal. Lastly, from a planning perspective, the ability to filter datasets published by the City Planning Department provides a quick and easy way to get to relevant data faster.

The biggest limitation of the City of Toronto's open data portal was the inconsistency of their features. For example, every dataset has a "data preview" option, in which the user would be able to visualize the data in some form (map or table). However, for a large number of datasets, this feature was not available and therefore cannot be seen until it was exported. Another weakness was the lack of a data schema, or a table explaining what each field in the data means. Once the data is downloaded, there may be a "read-me file" which could provide more information. But in some cases, the user is left to figure out on their own, which can be extremely difficult for large complex datasets like zoning.

D.1.4 Development Application Requirements

The City of Toronto has typically five different large development applications including an Official Plan and/or Zoning By-law Amendment, Draft Plan of Subdivision, Draft of Condominium, Site Plan Control and Part Lot Control Exemption (City of Toronto, 2017). Pre-consultation meetings with City staff are highly encouraged as this will determine what additional documents, also known as the Term of Reference and the level of detail required for the application (City of Toronto, n.d.). However, planning rationales are required for all Official Plan and/or Zoning By-law Amendment, Draft Plan of Subdivision, Draft of Condominium and significant Site Plan Control applications (City of Toronto, n.d.). The City suggests all planning rationales contain numerous items including a description of built form, site and surrounding land use and the property's planning history (City of Toronto, n.d.).

In comparing the sampled planning rationales of various development applications in Toronto, there were some evident consistency in following the requirements from the City of Toronto (Bousfields Inc, 2017; WND Associates, 2018; Urban Strategies, 2012). Public transportation was commonly discussed, as every application discussed its proximity or lack thereof to a transit stop. One interesting commonality was the use of "screenshots" or captured images of the Official Plan Land Use Designation maps, which are in a portable document format (PDF), to display the respective study site and its surrounding land uses. Though a description of official plan compliance is required by the City, planners seem to be using inefficient means to display this information, heightening the possibility that this information is not available in any other format. However, each planning rationale followed a hierarchical planning policy framework, outlining how the development site met the requirements of the provincial and municipal interests. Though each planning rationale differed in structure, there was a clear understanding of what information was required to support the proposed development, as they all had similar components.

D.1.5 Land Development Data Availability

The City of Toronto had the highest number of available land development data with a score of 80%. Of the eight datasets that were found, six were under the City Planning publisher filter – High Order Transit (TTC subway and streetcar stops) and Property Boundaries were published by other departments. On the date of the data collection, the oldest dataset was Large-Area Plans (Secondary Plans) with a refresh date of January 31st, 2017. On the other hand, the most recent dataset was Major Development Applications (updated monthly), which appropriately indicates

the frequent changes to that dataset. The High-order Transit (TTC subway and streetcar stops) were only available as a GTFS, thus presenting an opportunity for the City of Toronto to provide this information as a ready-to-go shapefile which could help save users time. Though this study is not intended to assess the quality of each dataset it should be noted that the Zoning dataset was extremely hard to interpret as there were numerous columns/fields, but no data schema.

The two datasets that could not be found were Land Use (Official Plan Land Use Designations) and Active Planning Studies. However, both of these datasets can be found on the City's website in non-geospatial formats. The Official Land Use Maps are found on the city's Official Plan webpage, which breaks up the city into 11 portions where each has its own PDF land use map. This may explain why the studied planning rationales had screenshots of the land uses since it is not publicly available in any other format. The Active Planning Studies is also hosted on the City of Toronto website, with an interactive Google map with all the points of interest. The boundaries and the extents of each active planning study are hidden in the various PDFs of the supporting documentation. Nevertheless, both datasets, Land Use and Active Planning Studies, both appear to have some initial geospatial reference data (whether that is a map or coordinates), that could be shared publicly on the open data portal.

City of Toronto					
#	**Land Development Dataset**	**Dataset Name**	**Available (Y/N)**	**Published Date**	**Formats Available**
1	Property Boundaries	Property Boundaries	Y	12/31/2018	SHP
2	3D Massing	3D Massing	Y	11/30/2018	PDF, SHP, Autocad
3	Heritage Locations	Heritage Register	Y	4/20/18	SHP
4	City-wide Land Use Plan	Official Plan Land Use	N	n/a	n/a
5	Large-Area Plans	Secondary Plans	Y	1/31/2017	CSV, GeoJSON, SHP, GeoPackage
6	Small - Area Plans	Site and area Specific policies	Y	12/2/2019	CSV, GeoJSON, SHP, GeoPackage
7	Zoning By-law - Categories	Zoning By-law	Y	1/9/2020	SHP
8	Major Development Applications	Development Applications	Y	1/7/2020	SHP
9	High Order Transit - Stops (Current)	TTC Routes and Schedules	Y	Refreshed Daily	GTFS
10	Active Planning Studies	Active Planning Studies	N	n/a	n/a

Table 2: City of Toronto land development data results.

D.2 City of Montréal

D.2.1 Overview of Urban Growth in Montréal

Like Toronto, Montréal's population is growing rapidly and encouraging future urban development. The census subdivision of Montréal experienced a growth of 5.28% from 2015 to

2019, resulting in a total population of 2,052,910 (Statistics Canada, 2020). For the same time period, the Montréal CMA had a growth of 5.08% resulting in a population of 4,318,505 (Statistics Canada, 2020). The Montréal CMA has also experienced a population growth of over an estimated 66,000 people between August 1st, 2017 – July 31st, 2018 (Clayton & Shi, 2019). Geographically smaller than Toronto with an area of 365.65 km^2, Montréal is denser with a rate of 5,614 people per km^2 (Statistics Canada, 2017b).

Montréal recorded the highest Canadian economic growth in 2018, which has been supported by steady job creation and strong non-residential investment (The Conference Board of Canada, n.d.). The positive economic growth had a trickle effect on the population retention rates which has also encouraged new housing construction to meet these needs (The Conference Board of Canada, n.d.). Consequently, the Montréal CMA experienced 5,835 housing starts, 5,418 completions and 28,904 residential units under construction in quarter 4 of 2019 (Canada Mortgage and Housing Corporation, 2019). However, urban sprawl is a particular issue for Montréal as 100,000 commuters travel into the city core (94% by automobile) on a daily basis (Montréal Metropolitan Community, 2020).

D.2.2 Background on Open Data in Montréal

After 14 months of encouragement by Montréal Ouvert (Open Montréal) - a citizen initiative led by Jonathan Brun, Jean-Noé Landry, Michael Lenczner and Sébastien Pierre – and the broader open data community, City of Montréal launched its open data portal in 2011 (Montréal Ouvert, n.d.). Following that year, Montréal released its first Open Data Policy, outlining the

government's responsibilities and citizen rights – which was later revised in 2015 (Ville de Montréal, 2015). In March 2014, Montréal revealed its Smart and Digital City strategy with a vision of being the world's leading smart city by the year 2017 (Ville de Montréal, 2014). This strategy identified the need to improve the development of open data among the different boroughs as well as the goal of creating an open, interoperable technological architecture that promotes system decompartmentalization and data flow (Ville de Montréal, 2014). Additionally, the City of Montréal Data Governance Directive was also released which clarifies the ownership and principles of the City's data (Ville de Montréal, 2015). Furthermore, even within these initiatives, Montréal is continuing to grow as the city is in the process of adopting an Open Data Action Plan, identifying the best practices and improvements for the open data program (Ville de Montréal, 2019). Recently, the City of Montréal won $50 million dollars from Infrastructure Canada's Smart Cities Challenge, in which they proposed technical solutions to increase mobility and access to food using open data (Government of Canada, 2019).

D.2.3 Open Data Portal Observations

The City of Montréal's open data portal (portail données ouvertes) greets the visitor with a search box, recently added or updated datasets, twitter feed and news. The homepage also has 12 icons representing different themes including Social Policies, Infrastructure, Government and Finance and Transport. When a search item was entered, a list of relevant data was listed with a short description of each and the data format it may come in (i.e GeoJSON, SHP). Another filtering system was available by using keywords that acted as tags to help locate data, which is helpful in navigating the 344 available datasets. When a dataset was selected more information

was provided including, methodology (how the data was obtained), modification date, frequency of updates and sometimes a data dictionary (which acted as a data schema).

One of the most unique features of Montréal's open data portal was the "Activity Flow" which shared all the changes a dataset endured, including the name of the staff member who completed those revisions. This feature demonstrates thorough transparency from the City of Montréal's staff, but also allows the user to track any alterations or modifications over time. Each dataset webpage also had a comment section, where visitors and staff can discuss any concerns regarding the data.

The most obvious challenge was the language barrier, as the open data portal was only available in French and a translator was used to navigate the portal. However, this can easily be a barrier for a French-speaking user navigating an open data portal from Toronto, as an example. One limitation of the open data portal was the predetermined themes, as it wasn't clear where land development data would live under. For example, Land Use (Urban Plan – Land Allocation) was under the theme "Infrastructure", which may be unclear or ambiguous as infrastructure can pertain to roads and sewage rather than a planning policy. Lastly, the open data portal can benefit from features like data previews or more filtering options.

D.2.4 Development Application Requirements

Montréal is unique, as it has several tiers of the urban planning frameworks, as shown in Figure 1. This includes the Greater Montréal Metropolitan Land Use and Development Plan (PMAD)

(regional level), Scheme of Management and Development of Greater Montréal, Master Plan, Special Urban Planning Programs, Overall Development Plans, Zoning By-laws and more. Furthermore, Montréal is home to numerous boroughs, each having its own Zoning By-law. However, it seems the process to change the Zoning By-law goes through a similar process as other municipalities in this study including an initial review with city staff, public consultation and a vote by the Borough Council (Borough of Saint-Laurent, n.d.; Borough of Côte-des-Neiges–Notre-Dame-de-Grâce, n.d.). Additionally, some boroughs highly suggest preliminary meetings before submission in which staff can review items such as site plan, the purpose of the application and graphics showing the proposed development and its surrounding uses (Borough of Côte-des-Neiges–Notre-Dame-de-Grâce, n.d.). Due to language constraints, it was difficult to determine if a planning rationale or equivalent is required. However, with the complex planning framework mentioned above, it is assumed that the applicant must display compliance with these policies or regulations. In this regard, a comparison of various development applications was not conducted, as there was no primary source to retrieve this information.

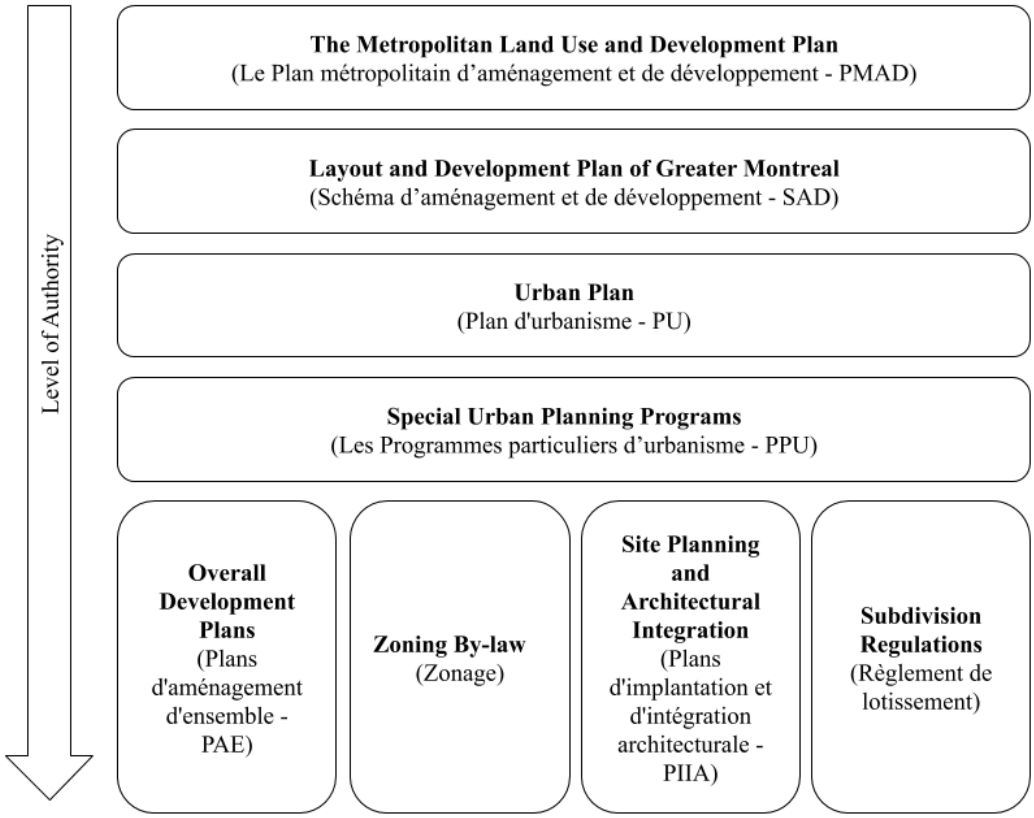

Figure 1: General planning framework for the City of Montréal.

D.2.5 Land Development Data Availability

Only six datasets out of the 10 were found on Montréal's open data portal. All datasets were published fairly recently, most were last modified in Fall 2019. The 3D Massing was only available as an AutoCAD DXF (Drawing eXchange Format) or a GML (Geographic Markup Language) file, which requires special software programs that were not available during this study. The High-order Transit (Société de transport de Montréal, Bus and Metro Stops) was available in both a shapefile and as a GTFS. Montréal's City-wide Land Use Plan (Urban Plan) has several secondary large area plans including borough documents and Special Urban Policy Programs, however only the latter was available on the portal.

Zoning, Major Development Applications and Active Planning Studies datasets were all not available on the open data portal. Zoning in Montréal is not harmonized, so selective boroughs (out of the 17) have their own zoning map(s) which can be viewed on an interactive map hosted by the City of Montréal. Active Planning Studies (Urban Projects) were also available on the City of Montréal's website, with boundaries of study areas and hyperlinks to more information. Small-area Plans were deemed "not applicable" in this study as there was no suitable policy or plan to fit the outlined description. All in all, there is an opportunity to release zoning and active planning studies to the open data portal for more access and information

City of Montréal					
#	**Land Development Dataset**	**Dataset Name**	**Available (Y/N)**	**Published Date**	**Formats Available**
1	Property Boundaries	Property Assessment Units	Y	10/2/2019	CSV, GeoJSON, SHP
2	3D Massing	Building 3D 2013	Y	9/24/2019	GML, 3DM
3	Heritage Locations	Protected sites and buildings under the Cultural Heritage Act	Y	9/14/19	GeoJSON, SHP
4	City-wide Land Use Plan	Urban Plan - Land Allocation	Y	10/18/2019	GeoJSON, SHP
5	Large-Area Plans	Urban plan - Special Urban Programs	Y	9/24/2019	GeoJSON, SHP
6	Small - Area Plans	Not Applicable	n/a	n/a	n/a
7	Zoning By-law - Categories	Not Available	N	n/a	n/a
8	Major Development Applications	Not Available	N	n/a	n/a
9	High Order Transit - Stops (Current)	Société de transport de Montréal, Bus and Metro Stops	Y	6/18/19	SHP
10	Active Planning Studies	Urban Projects	N	n/a	n/a

Table 3: City of Montréal land development data results.

D.3 City of Edmonton

D.3.1 Overview of Urban Growth in Edmonton

As the 5th largest population centre in Canada, the City of Edmonton is home to an estimated population of 972,223 in 2019 - a growth of 72,776 people since the last census in 2016 with an

annual average growth rate of 2.6% (City of Edmonton, 2019). Moreover, this population is fairly young, with over half of the population under the age of 40 years of age (City of Edmonton, 2019). However, Statistics Canada estimates a population of 1,447,142 for the year 2019, resulting in a growth of 8.15% from 2015 (Statistics Canada, 2020). Despite this significant population growth rate, density is fairly low compared to other large Canadian municipalities with 1,418 people per km^2 in 2019 (Statistics Canada, 2017d).

Lower density may be due to the numerous annexations Edmonton has endured since its incorporation in 1892 (City of Edmonton, 2017). On January 1st, 2019, Edmonton went through yet another annexation, adding another 8,260 hectares to the municipal boundary to accommodate future growth (City of Edmonton, n.d.). Furthermore, between 2006 and 2016, Edmonton has converted 1,000 hectares of agricultural land into urban areas (City of Edmonton, 2017). Agricultural zoned lands accounted for 43% of the land in 2006, which dropped to 25% in 2016 while "developed land increased from 57% to 69%, demonstrating the growing urbanization of the municipality (City of Edmonton, 2017). Consequently, there were 2,484 housing starts, 2,083 completions and 10,260 residential units under construction in quarter 4 of 2019 for the Edmonton CMA (Canada Mortgage and Housing Corporation, 2019).

D.3.2 Background on Open Data in Edmonton

Edmonton is known for its leadership in the open data movement in Canada, with numerous awards including "Canada's Most Open City" by Public Sector Digest for several years (City of Edmonton, n.d.). Edmonton's first open data catalogue was launched in 2010 which was

followed by the first Open City Initiative in 2014 (City of Edmonton, 2017a). The Open City Imitative is the City's "municipal perspective on the philosophy of open government" and was refreshed in 2017 (City of Edmonton, 2017a). This revision included goals and actions for Edmonton's Open City to become more transparent, participatory, collaborative, inclusive and innovative by 2040 (City of Edmonton, 2017). Additionally, Edmonton released its Open City Policy articulating the city's commitment to being honest and cooperative (City of Edmonton, 2015). To ensure this policy is followed, the City created an open data committee that meets monthly guiding the future of open data in the city (Public Sector Digest, 2019). Additionally, the Open Data Strategy released in 2017 is a measurable action plan to increase the accessibility and quality of government data (City of Edmonton, 2017b). Due to the highly involved and progressive work by the City of Edmonton staff, the city hosted the Canadian Open Data Summit in 2017 (City of Edmonton, 2017b).

D.3.3 Open Data Portal Observation

The Edmonton open data portal has the largest catalogue with 2486 datasets. The landing page directs the visitor to various options including a "101" on how to use the site, data catalogue and ability to suggest a new dataset. Like other open data portals studied in this research, the user has the ability to filter the datasets in numerous ways, by 38 categories, 12 view types, 8 departments and over 1300 tags. After filtering or searching for a dataset, the results page presents a preview for each relevant dataset, providing information on the number of views, tags and data type. Once a dataset is selected, an abundance of information and features is shared such as table

preview, data schema and related content. The portal also has several ways the user can visualize the data such as creating a customized map or chart/graph.

Edmonton's open data portal's greatest strength is the various visualization options, allowing users to preview and analyze the data before downloading. The importance of this feature allows planners and any other user to begin analysis without the use of third-party software. One visualization option is to create various charts or graphs using the information provided in the dataset's table, in which the user may filter and configure to their liking. Additionally, if the dataset has geospatial references, the user may create a map and use various symbology to display their information (such as a heat map). If the user has registered for the free open data portal account, they may save their visualizations and view it later. Another positive component is the "Related Content Using this Data" links located at the bottom of each dataset page. Through this option, users can connect to other datasets or pre-developed maps that use the data of interest.

One of the major weaknesses of the open data portal was a large number of datasets and poor tagging organization. For example, typing in "zoning" in the search resulted in 114 results, meanwhile using the "zoning" tag resulted in seven results. Among these seven datasets, five of them belong to the same source of data but were separated due to its data type (i.e. a filtered view or a chart). The desired dataset was labelled "City of Edmonton - Zoning Bylaw Map" but only had the tag "zones", so it did not populate when filtered with the tag "zoning". There is a

need for the City to review its tagging system and possible ways to show more interrelationships between datasets. All in all, finding the desired dataset typically took longer than other portals.

D.3.4 Development Application Requirements

The City of Edmonton has several approval bodies for various activities in the development review process, including City Council and Development Compliance Branch (City of Edmonton, n.d.c). Edmonton classifies the rezoning applications into three categories: Non-Complex Applications, Complex Applications and Very Complex Applications. Non-Complex Applications refer to proposals that are low-density in nature and have no change to the land use designation (City of Edmonton, 2019). Complex Applications are proposals that may have direct control zones or special area zones. Lastly, Very Complex Applications are proposals that have unique infrastructure needs and may significantly impact the neighbourhood. Complex and Very Complex Applications are highly suggested to have a pre-application meeting with the City staff (City of Edmonton, 2019). Depending on the application type mentioned above and its location (such as mature or core areas of Edmonton) various documents are required in addition to the Rezoning Application including, urban design brief, environmental site assessments and 3D models (City of Edmonton, n.d.e). A planning rationale or equivalent was not explicitly listed on the Rezoning Application Checklist, but it seems information regarding land use, context and conformity to the City's vision can be found in the required Urban Design Brief or other documents (City of Edmonton, 2019a).

The three sampled documents (two urban design briefs and one rezoning application report) were compared to analyze what planning data was used or lack thereof (Stantec Consulting, 2017; B&A Planning Group, 2018; Dialog, 2019). Each document displayed a zoning map and/or land use map, highlighting the site of interest and surrounding uses. Additionally, each document referred to existing uses surrounding the sites whether this was through photographs, text or creative maps. Connectivity and/or transit were also discussed in all three documents; some documents acknowledge public art, public space and the natural environment.

D.3.5 Land Development Data Availability

Edmonton had a total of four out of the 10 datasets that could be found on the open data portal. Though challenging to find, Zoning By-law and Major Development Applications (Development Permits) were located and had the ability to visualize before exportation. Edmonton's Light Rail Transit (LRT) stops/stations were also found to satisfy the High-order Transit dataset. However, this data was only available as CSV with coordinates that could be geocoded in a respective GIS software platform - this was a similar case for Heritage Locations (the Register and Inventory of Historic Resources in Edmonton). A notable mention is the Building Footprint dataset which would meet the 3D Massing dataset requirement if it had a height value.

Property Boundaries (Parcels) were unable to be located on the open data portal but were able to view on City of Edmonton's interactive map platform (City of Edmonton, n.d.f). The lack of open Property Boundaries may be due to the data ownership by Alberta Land Surveyors, which regulates boundary markers (The Alberta Land Surveyors' Association, n.d.). Furthermore, Land

use and area plans were not available on the open data platform, including City-Wide Land Use, Large-area Plans and Small-area Plans. It is stated on the City's website that there are nearly 180 plans in effect that impact land use development, which can be the root of the challenge in uploading such plans on the open data portal (City of Edmonton, n.d.d).

City of Edmonton					
#	**Dataset**	**Dataset Name**	**Available (Y/N)**	**Published Date**	**Formats Available**
1	Property Boundaries	Not Available	N		
2	3D Massing	Building Footprint (no 3D)	N	5/1/1118	CSV, JSON, Excel, GeoJSON, SHP, KML
3	Heritage Locations	The Register and Inventory of Historic Resources in Edmonton	Y	28/12/19	CSV, Excel, JSON?
4	City-wide Land Use Plan	Municipal Development Plan - Land Development Concept	N	n/a	n/a
5	Large-Area Plans	Area Structure Plans	N	n/a	n/a
6	Small - Area Plans	Neighbourhood Structure Plans	N	n/a	n/a
7	Zoning By-law - Categories	Zoning By-law 12800	Y	1/3/2020	CSV, JSON, Excel, GeoJSON, SHP, KML
8	Major Development Applications	Development Permits Map	Y	1/13/2020	CSV, JSON, Excel
9	High Order Transit - Stops (Current)	LRT Stations and Stops	Y	12/28/2019	CSV, JSON, Excel
10	Active Planning Studies	Planning Applications	N	n/a	n/a

Table 4: City of Edmonton land development data results.

D.3 City of Vancouver

D.4.1 Overview of Urban Growth in Vancouver

The City of Vancouver is the smallest census subdivision in this study, with an area of 114.97 km^2 and an estimated population of 685,885 in 2019 (Statistics Canada, 2017f; Government of British Columbia, 2020). Metro Vancouver (formerly known as Greater Vancouver Regional District), which includes 21 municipalities including the City of Vancouver, City of Richmond and District Vancouver, is home to an estimated 2,691,343 people - a 5.7% growth since 2015 (Statistics Canada, 2020). However, for the purpose of this study, only the City of Vancouver will be compared which has a population growth of 4.14% since 2015 (Government of British Columbia, 2020). Given its small geography, Vancouver is highly dense with 5,966 people per km^2 (Statistics Canada, 2017f).

In 2019, the Vancouver CMA had 5,723 housing starts, 6,562 completions and a whopping 46,065 residential units under construction (Canada Mortgage and Housing Corporation, 2019). Though these numbers include the development outside of the study area of the City of Vancouver, it can allude to the growing development activity occurring within and outside the core. In comparison to other Lower Mainland municipalities in British Columbia, the City of Vancouver ranked the lowest in a land-use regulation index by Fraser Institute, where the city was noted to have long approval timelines, strong community or council opposition and high-frequency of rezoning (Green & Filipowicz, 2017). The City is attempting to handle the high number of development applications through a program called “Applicant Supported and Assisted Process”, which expedited 800 housing programs in 2018 (City of Vancouver, 2019).

This will assist with the City's goal of creating opportunities for 72,000 new housing units by 2027 (City of Vancouver, 2018).

D.4.1 Background onOpen Data in Vancouver

The City of Vancouver first released its open data portal in 2009 but recently revamped the portal in summer 2019 including user accounts and open APIs (City of Vancouver, 2019). This came from recommendations outlined in the "City of Vancouver's Digital Strategy", arguing that open data has the opportunity to be more beneficial for the city by engaging stakeholders and establishing priority for ongoing release (City of Vancouver, 2013). This Digital Strategy is first of its kind in Canada and has been the pivoting factor for the City of Vancouver's award in Large Public Sector Transformation at the 2018 IT World Canada Digital Transformation Conference and Awards Ceremony (City of Vancouver, 2018). The City is also undertaking big changes to its mapping services through its Geospatial Roadmap Program to improve the quality and management of its data (City of Vancouver, n.d.). Through this program, the City revamped its VanMap where users can visualize some of the open data available and create maps using the Esri platform.

D.4.3 Open Data Portal Observations

The City of Vancouver's new open data portal's homepage invites the user to either start searching immediately, filter through a set of dataset themes or begin learning about the platform. Additionally, users are able to make an account and get email notifications for any updates to datasets they are "following". Once the user finds a selected dataset, numerous

features are available including the ability to view the data table, search within the dataset, view a map and in some cases analyze data by creating a graph. The platform also allows the user to generate API or export the data in numerous flat or geographic formats. Furthermore, there is also a “Chart Builder” and “Map Builder”, in which users can select their dataset, map or graph it and save it to view it later.

In comparison to all the other open data portals, the City of Vancouver’s platform had a very smooth integration, flow and organization, as datasets were easily and quickly found. Their dataset category theme “Property and Development” hosted four of the development data investigated in this research. Yet, it was the level of consistency between datasets that improved the experience, as nearly all datasets were available to be incorporated in the features they offer (chart builder, search records etc.). Additionally, the user account function was a delightful option, especially for returning users or those who need to keep track of data changes. Lastly, one of the benefits of the open data portal was the communication provided in the “Information Tab”. For example for Zoning Districts and Labels, the City provided currency, accuracy and direct links to the by-law text and website.

Compared to the other cities, Vancouver had the lowest quantity of datasets with 172 (which is not necessarily a limitation, but an observation). A minor constraint was the default search settings which would populate items in an order based on its latest modification, rather than its relevance to the word typed. However, since there isn’t much data to search through, after any filtration it was easy to find the data quickly.

D.4.4 Development Application Requirements

For the City of Vancouver, development approvals are regulated by their Zoning and Development By-law. If necessary, applicants must submit a rezoning application prior to their development application, in which they will receive a permit (however this is exclusive to building permits). Therefore rezoning applications hold more planning-related information including rationales. There are three types of rezoning: site-specific, plan changes and text changes. Site-specific zonings refer to applications that are interested in creating new zoning (a comprehensive development district zoning) that allow certain uses or forms for a specific site. Plan changes, on the other hand, are the means of changing one zoning district to another. Lastly, text changes refer to changing the regulations permitted in a zoning district (i.e. permitted uses, density) (City of Vancouver, n.d.). Typically, a rezoning application goes through a rezoning enquiry, which is to get pre-approval on drawings and proposals before submission. To make such an inquiry a "rezoning booklet" is required which includes site context, proposal details, applicable policies and guidelines, and Form of Development & Urban Design Analysis (the City of Vancouver, Application for Rezoning Advice, n.d.).

Three rezoning applications were compared which were found using the City of Vancouver's Rezoning Application webpage (Shape Architecture, 2019; Perkins & Will, 2019; GBL Architects, 2019). On this webpage, the City of Vancouver breaks up the rezoning booklet into subsections (i.e. site plan, landscape plan, shadow study) which allows for consistency across applications. However, the subsection "Rezoning Rationale" had varied contents between the three studied applications, as some went into more detail of policy and/or sustainability. Unlike

other municipalities, transportation was not heavily discussed but view cones to specific sites (such as Grouse Mountain) were analyzed or mentioned. Additionally, green building and/or sustainability measures were also a common theme between all applications.

D.4.5 Land Development Data Availability

The City of Vancouver differs from other municipalities as it does not currently have a City-wide Land Use Plan, but is in the process of making one that is expected to be implemented in the year 2022 (City of Vancouver, n.d.). With that being said, there were only nine land development datasets to be investigated, in which six were available on the open data portal. As mentioned four of these were easily found under the "Property and Development" theme which included Zoning By-law (Zoning By-law 3575 Districts and Labels), Heritage Sites, Property Boundaries (Property Parcel Polygons) and 3D Massing (Building Footprints 2009). The latter provided numerous height data including the building's highest and lowest elevation. High-order Transit (Rapid Transit Stations) was also found on the platform, which displayed Translink's SkyTrain stations (Canada, Expo and Millennium lines) in Vancouver. Active Planning Studies (City Projects Package) was available, though it was a point file rather than a polygon showing boundaries.

Large-Area Plans (Community Plans) were not available on the open data platform and coincidentally so weren't the Small-Area Plans (Sub-Area Policies). The geographic information required for this is locked in PDFs available on the City of Vancouver website. The City of Vancouver seems to have good public data on development and rezoning applications as they host this information on their website, but missed an opportunity by not hosting this information on their open data platform, allowing users to download and reuse this information.

City of Vancouver					
#	**Dataset**	**Dataset Name**	**Available (Y/N)**	**Published Date**	**Formats Available**
1	Property Boundaries	Property Parcel Polygons	Y	1/13/2020	CSV, JSON, GeoJSON, SHP, KML, DWG
2	3D Massing	Building Footprints 2009	Y	5/7/2019	CSV, JSON, GeoJSON, SHP, KML, DWG
3	Heritage Locations	Heritage Sites	Y	12/30/2019	CSV, JSON, GeoJSON, SHP, KML, DWG
4	City-wide Land Use Plan	Not Applicable	n/a	n/a	n/a
5	Large-Area Plans	Community Plans	N	n/a	n/a
6	Small - Area Plans	Sub-area Plans	N	n/a	n/a
7	Zoning By-law - Categories	Zoning By-law 3575 Districts and Labels	Y	9/16/2019	CSV, JSON, GeoJSON, SHP, KML, DWG
8	Major Development Applications	Not Available	N	n/a	n/a
9	High Order Transit - Stops (Current)	Rapid Transit Stations	Y	3/8/2019	CSV, JSON, GeoJSON, SHP, KML, DWG
10	Active Planning Studies	City Projects - Site	Y	4/29/2019	CSV, JSON, GeoJSON, SHP, KML, DWG

Table 5: City of Vancouver land development data results.

D.3 City of Ottawa

D.5.1 Urban Growth in Ottawa

As the nation's capital, Ottawa is home to an estimated 1,028,514 people, while the Ottawa-Gatineau CMA is estimated to have a population of 1,441,118 (Statistics Canada, 2020; Statistics Canada, 2020). However, in 2015, Ottawa had a population of 948,461 eluding to a growth of 8.44% or an average annual growth rate of 2.11% (Statistics Canada, 2020). Similarly, the Ottawa-Gatineau CMA faced a growth of 7.76% of its population of 1,337,305 in 2015 (Statistics Canada, 2020). What sets Ottawa apart from other large municipalities in this research, is the large geographical area of 2,790.30 km^2 (Statistics Canada, 2017). For context, this is larger than Toronto, Edmonton, Montréal and Vancouver combined. Therefore, population density is fairly low with approximately 368 people per km^2. Ottawa is home to the largest tech park and understandably federal employment nodes in Canada, attracting migrants to the city (City of Ottawa, 2016).

Despite the size of the municipality, Ottawa is considering expanding the urban boundary outlined in its Official Plan. By the end of March 2020, it is expected that the City's planning committee and its agriculture and rural affairs committee deliberate Ottawa's land budget in meeting the needs of the future population (Buckles, 2020). The Official Plan also set a goal of 38% of new units to be located in urban and/or suburban areas for years between 2012-2016, in which it exceeded with a rate of 51.4% (City of Ottawa, 2019). The City issued over 8,000 residential unit permits in 2018, the highest amount since amalgamation in 2001 (City of Ottawa, 2019). This urban growth is evident as the Ottawa CMA, had 2,525 housing starts, 1,740

completions and 9,851 under-construction residential units in CMHC 2019 Q4 (Canada Mortgage and Housing Corporation, 2019).

D.5.2 Background on Open Data in Ottawa

Ottawa launched its first open data catalogue in 2010 but has recently revised the portal in 2019 (Barrie, 2019). The City of Ottawa engaged in public consultation to understand how users are using the open data, in order to best serve them (Public Sector Digest, 2019). Additionally, the open data program is ingrained in the City of Ottawa's Smart City 2.0 Strategy (City of Ottawa, Smart City 2.0, 2017). This strategy has three main goals for the city including increasing connectivity, smart economy and innovative government (City of Ottawa, 2017). Another key publication is the City's Open Data License which establishes what users can do with open data and outlines their responsibilities (City of Ottawa, n.d.). The City has encouraged re-use, as they hosted an Apps4Ottawa competition in 2013, which rewarded users on their creative and innovative uses of open data (City of Ottawa, n.d.). With these efforts, the City of Ottawa came in third place of the public Sector Digest's Open Cities Index, a jump of seven spots from their previous ranking (Public Sector Digest, 2019).

D.5.3 Open Data Portal Observations

Similar to the other open data portals observed in this study, the City of Ottawa's open data portal greets the visitor with a search engine and dataset categories to begin filtering. The welcome page also showcases map applications done by the City such as "Construction Mapping" or "Floodplain Risk". However, users are also able to filter by content type, source,

tags or enter a time frame to see what dataset was updated in a given period. When a dataset is selected additional information such as accuracy, update frequency, and related data are shown. Additionally, the dataset is able to be visualized in a table or where the user can filter data and export what they need. Ottawa's Open Data Portal also features an "API Explorer" which helps web application developers tap into the City's resources.

The City of Ottawa's open data portal platform is powered by Esri, a popular and widely used GIS software organization, responsible for applications like ArcGIS. For those who use this software often, the open data portal had a familiar interface. The portal also allows you to log in to your Esri account and add data from their portal to create an Esri "Web map" or "Story Map". It is also evident that City uses Esri's services as they have pre-populated web maps and apps using datasets from the portal. Additionally, all geospatial datasets have an interactive keymap where users can quickly view the map before exporting it or even limit the need to. One key feature is that the portal is bilingual with the ability to view it in French. Moreover, the search engine was able to detect the inputted text and provide suggestions to datasets before hitting enter, increasing the speed in finding datasets.

One downfall of the portal was the lack of information in the overview section, which typically had one sentence describing the data. More description could offer more information to those who are not familiar with the data. Furthermore, if a user is not familiar with the Esri interface, they may not be aware of some of the functions. For example, the content type "Feature Layers"

are datasets that have a spatial reference (this can be a table with coordinates of a geographic feature), thus it is available to be exported for GIS use.

D.5.4 Development Application Requirements

Since Ottawa and Toronto are both located in Ontario, the general development process is quite similar in structure and flow. Nevertheless, Ottawa has six types of development applications: Official Plan Amendment, Major or Minor Zoning By-law Amendment, Site Plan Control, Plan of Subdivision Vacant Land and Common Element Condominiums and Municipal Concurrence and Public Consultation Process for Antenna Systems. However, nearly all applications must be accompanied by a planning rationale including Design Statement and Integrated Environmental Review Statement, as well as a survey plan, concept plan and public consultation strategy (City of Ottawa, 2020). The City of Ottawa has organized a planning rationale checklist that ought to be reviewed during the pre-consultation meeting with city staff. The checklist contains items such as heritage considerations, planning history, connections to the public transportation system and the local context (City of Ottawa, n.d.).

Three development applications were sampled from the City of Ottawa's Development Application Search tool/map, planning rationales were pulled for analysis (Holzman Consultants Inc, 2020; Richcraft Group of Companies, 2015; Novatech, 2019). A noticeable difference between these planning rationales compared to other municipalities is the lack of visual components or graphics (such as maps or 3D models), however, this may be due to a poor selection of applications. When images or maps were shown, it appeared as screenshots of

existing online maps such as Google Maps or Official Plan PDF maps. For example, each zoning map was screenshots of Ottawa's online interactive map, GeoOttawa. Moreover, the text follows a similar structure to the City of Toronto's planning rationales, by going through a hierarchical planning policy framework. Each application mentioned cultural or natural heritage at different magnitudes.

D.5.5 Land Development Data Availability

Out of the 10 datasets investigated, Ottawa's open data portal hosted four of these. The dataset for High-order Transit (O-Train), Ottawa's LRT stations were published, as well as the related data of the upcoming stations for the new expansion. Active Planning Studies (Community Design Plans) are also available along with their statuses (completed or in progress) as well as french versions in the dataset. Heritage Sites (Built Heritage) and Large-area Plans (Secondary Plans) were also available to download.

Property boundaries were not available to download, but this may be due to provincial constraints as, the Ontario Government (Ministry of Natural Resources), the Municipal Property Assessment Corporation (MPAC) and Teranet Enterprises Inc. came to an agreement to collect all of the parcels within the province into one database known as the Ontario Parcel Database (Teranet Enterprises Inc., n.d.). Therefore, municipalities wishing to "open" this data, must have to enter a special agreement/license to do so. Furthermore, Small-area Plans were deemed unavailable however there were a few of these boundaries within the Secondary Plan dataset. It was also not clear if these were the appropriate boundaries as names of these features did not

exactly match what was outlined in the Official Plan. The City of Ottawa, hosts a few of the missed land development data online, through their website applications or other mapping services. For example, Zoning (Zoning By-law 2008-250), was available to view on their GeoOttawa mapping platform but was unavailable on their portal. This web map also has a set of layers with one grouping titled “Planning” which hosts numerous relevant data (that is not available on the open data portal) such as, Official Plan Urban Boundary and Public Realm Plans. Furthermore, Development Applications can be searched on a Service Ottawa website, but this listing is not available on the portal. 3D Massing was not available, but the building footprints were available for export.

City of Ottawa					
#	**Dataset**	**Dataset Name**	**Available (Y/N)**	**Published Date**	**Formats Available**
1	Property Boundaries	Parcels	N	n/a	n/a
2	3D Massing	Building Footprint	N	n/a	n/a
3	Heritage Locations	Built Heritage	Y	3/29/2019	CSV, SHP, KML
4	Land Use	Schedule A – Rural Policy Plan & B – Urban Policy Plan	N	n/a	n/a
5	Large-Area Plans	Secondary Plan	Y	10/29/2019	CSV, SHP, KML
6	Small - Area Plans	Site Specific Policies	N	n/a	n/a
7	Zoning By-law - Categories	Zoning By-law 2008-250	N	n/a	n/a
8	Major Development Applications	Development Applications	N	n/a	n/a
9	High Order Transit - Stops (Current)	O-train stations	Y	8/16/2019	CSV, SHP, KML
10	Active Planning Studies	Community Design Plan Boundaries	Y	9/3/2019	CSV, SHP, KML

Table 6: City of Ottawa land development data results.

E. Discussion

E.1 Results

The City of Toronto had the highest amount of available land development data with a score of 80%, followed by the City of Montréal and the City of Vancouver at 66%, then the City of Edmonton and City of Ottawa at 40% (findings can be found in Table 7). There are a few possible justifications or underlying reasonings that influenced these results. For one, the final results also coincide with the urban centre population counts for 2016 form largest to smallest (Statistics Canada, 2017). Therefore there may be a strong link between the population rate and land development data, which can include higher demand or more economic flow to support their open data platforms. Another evident rationale may be due to the selection of the datasets, which may be heavily influenced by the City of Toronto's framework. However, Ottawa, which is under a similar planning framework to Toronto ranked one of the lowest. It was unexpected for the City of Edmonton, to have such a low result as it hosted the highest number of datasets and is known for its open data initiatives. It may be a question about quality versus quantity, ensuring the data that is shared is what users need. It was also anticipated for Montréal to have a lower amount of datasets, primarily due to the language barrier and locating the datasets appropriately.

Development Dataset	**City of Toronto**	**City of Montreal**	**City of Edmonton**	**City of Vancouver**	**City of Ottawa**	**Total # of Municipalities**
Property Boundaries	Y	Y	N	Y	N	**3**
3D Massing	Y	Y	N	Y	N	**3**
Heritage Locations	Y	Y	Y	Y	Y	**5**
Land Use	N	Y	N	N/A	N	**1**
Large-Area Plans	Y	Y	N	N	Y	**3**
Small - Area Plans	Y	N/A	N	N	N	**1**
Zoning By-law - Categories	Y	N	Y	Y	N	**3**
Major Development Applications	Y	N	Y	N	N	**2**
High Order Transit - Stops (Current)	Y	Y	Y	Y	Y	**5**
Active Planning Studies	N	N	N	Y	Y	**2**
Total # of Available Land Development Datasets	**80%**	**66.70%**	**40%**	**66.70%**	**40%**	

Table 7: Land development dataset results

Municipality	Key Features	Limitations
City of Toronto	- Data Quality Score - "Knowledge Centre" - City Planning Department filter	- Inconsistent features between datasets - Minimal communication on data schema
City of Montréal	- "Activity Flow" for each dataset - Comment section	- Unclear dataset themes - Lack of data preview features - Only available in French
City of Edmonton	- Numerous data visualization tools - User account services - Related data linkages	- Very large number of datasets to search within - Poor tagging/filtering system
City of Vancouver	- Consistent features and information between datasets - User account services - Clear category of "Property and Development"	- Default search result settings based on modification rather than relation to the searched word
City of Ottawa	- Smart integration to Esri services - Available in French and English - Quick data suggestions	- Lack of dataset information - Limited flexibility due to Esri platform

Table 8: Summary of open data observations.

Heritage Sites and High-order Transit datasets were most commonly found, as every city had this information available on their open data portal. It was common for cities to have a register or a system that tracked heritage locations, that was easily converted to a point file or a CSV. Every city had some sort of High-order Transit whether it was a LRT and/or subway system, which was also shared as a point shapefile. This may imply that point files, that is simply the location of a specific site is more likely to be open. On the other hand, Montréal was the only city (omitting Vancouver) that uploaded the City-wide Land Use on their open data portal, making this one of the most scarcest datasets. Small-area Plans were also rare, as the City of Toronto was the only municipality to publish this. Yet, Large-area Plans were found in three open data portals.

Therefore it seems plans that are city-wide and typically with various classifications or plans that are for site-specific areas tend to be not open datasets for public use.

E.2 Research Limitations:

There are several limitations in the research which may influence the results. Comparing municipalities' available land development data on a standard set does not embrace the complexities and differences in each city's planning framework. Each city has its own planning and development system and therefore may have its own list of "land development data". However, for comparison, this was the natural point that connected cities together, in hopes to get a glimpse of land development data availability across Canada. The benefits of the cross Canada evaluation is to compare and contrast how large municipalities are handling land development data, and to identify ways they can learn from one another. Furthermore, planning is provincially mandated and therefore the province needs to be at the forefront in delivering open land development data. For example, the availability of property boundaries are inherently due to the data ownership standards put forth by the provincial government. The capacity of the municipality's ability in providing land development data is heavily dependent on the province's leadership in the open data movement and smart city initiatives. However there is a general misconception that municipalities and governments ought to provide open data portals, as this has been the norm. Yet the ability and capacity to do so is also influenced by other factors including technical and political issues (Janssen,Charalabidis & Zuiderwijk, 2012). "Opening" data is beyond just publishing data on the portal and requires thoughtful consideration of all the barriers involved. Additionally, this research is based on one person's evaluation of information

and the planning framework, which is considerably stronger for the City of Toronto. Next research should collaborate with planners in each municipality that has strong knowledge of open data and development application systems in their city. Furthermore, each dataset was measured equally in weight, though some may have less of an impact than others (for example, active planning studies may be less of an importance than Zoning by-law). Lastly, the data was researched for a single point in time, which does not account for any possible changes/updates since then. However this limitation is the same one that presents itself in all benchmark research. These limitations aside, the findings presented here still shed important light on next steps needed.

F. Conclusion

The Canadian Institute of Planners' *Codes of Professional Conduct* (2016) has established one of the responsibilities of a planner is to provide "full, clear and accurate information on planning matters to decision-makers and members of the public". Meeting this responsibility is presumingly more feasible due to technological advancements and access to information. Open data platforms, therefore have been argued to have the potential to encourage "smarter" decisions on urban development (Landry, 2019). Yet this research has demonstrated the lack of integration of open data and urban planning, revealing the shortage of open land development data across large municipalities in Canada. Municipalities are struggling to establish the role of open data in land use planning, and exploring the benefits from doing so (i.e. better development application quality). On the other hand, municipalities are ambitious in progressing other technical initiatives

such as big data and API. Municipalities are encouraged to use their existing open data programming/platforms to its full potential in forming a better synergy between open data and urban planning. Furthermore, the provincial government bodies will have to take leadership in exemplifying this relationship as they regulate land use planning in cities. Provincial bodies not only need to practice opening land development data, but also effectively encourage the local urban development community (e.g. public bodies, private sector, non-profit organizations citizens) to be fully engaged and educated in open data. Only then, the full potential of open data can be unlocked, resulting in the knowledge sharing and effective data-driven problem-solving needed to address the challenges of modern urban development" (Landry, 2019).

G. Recommendations

Discovering open data's true alliance within the urban planning system, requires action from all parties in the urban development community. This study should be treated as a kickstart to begin a conversation on how the urban development community can generate and open land development data. The identified limitations and challenges in this paper suggest new leadership and collaboration is needed to take this research further.

G.1 Municipal Planning Departments

<u>Department Collaborations and Communication (internally and externally)</u>

Urban planning has always been complex as it requires various, and at times contradictory, considerations of multiple departments. Within municipal governmental bodies, each department typically produces data solely, with little consideration on how other departments may use it.

However this issue is also apparent within planning departments themselves, as separate divisions generate and release data inconsistently among their associates. Therefore there is a need to create consistency and fluidity among municipal staff on how land development data should be treated and released. By clearly communicating a mandate, land development data could be more uniform and staff can be held accountable for its quality and release on the open data platform.

Conduct a City-based Land Development Data Inventory Check

Every city is noticeably unique and distinct in its development review process. Therefore there is an opportunity to progress this current study into an in-depth, locally sensitive analysis of the availability of land development data. Development review staff should identify what land development data means to their respective city, which may derive from the expectations of a good quality development application. If pursued, there may be value in a weighting metric, indicating which datasets are significantly important versus those that are more supplementary. It is suggested that the proposed inventory check incorporate datasets beyond geospatial data, which may require collaboration with the information and technology, engineering and/or open data departments.

Conduct a Land Development Data Survey from the Urban Development Community

Architects, engineers, planners, real estate agents, developers, construction companies and many more professionals are involved in the development review process, even before it gets to the city staff. Urban planners should connect with their local urban development community to get

feedback on ways they can improve their development review process and track the datasets they often use or have trouble getting access to. The KPMG (2019), *End-to-End Review of the Development Review Process,* for the City of Toronto, is definitely unique and demonstrates an efficient exemplar for other cities. Yet, there is an opportunity to dig deeper to get the first-hand experience in navigating the open data portal and getting access to land development data. The benefit of this research is to thoroughly understand the demand for land development data, as well as the users ability in interpreting the data.

G.2 Open Data Teams and Advocates

Improve the Open Data Portal Flow and Features

Though this was not the primary focus of the research, the user experience and interface (UX/UI) of open data portals greatly impacted the difficulty in retrieving and analyzing data. The municipal open data departments are encouraged to advance their platforms ensuring users find what they are looking for quickly and efficiently. Features such as data visualizations (chart and/or map), data schemas, account management and effective dataset categorization are just a few ways that enhance the ease of research. However one of the most essential components in progressing open data portals is continuous user communication and feedback. Open data portals that were simple but yet powerful (i.e City of Vancouver) helped research run much smoother and effectively.

Clearly Communicate What Information is Public and/or Open

Nearly in all cases in this research, if the dataset was not on the open data portal, it was publically available on the respective city's website in some form. Therefore it was rarely a case that the city did not have this information, it was more of the matter that it was not in the portal. However, it was not clear on why this was the case. Municipal governments are pressured to continue providing open data for free, despite the various indirect and direct costs required to process them. With the support of municipal planning departments, open data teams need to be transparent on the challenges and limitations in releasing certain datasets, especially to the urban development community.

Explore the Possibility of User Charges

For open data to play its revolutionary role, as outlined in various municipalities' smart city strategies, more manpower and technical upgrades are required. Yet, open data is intended to be a free service to ensure everyone has access. How do municipalities plan on financially supporting the growth and development of open data? Several open data advocates have explored the possibility of user charge or specific fees for certain groups (Williams, 2017; Nicklin, 2017). Further research is required on this possibility and other ways of funding open data initiatives. Such research would consider a user charge that would be sensitive to various open data users (e.g. citizens, private companies etc), have the capacity to recover processing expenditures and be reflective of the quality of the dataset itself.

Support Innovative Urban Development Software Companies

Numerous software developers are tapping into open data portals to produce creative and inventive applications. For example, there are numerous transit apps that use open GTFS data to give customers real-time locations of public transit vehicles. However, there is also a growth in proptech companies that can benefit from more open relevant data. In other words, there may be other ways that the development community (including municipal staff) can access the open data outside of the portal, but it requires the support of the municipality. Recently, the City of Toronto's city planning department announced their six-month pilot exploring Ratio.City's[2] urban analytics and mapping software, which uses a large amount of open data (CityPlanTO, 2020). Such collaborations can be a learning opportunity for municipalities as it exposes new ways of thinking and creative solutions to our urban development challenges.

G.3 Provincial Municipal Ministries

Educate Planners on Open Data

As technology becomes more integrated in urban development, planners of all sectors require a comprehensive knowledge on open data and its properties. If planners know more about open data and its portals, there can be more conducive conversations on progression and improvements. Furthermore, with this knowledge planners can become more aware of data properties and quality and therefore use it in a more accurate and appropriate manner. Provincial bodies typically operate registered professional planners (RPP) certification, and have the opportunity to train upcoming planners on open data and its capabilities. Furthermore, accredited

[2] In the spirit of transparency, this research emerged from the author's experience as an intern at Ratio.City in the summer of 2019. As a current employee of this company, the author recognizes that there are ongoing challenges that need to be explored and examined.

schools in which future RPP must attend can incorporate open data lessons in class. For example, Ryerson University's School of Urban and Regional Planning brings in Richard Pietro to host his "Open Data Iron Chef" workshop to teach aspiring planners about the power of open data (Re: Open Gov, n.d.).

Encourage and Support Municipal Open Data Initiatives

As the leader in land use planning, provincial bodies need to acknowledge their role in the lack of land development data at the municipal level. For example, it may be the shortage of land development data is due to the lack of provincial funding. Another possibility is that there is no clear mandatory standard on how municipalities share land development data. Nevertheless, provincial bodies have strong influence on the advancement of open land development data - their support and reinforcement can push municipalities to the next level.

Technology and data-driven decisions are becoming more apparent in how we adapt and plan for better urban living conditions for all. However, implementing smart city initiatives across Canadian large urban centres will take numerous years to come. Municipal open data, which is already implemented across many municipalities, serve as a potential source of information that can respond to urban issues. These findings may interest planners as it serves as a current state analysis of how well land development data is being distributed, as well as the possible restrictions on making data-driven decisions for urban development.

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