Smart Cities Should Look ‘Smart’: Innovating Policy Towards More Liveable Telecommunications Infrastructure

by

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Abstract

This Major Paper presents research on the physical execution of the Smart City, ICT infrastructure implementation and the role of urban design policy, using the City of Toronto as a case study. The research is focused primarily on telecommunications infrastructure in the City of Toronto. My research concerns the question of whether ICT infrastructure will negatively affect the urban design of cities.

A qualitative methodology approach is applied in this research, including a literature review, policy review, site observations and semi-structured interviews with professionals in the fields of urban design, urban planning, infrastructure planning and city planning.

This Paper presents a scholarly evolution of the Smart City paradigm, defining the physical components of the Smart City in the urban context. This is followed by a policy review of the specific urban design policies which guide ICT infrastructure in the City of Toronto. The bulk of this paper consists of a case study and research findings from site observations and semi-structured interviews. Three themes from the policy review are presented, which guide the interpretation and analysis of field observations. A major finding is that, although there is consensus on the importance of urban design standards in policymaking for Smart City infrastructure, the City of Toronto has not sufficiently considered the urban design implications of ICT infrastructure.

Keywords: Smart City, ICT infrastructure, Telecommunications, urban design, urban planning, Toronto

Foreword

Relation of Major Paper to Plan of Study

This paper is a part of my Plan of Study (POS) for completing the Master in Environmental Studies program. My Area of Concentration is related to the role of land use planning and urban design in the execution of infrastructure projects which transform, orient, and develop the physical form of a city.

This paper aligns with all components of my POS and helps me fulfill a number of Learning Objectives, which are as follows:

1.Land Use Planning

Learning Objective 1.1: To obtain the knowledge, skills, and competencies necessary to meet the program requirements of the Canadian Institute of Planners and the Ontario Professional Planners Institute for candidate membership.

2.Urban Design

Learning Objective 2.2: To develop an understanding of urban design theory and process, in order to support my studies as a graduate planning student, and my planning career.

3.Infrastructure Planning

Learning Objective 3.2: To obtain knowledge of the public and private sector role in infrastructure planning, and to understand the politics of infrastructure provisioning, including the interests of the corporate organizations and the public.

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Chapter 1: Introduction

The physical infrastructure of Information and Communications Technologies (ICT) should be considered an issue of urban design. The emergence of the Smart City paradigm symbolizes a "new kind of technology-led urban utopia" (Hollands, 2015.p. 62). Technology is to be used to improve the overall experience of urban life. Once installed, ICT infrastructure is likely to remain in place for decades, however, which may affect the arrangement and appearance of communities. Examples include the clustering of above-ground equipment, like 'green' telecommunications 'boxes', or below grade structures, such as 'Grade Level Boxes', easily seen within the public realm from the road, or home, and affecting the 'curb appeal.' In other words, it is ugly. The lack of design concept, the consideration of orientation, materials, and usage of space can affect the arrangement and appearance of communities. The embedding of technology into the city fabric is at the core of the Smart City discourse, but there remains a lack of research focused on the physical impacts of Smart City execution on the urban environment. The City of Toronto has not sufficiently considered the urban design implications of ICT infrastructure

This Major Paper address this gap and investigates the spatial implications of the application of ICT infrastructure, focusing primarily on wired telecommunications infrastructure in the City of Toronto. Throughout my research, I will demonstrate that, although keen on becoming a Smart City, the City of Toronto has not sufficiently considered the urban design implications of ICT infrastructure.

This chapter begins by presenting the core research questions and methodology. This is then followed by establishing the current context. Chapter 2 presents a scholarly evolution of the Smart City paradigm, defining the physical components of the Smart City in the urban context. Chapter 3 describes the evolution of the Smart City paradigm in the City of Toronto, followed by

a policy review of specific urban design policies and guidelines which guide ICT infrastructure. The chapter then presents a case study of urban design field observations in the City of Toronto and shares the research findings. Chapter 4 presents perspectives on urban design for ICT infrastructure in the City of Toronto. Chapter 5 concludes the Major Paper with suggestions for further research directions.

It should be noted that for the purpose of this paper, the term Information Communications Technology (ICT) is generally understood to mean infrastructure providing the transportation of data and information, and has come to be used to refer to the core networked infrastructures applied to Smart Cities. In the literature, ICT tends to be used to refer to telecommunications networks, including broadband cables, fibre cables, and also sensors. In the field of urban planning, various terms for ICT can be found, but predominantly the terminology of 'utilities' is used as found in Government documents. Throughout this paper, I use the terms 'ICT', 'telecommunications', and 'utility' interchangeably.

Additionally, the focus of this paper is wired telecommunications, as although telecommunications are exclusively a Federal jurisdiction enforced by the *Telecommunications Act*, the actual administration of the wired physical plant is accomplished at the Municipal level (FONTUR, 2017).

Telecommunication Towers and Antennas are not addressed in this paper. Telecommunication Towers and Antennas are governed by Federal Legislation under the Federal Radiocommunication Act (Toronto, n.d. a). Unlike wired telecommunications, they are administered by Industry Canada. Provincial legislation such as the Planning Act, including zoning by-laws, does not apply to these facilities (Toronto, n.d. a). The approval of the location of new telecommunication towers is the responsibility of Industry Canada, and under some circumstances, Industry Canada can request the City of Toronto to comment on the proposal (Toronto, n.d. a). In the case of a dispute, a final decision is made by Industry Canada (Toronto, n.d. a).

A. Research Questions and Methodology

i. Research Questions

My core research questions are; Is there a consensus on the importance of urban design standards in policymaking for Smart City infrastructure? Is the placement of ICT infrastructure subject to urban design standards in Toronto? Is ICT infrastructure in Toronto subject to urban design standards, and are those standards being implemented?

My research will also seek to respond to the following questions;

- Does ICT implementation take urban design issues into account?
- Is Canadian telecommunications design only utilitarian (designed to be useful or practical rather than attractive)? What is the current policy concerning ICT placement?
- Is the consideration of ‘aesthetics' during equipment design and placement a worthwhile endeavour?
- How are the current guidelines being used?

ii. Methodology

A qualitative methodology approach is applied in this research, including a literature review, policy review, site observations and semi-structured interviews with professionals in the fields of urban design, urban planning, infrastructure planning, and city planning.

Six semi-structured interviews were conducted, approximately one hour in length, and were held over a month-long period, starting from June and ending in early July 2019. The semi-structured interviews were held with professionals in both the public and private sectors. Two participants are current employees of the City of Toronto, employed as both architect - urban designers and urban planners; one participant recently stepped away from the City of Toronto; two others are senior managers for two telecommunications companies, and the remaining, a senior manager of a private construction firm working in infrastructure planning. The purpose of the interviews was to understand whether there is a consensus on the importance of urban design standards in policymaking for Smart City infrastructure in Toronto.

A review of sources used by planners and policymakers was done to frame the case study, including the following City of Toronto Urban Design Documents: City of Toronto Official Plan, Complete Streets Guide, Vibrant Streets Guidelines, Streetscape Manual, Universal Equipment Placement Guidelines, Utility Cut Permit Applications, and Municipal Consent Requirements. I extracted from the documents, reviewed the guidelines pertinent to ICT, and compiled this information in an excel format. I used this consolidated urban design information during my field visit as a rubric for critical evaluation of whether the guidelines are reflective in physical form.

For the case study, I identified five sites in the City of Toronto with ICT builds. There are three primary telecommunications companies in Canada (Bell, Rogers, Telus), and several secondary providers (Zayo, Beanfield, Cogeco). Five sites with ICT builds by five different companies were chosen using T.OINview, an interactive map of planned infrastructure

construction, available publicly through the City of Toronto website. Considering five of these companies provided me with a representative cross-section to planning and designing ICT. The five sites were listed as active infrastructure projects, all installing new cable infrastructure.

T.OINview provides information regarding the type of build, the company and or vendor conducting the build, location of build and dates. The aim of the case study was to answer the question; are design standards being implemented specifically in the placement of ICT infrastructure in Toronto? Field observations were conducted throughout June 2019.

B. The Race to Become a Smart City: Has it Considered Urban Design for its New Shiny Technology?

The Smart City concept has grown in popularity in recent years, infiltrating debates and visions for future city development. With the majority of the world's population now living in urban areas, this concept has gained vast popularity with its inherently positive promises to solve the many problems cities are now experiencing (Coletta et al. 2018). Recently there has been an extensive amount of literature published concerning the outcomes and benefits of smart cities, as well as the deployment of specific Smart City technologies, but few researchers have addressed the Smart City from as an urban design problem (Hollands,2008: Soderstrom et al.,2014: Townsend,2013).

The race continues and the recently proposed project, Sidewalk Labs Toronto, the sibling company to Google, is an example. The digitally wired neighbourhood project has presented relatively positive and exciting ideas to the public in terms of 'innovative technologies,' but the plans have been mostly secretive, with little space for public comments, garnering criticism from the public regarding privacy and algorithmic bias (Saxe, 2019; Schwab,2019). Although this example is not addressed in the Major Paper, it provides an example of the scale of organizations involved in pursuing the building of the Smart City.

Additionally, the 2006 ruling by the Canadian Radio-television and Telecommunications Commission (CRTC) regarding broadband 'high-speed internet' to be a basic telecommunications service for all Canadians, presents potential pressure applied to Municipalities to have this infrastructure available (Saltzman,2016). What are the costs and potential disruptions associated with the implementation of this ICT infrastructure City?

In their book *Telecommunications and the City* (2002), Graham and Marvin highlight the opportunity for further work in the area of telecommunications and the city, citing a lack of

analysis concerning the relationship between cities and telecommunications in the field of urban planning and urban studies. They suggest that new technologies are "unproblematically technical-fix-style solutions for the perceived social and environmental inadequacies of the industrial city" (p.7).

Does the race to become a Smart City suggest the existence of a ‘dumb city’? (Coletta et al. 2018). A recent *New York Times* opinion piece by Dr. Saxe of the University of Toronto shared her perspective on the Smart City. She stated that “There will always be a place for new technology in our urban infrastructure, but we may find that often, “dumb” cities will do better than smart ones…rather than chasing the newest shiny smart-city technology, we should redirect some of that energy toward building excellent dumb cities – cities planned and built with best-in-class, durable approaches to infrastructure and the public realm” (Saxe, 2019).

This leads to my interest and question of whether discourses on urban design can inform and benefit this digital augmentation of space, and has led me to a more critical open question on whether the role of urban design in the implementation of ICT infrastructure is required.

My research is interested in further investigating this lack of analysis, particularly by understanding the relationship between cities and telecommunications and by understanding whether the urban design guidelines and policy used to guide ICT infrastructure are effective. Access to the benefits of a Smart City begins with infrastructure, but as “city fabric changes slowly yet technology changes rapidly,” there is a worrying lack of thought about adaptation in this desire to install the consumer tech layer as if it were core building services” (Kitchin, 2014, p.10). But do the physical components of a Smart City necessarily guarantee a city of being ‘smart’ or just ugly?

Chapter 2: Urban Design and the Smart City

The chapter begins by describing the scholarly evolution of the Smart City paradigm and assigning a definition to the term. This is followed by defining the physical components of the Smart City in the urban context, framing the opportunities and limitations of the physical Smart City from both a critical and urban design perspective.

A. Understanding the Smart City

As global population trends are shifting from rural to urban areas, cities are experiencing a transition in population increases and are seeking optimal solutions for sustainable development, energy, environment, safety and public services (Arroub et al. 2008; United Nations. 2018). According to the United Nations *2018 Revision of World Urbanization Prospects,* over half of the world's population lives in urban areas, and this is expected to increase by 2050 (United Nations. 2018). With the majority of the world's population residing in urban areas for the first time in human history coupled with changes in urban development, demographic pressures, a warming climate and unstable economics, many cities are exploring future modes of planning and problem solving focused on the city (Shelton et al. 2014; Arroub et al. 2008).

The Smart City paradigm has gained popularity over the last decade, becoming a leading future city model encompassing multiple urban strategies around ICT and new infrastructures to mitigate the problems generated by rapid urbanization (Chourabi, 2012; March, 2016). Discussions regarding the Smart City concept have also dominated research in recent years, in

a scholarly effort to understand what this 'ambiguous' term really means, ideologically reveals, and also what it hides (Harrison, 2010; Hollands, 2008). As Hollands puts;

> Ideas about future urban development are closely entwined with discussions about the dramatic impact ICTs will continue to have on our lives in the 21st century, and nowhere is this more evident than in the idea of the smart city (2015)

The concept of the Smart City was in part born from dialogues among scholars and practitioners on the future of cities from concepts such as the innovation city, digital city, networked city, informational city and creative city (Firmino, 2014; Hollands, 2008; Kitchin, 2014; March, 2016). The concept is now offered up by large technology corporations, such as IBM, one of the major corporate players promoting the vision of the future city as a Smart City (Shelton et al. 2014).

As Batty (2012) states, the Smart City is a "fusion of ideas about how information and communications technologies might improve the functioning of cities" (p.483). The prescriptions set forth by the Smart City paradigm lean on technology, connectivity, and sustainability as the central components (Shelton et al,2014). In essence, the Smart City aims to use the massive amounts of collected data, or 'big data', about society as a means to rationalize the planning and management of cities, with the intent of offering its citizens the highest possible quality of life (Kummita & Crutzen,2017; Townsend,2013; Shelton et al. 2014; McNeill, 2015).

B. Planning the Physical Smart City

The embedding of technology into the city fabric is at the foundation of the Smart City. Smart cities by definition appear to be wired cities, or "highway system of the twenty-first century," and as such many towns and cities across North America are increasingly wedded to the idea that they have to be connected in order to be competitive in the new global economy (Holland, 2008). Emerging as a solution;

> Smart City restructuring has emerged as a significant source of hope for urban futures. It promises a new era of optimized 'smart' infrastructure management that connects the supplies and demands of people, organizations and objects in new and exciting ways. The Smart City formulation is integral to enhancing economic competitiveness, quality of life and a dynamic image – a key urban imaginary for the emergent 21st-century city (as cited in March, 2016, p.1696)

The planning of the Smart City often is led by private global firms and companies such as IBM, Siemens and Cisco, who all play a major role as the technology enablers and influencers, with corporate-led interests and 'techno-utopian' expectations of ICT infrastructure (Graham & Marvin, 2002; Soderstrom, 2014). Indeed, there has been a serious critique of the entangling of neoliberal ideologies with technocratic governance, and "the dystopian potential for mass surveillance has critically influenced academic dialogue on the self-congratulatory nature of the smart city" (Hollands, 2008, p.305).

Kitchin states that the role and strategies which IT corporations have adopted "mirrors that of US car manufacturers in the mid-twentieth century in creating a form of technology-led urbanism centred on car transportation" (2013, p. 10). As such, this technology-led urbanism

centred on car transportation saw public transport networks closed and replaced by vast road-building which consequently then shaped patterns of urban development (Kitchin, 2013). Kitchin's article, *The real-time city? Big data and smart urbanism* asks, "what the smart city equivalents might be of Robert Moses' tangled, congested and polluted freeways or the failures of the Pruitt Igoe housing complex?" (2014, p. 10).

Cities are complex and highly organized systems, and "a collection of elements that act independently of one another but manage to act in concert." Their state of balance is susceptible and subject to continuous changes, as well as dependent on how we intervene in their organization through different forms of planning (Mora, Bolici, & Deakin, 2017). As the "city fabric changes slowly yet technology changes rapidly," this exposes a juxtapose in regards to the thought and adaptation of the "installation of the consumer tech layer as if it were a service" (Kitchin, 2014, p.10).

Similar to water and sewage infrastructure, ICT infrastructure is not ephemeral, and should be understood as "basic physical structures and facilities needed for the operation of a society" in the 21st century. Indeed, the development and implementation of ICT at the core of the Smart City operation is its physical network (Hoon Lee et al. 2012; Batty, 2012; Hanniman & Young 2015, p.17). According to Chourabi et al. (2012), "the new intelligence of cities, then, resides in the increasingly effective combination of digital telecommunication networks, the nerves, ubiquitously embedded intelligence, the brains, sensors and tags, the sensory organs, and software, the knowledge and cognitive competence" (p.2290).

In their book *Telecommunications and the City* (2002), Graham and Marvin highlight the opportunity for further work in the relationship between cities and telecommunications in the fields of urban planning and urban studies, stating that there is a lack of analysis. Their seminal work put forth the notion that new technologies are "unproblematically technical-fix-style solutions for the perceived social and environmental inadequacies of the industrial city" (Graham & Marvin, 2002). Their work also suggests that 'smart cities' and 'innovative

technologies' provide "simplistic and utopian approaches," which are often directly fueled by "interests in computing and telecommunications industries, keen to foster positive public images to new technologies as a stimulus to growth markets" (Graham & Marvin, 2002, p. 7). There are risks that "the city increasingly expresses the desires, images and values determined by the private sector instead of public values" (Hollands, 2015; Vanolo, 2014).

McNeil's work *Global firms and smart technologies: IBM and the reduction of cities* presents a compelling case, arguing that the spread of Smart City technologies, policies and practices are strategically led by a small powerful group of firms, constructing a market by "reducing and simplifying urban problems for solution through the sale of proprietary software packages, consultancy services and hardware to their clients in city governments" (McNeil, 2015, p. 562). Further critical scholarship has emerged regarding the promises and delivery of the Smart City, and as Kitchin states, "'Smart City vendors have tactically started to alter the discursive emphasis of some of their initiatives from being top-down managerially focused to stressing inclusivity and citizen empowerment" (as cited in McNeil, 2015, p. 562).

Cities are becoming more wedded to the notion that they must become connected to become 'smart', yet becoming 'smart' to remain competitive in the new global economy is widely argued in the literature to contribute to the domination of neo-liberal urban spaces, greatly influencing the discourse on the future city (Grossi,2017; Hollands,2008; Shelton et al, 2014; McNeil,2015) The "characterization of these changes through the use of the term 'Smart' Cities can create certain assumptions about this transformation, suggesting that the embedding of digital technologies in urban infrastructure is a "positive and a rather uncritical stance towards urban development" (Hollands, 2008).

This 'digital revolution' has most cities using the Smart City paradigm as a project with an aim to retrofit the existing urban socio-technical fabric by way of adding a new layer of technology or digital skin to the built environment, and as such, this convergence of information and communication technologies is producing urban environments that are different from

anything that we have experienced in the past (Batty,2012; March, 2016 p.1696). As Hollands suggests, ICT infrastructure such as telecommunications infrastructure can influence the physical orientation of space and be visually prominent, especially if not well located. The reconstruction of cities is required to physically lay down the cable, the implementation which itself is not necessarily smart, and therefore may influence the physical arrangement and appearance of communities (Hollands,2008).

The construction of 'greenfield' smart cities is a rare exception; therefore the Smart City is often assembled in a fractured way, "integrated awkwardly into existing configurations of urban governance and the built environment" (Shelton et al, 2014, p.15). As mentioned, the practice of ICT implementation is mainly driven by the private technology industry, and as Aurigi suggests, too often tends to overlook "place-making issues and tensions to emphasize the technological innovation and some social advantages of ICT initiatives" (Aurigi, 2012).

This approach of the digital intervention by just 'adding' something to the 'urban space' and relying on the fact that giving 'more' to the city must be a good thing, suggests isolation from spatial design knowledge and practice (Aurigi, 2013).

Applying a landscape design lens, Nijhuis and Jauslin further claim that there is a tendency to engineer infrastructures for single purposes, and suggests that these single-purpose infrastructures often result in "disrupted landscapes, defaced retrofitted constructions and buildings, and erasure of cultural and natural values" (Nijhuis & Jauslin, 2015). Furthermore, they state that "the potentials of infrastructure for performing the additional task of shaping urban landscapes are largely unexploited" (Nijhuis & Jauslin, 2015, p. 16).

The terminology of 'Smart' implies a positive urban-based technological innovation, therefore it may be pertinent to ask if there is a disjuncture between image and reality? Does the term 'Smart Cities' "create certain assumptions" regarding city transformations and "play down underlying urban issues and problems?" (Hollands, 2008, p. 304). As ICT infrastructure propels the realization of the Smart City by laying its foundation, thus playing a role in placemaking, it is

therefore of importance to further understand how ICT infrastructure is poised to reshape our urban environments.

In terms of Smart City development, it is important to reconcile the relationship between physical space and function. Indeed, as this literature review explores, ICT infrastructure may be a catalyzing force and is transforming various spatial dimensions of cities and urban places in its wake (Durate & Firmino, 2009; Yovanof & Hazapis, 2009).

Chapter 3: The Use of Urban Design Policy in Smart City Planning

This chapter shares research findings regarding urban design policies and guidelines for ICT builds in the City of Toronto. This chapter begins by describing the evolution of the Smart City paradigm in the City of Toronto and the physical components of its make-up. Policies that guide the urban design of ICT infrastructure in Toronto are identified and followed by a policy review of the specific urban design policies and guidelines. This chapter concludes by sharing findings from the field observations.

A. Toronto's Smart City Planning

Since 2016, the City of Toronto has embarked on a journey of understanding what a 'smarter' Toronto could mean by developing a vision and roadmap for itself. The city's understanding of the Smart City is defined as follows;

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

Discussions related to a Smart City future began in 2016 as the City of Toronto, together with the Toronto Region Board of Trade (TRBOT), formed a Smart Cities Working Group (SCWG) (City of Toronto, 2018a). The SCWG includes both private and public-sector members from the TRBOT's Municipal Performance Standards Committee, City of Toronto's Economic Development and Culture Division, Technology Division, and Chief Transformation Officer.

Organized with the intention to raise awareness of local and international Smart City developments, the group set out to develop a Smart City vision and roadmap for the City of Toronto. The group published a report in 2017, entitled *Choices for a Smarter Toronto: A Call for Collaborative Action,* outlining the group's progress and vision, while also aligning with the Government of Canada's Smart Cities Challenge, announced in 2016 (ARUP, 2017). This challenge, open to all Canadian municipalities, was designed to encourage the development of innovative solutions to urban challenges through better city planning and the implementation of connected technology, with the opportunity to win a grant upwards of $50,000 to support and develop the proposal (ARUP, 2017).

i. Internet Connectivity

The 2017 *Toronto Broadband Study,* published by the City of Toronto's Information Technology and Economic Development Department, put forth suggestions for leveraging existing assets and expanding new infrastructure. Focusing not only on the broadband technology required for 'smart city development' but the study also suggested that investment in broadband could play a critical role in both economic development and job creation (FONTUR, 2017).

On the heels of the SCWG launch to produce a vision for what 'smart' means for Toronto, Bell Canada announced in 2015 an investment of $1.5 billion to build the required infrastructure for broadband fibre connections in the City of Toronto (Bell Canada, 2018). During the 2015 announcement, Toronto Mayor John Tory stated that "Toronto is a city always planning for the future, and this is the kind of major technology infrastructure investment we need to ensure our status as a world-class Smart City…a great example of business leaders supporting diverse and innovative economic future for our city" (Bell Canada,2018). In general, most of the existing

telecommunications built infrastructure in the City of Toronto is owned by Bell and Rogers, and a minority of existing network is owned by Beanfield Metroconnect (FONTUR, 2017). More detailed information in regards to existing infrastructure is limited, as it is closely guarded by companies for competitive reasons. Data collected by the CRTC is available but is also limited in regards to detail, providing a general overview of existing speeds, access, pricing, etc. (FONTUR,2017).

The building of high capacity broadband infrastructure is the foundation of the Smart City. Investment in broadband and overall access to internet connectivity requires building new infrastructure and continued maintenance, a very expensive endeavour for cities to undertake.

In an article published in 2019, Rogers CEO Joe Natale stated that “network-building is a capital-intensive business that requires constant care and feeding. Like local transit, you can’t build a subway line and walk away. You need to keep up with capacity, you need to keep up with demand.” (Jackson, 2019).

ii. The Physical Implementation of ICT.

National policies constrain the set of policy strategies available to lower levels of Government, and as such, municipalities must accommodate the request by companies like Bell and Rogers to install new infrastructure (Rajabiun & Middleton, 2014). The installation of the foundational infrastructure for the Smart City isn’t often a very ‘smart’ process. The process includes multiple phases, design, permitting, and physical construction. For example, the Bell Canada project was stated in the *Toronto Broadband Study* to have approximately 70 percent of their project deployed through using poles, and the remaining percentage to be deployed via trenching (FONTRUR, 2017).

The City of Toronto roads, sidewalks, and boulevards are maintained by the Transportation Services division. The City of Toronto issues approximately 50,000 permits for utility cuts annually (Schaus & Laflamme, 2018). According to *OpenData* published by the City of Toronto Transportation Services, there have been to date approximately 54501 permits granted to utility companies to perform excavation within the public right-of-way (the City of Toronto, n.d). *[1] The municipal right-of-way provides space for utility companies, such as the required telecommunications for the Smart City, through the use of both underground and at-grade space (Monri, 2015). The space within the municipal right-of-way is limited and creates constraints for the implementation of new infrastructure (Monri, 2015).

Bell Canada stated in a 2017 article that, “while we have rolled out similar fibre infrastructure projects in other cities in eastern Canada, Toronto is the biggest build by far…it rivals the biggest rollouts by carriers like Verizon and AT&T, and is much more extensive than the Google Fibre projects in US cities” (Lakey, 2017).

[1]* Data was filtered manually in order to view information on permits issued only to telecommunications companies. Report reviewed was published, July 23,2019. https://open.toronto.ca/dataset/utility-cut-permits/

B. Urban Design Policy for Urban Planning in Toronto

There are a number of Federal policy documents that regulate the provision of telecommunications services, a Federal responsibility in Canada. Telecommunications are recognized as a "utility of critical importance to the daily lives of Canadians across the country," and are enforced through Sections 42-44 of the *Telecommunications Act.*

There are also Provincial planning documents that establish the framework for land use planning in Ontario, and contain policies regarding telecommunications infrastructure. The Provincial policy recognizes the strong relationship between reliable, efficient telecommunications services and creating economically competitive and 'smart' communities (Government of Ontario, 2014).

This section presents a brief overview of each policy, in a hierarchical order. Pertinent policies that inform the urban design policies and guidelines in the City of Toronto are noted. This section is presented in two parts. First, a hierarchical overview of the Federal and Provincial policies which guide the Municipalities. Secondly, a review of the Municipal urban design policies and guidelines relevant to ICT infrastructure in the City of Toronto.

Federal and Provincial Policy

The Federal Government, through the CRTC, maintains jurisdiction over wired and wireless telecommunications in Canada.

The *Telecommunications Act* recognizes telecommunications as a critical utility. Telecommunications are exclusively a Federal jurisdiction enforced through *Sections 42-44* of the *Act.* The Federal *Telecommunications Act* (1993) defines telecommunications as "the emission, transmission or reception of intelligence by any wire, cable, radio, optical or other electromagnetic systems, or by any similar technical system."

The *Act* maintains the important role telecommunications play in Canada, outlining the following objectives in Section 7;

> (a) to facilitate the orderly development throughout Canada of a telecommunications system that serves to safeguard, enrich and strengthen the social and economic fabric of Canada and its regions;
>
> (b) to render reliable and affordable telecommunications services of high quality accessible to Canadians in both urban and rural areas in all regions of Canada;
>
> (c) to enhance the efficiency and competitiveness, at the national and international levels, of Canadian telecommunications;
>
> (d) to promote the ownership and control of Canadian carriers by Canadians;
>
> (e) to promote the use of Canadian transmission facilities for telecommunications within Canada and between Canada and points outside Canada;
>
> (f) to foster increased reliance on market forces for the provision of telecommunications services and to ensure that regulation, where required, is efficient and effective;
>
> (g) to stimulate research and development in Canada in the field of telecommunications and to encourage innovation in the provision of telecommunications services;
>
> (h) to respond to the economic and social requirements of users of telecommunications services; and
>
> (i) to contribute to the protection of the privacy of persons.

The Federal jurisdiction and recognition by the *Act* that telecommunications are a 'critical utility' are of importance, particularly in order to understand the relationship between telecommunications, urban planning, and urban design. In addition, the term 'utility' is used to reference telecommunications, specifically wired telecommunication as opposed to towers and antennas, in all proceeding Provincial and Municipal documents.

Next is the *Ontario's Planning Act*, which establishes the rules for land use planning throughout the Province, and provides a basis for Provincial interests via planning policies that guide the future of development, and for municipal in preparing official plans (Ontario, 2019).

The *Provincial Policy Statement (PPS)* under the *Planning Act*, issues Provincial policy directions on matters of Provincial interest related to land use planning (Ontario,2014). In regards to telecommunications, the *PPS* contains policies that support the importance of providing "efficient, viable, coordinated telecommunications services," and strongly supports the role of communications in "creating economically prosperous communities," specifically in creating "smart" economically competitive communities (Ontario, 2014). *The PPS* definition of infrastructure includes communication and telecommunications equipment, in recognition of its importance as a "foundation for development."

Next, the *Places to Grow Act 2017* provides the Province with the authority to establish growth plans. The *Act* is designed to manage growth and development in order to support economic prosperity and protect the environment, including infrastructure which is defined to include communications and telecommunications infrastructure (Ontario,2017). The *Greater Golden Horseshoe Plan (GGH)*, a management policy for southern Ontario, is found under the *Places to Grow Act 2005* and contains policy direction supporting urban design. The *GGH* includes the *Greenbelt Plan*, the *Oak Ridges Moraine Conservation Plan*, and the *Niagara Escarpment Plan*.

The following policies, although they do not regulate telecommunications, emphasize the importance of growth, development, intensification, and the public realm. The Provincial plans recognize the importance of telecommunications as a "critical utility" and integrate this 'utility' with land use planning, and broadly permit telecommunications while reasonably balancing its impacts.

Municipal Policies and Guidelines

Although telecommunications are exclusively a Federal jurisdiction enforced by the *Telecommunications Act*, the actual administration of the physical plant is accomplished at the Municipal level (FONTUR, 2017). Considering this, it should be noted that Municipalities are creatures of the Province, and have no inherent powers, only those granted to it by the Province in statute, regulation, policy and guidelines.

To reiterate, due to the Federal jurisdiction over wired and wireless telecommunications in Canada, the city of Toronto's role is limited. The physical implementation of wired infrastructure, like fibre and broadband cables, is organized at the Municipal level as the City has control of its own rights-of-ways, and issues permits for construction and other utility activities within these rights-of-way (FONTUR, 2017, p.21). Each facilities-based competitor, licensed by the CRTC, is responsible to negotiate the terms required for access of a Municipalities right-of-way, and "where an acceptable agreement cannot be reached the CRTC can enforce its conditions on the municipality" (FONTUR, 2017 p.21).

Furthermore, municipalities such as the City of Toronto who control their own right-of-way and issue permits for construction and other utility activities, are also "encouraged to produce their own protocol or policies for consultation that reflect local preferences or requirements" to prevent unsightly or overly large installations (FONTUR, 2017 p.21). In an effort to assist Municipalities and utilities in the negotiation for right-of-way access, as well as in the coordination of utilities (particularly in downtown areas which are crowded and have limited space and capacity for new infrastructure), a *Public Utility Co-Coordinating Committee* (PUCC) was developed and supported by the CRTC (FONTUR,2017).

The following section takes an in-depth look at the City of Toronto urban design policies and guidelines as they relate to the urban design of ICT telecommunications infrastructure.

City of Toronto Official Plan

The *Official Plan* is intended to ensure that the City of Toronto evolves, improves and realizes its full potential in areas such as transit, land use development, and the environment. Although the telecommunications facilities are not subject to the *Official Plan, Zoning By-law, or Site Plan Approval process,* applicants for new telecommunication infrastructure are to consult with the City of Toronto on the location of the proposed infrastructure prior to the issuance of a permit.

The *Toronto Official Plan* states in *Chapter 3.1.1 The Public Realm, Policy 6(a) (b)*;

"sidewalks and boulevards will be designed to provide safe, attractive, interesting and comfortable spaces for pedestrians by:

a. providing well designed and co-ordinated tree planting and landscaping, pedestrian-scale lighting, and quality street furnishings and decorative paving as part of street improvements; and
b. locating and designing utilities within streets, within buildings or underground, in a manner that will minimize negative impacts on the natural pedestrian and visual environment and enable the planting and growth of trees to maturity."

To reiterate, the *Provincial Planning Act* allows the basis for Municipalities to prepare its own *Official Plan* and policies that will guide future development, and are consistent with the *Provincial Policy Statement.* In regards to the new telecommunication infrastructure, although the *Official Plan* does not regulate the infrastructure, it does provide planning tools, such as the requirement for utilities to consult with the City of Toronto on the location of proposed infrastructure prior to the issuance of a permit.

Toronto Complete Streets Guidelines

The *Complete Streets Guidelines* vision for complete streets stems from *Toronto's Official Plan* and was adopted by City Council in August 2014 after in-depth public and stakeholder consultation (City of Toronto, 2017c). Developed as an approach to design city streets, the document states that the overall objective is to create a well-functioning street network that is planned and designed to provide safe access and efficient operation for all street activities and functions (City of Toronto, 2017c). The guideline defines complete streets as being "designed to be safe for all users: people who walk, bicycle, take transit or drive, and people of varying ages and levels of ability" (City of Toronto,2017c). The *Complete Streets* guide builds on many of the City's existing policies and guidelines and provides a toolbox of ways to improve Toronto's streets.

In regards to ICT infrastructure, the guideline identifies telecommunications as utilities and is primarily focused on the location and placement of the physical plant in the public realm. Pedestrian design principles are covered in Section 4.1 (7) and (8), which focus on alleviating the impact utilities may have on the pedestrian. In particular, Section (8) references coordination with utilities, and the need for early coordination to ensure pedestrian clearway, universal accessibility, and to minimize conflicts among utilities, street furnishings, trees, and landscaping. Section 4.6 provides direction on designing the public realm and placemaking, stating that "sidewalk zones serve as vital public spaces," and that various elements are important components of placemaking, including the "sensitive placement" of utilities.

Section 4.7, *Utilities, Maintenance and Operations*, emphasizes the important consideration to reduce "above ground clutter and minimize negative impacts of underground utility repair, modification and replacement where possible". This section emphasizes the importance of utilities and their role in our daily lives, and reiterates the need for early project coordination of utilities to maximize opportunities for well-designed sidewalks that have "safe access, use and

maintenance," using a "complete streets approach to ensure safe and efficient operation of city streets and the utilities".

Vibrant Streets Toronto's Coordinated Street Furniture Program Design and Policy Guidelines

The *Vibrant Streets Guidelines* help to standardize the location of street furniture, and is focused on the design, installation and maintenance of street furnishings. Street furniture includes items such as transit shelters, litter bins, recycling bins, information pillars, publication boxes, and other amenities (City of Toronto,2012). The guidelines are aimed "to establish a linear pedestrian clearway; to enhance the use of the right-of-way through the placement of furniture based on usage patterns, open space and surrounding architecture; to maintain site lines at intersections" (City of Toronto, 2012). The *Vibrant Streets Guidelines* states that;

> Toronto's streets are currently furnished with a varied collection of street furniture; some very old, some quite new, some well-designed and some not so. Collectively, streets often feel disorganized and cluttered and appear neglected. The purpose of Toronto's Coordinated Street Furniture Program is to address these issues and bring a new sensibility to our streets (p.3)

The implementation of the guidelines was executed through a request for proposal process after a public consultation process to develop the document. The request for proposal sought proposals from the private sector to provide and coordinate street furniture elements. In 2007, the City of Toronto entered into a 20-year agreement with Astral Media for the supply, manufacturing, installation and maintenance of 25,000 street furniture elements (City of Toronto, 2012).

Although the *Vibrant Streets* document does not directly reference ICT infrastructure, (the document noting that such 'furniture' falls outside the scope of the coordinated program), it does suggest that street elements under the jurisdiction of different agencies and outside the scope of this project should be improved. A summary of information from the public consultations is presented in the document, where a public suggestion is made for the removal of "ugly utility boxes" (p. 48).

Toronto Streetscape Manual User Guide

The *Streetscape Manual* is a reference tool that was developed to guide the design, construction and maintenance of sidewalk and boulevard improvements. Focused on the design quality of the public right-of-way, with attention to the coherence, beauty, durability, and accessibility, the *Streetscape Manual* is used as the standard in the design and reconstruction of all City streets (p.2).

The document acknowledges utilities in three separate sections. Section 2.1, *Organizing the Functional Makeup of the Sidewalk,* states that "the sidewalk zone must be designed to provide safe, efficient and accessible pedestrian movement while balancing competing demands for limited space" (p.10).

Section 3.2, although dedicated to street trees, does reference ICT infrastructure. The section states that the manual has been developed to permit better integration between trees and utilities as "in the past buried utilities had often been a significant limiting factor in how and where trees are planted" (p.15). The section highlights the importance of early coordination between tree planting and utilities to maintain a successful streetscape.

Section 5.0 and 5.1, *Public Utilities*, explains utility congestion as being a major problem within the right-of-way, both above and below ground. Utility congestion "poses a particular

challenge to tree planting and the overall quality of the sidewalk zone," and new types of utilities such as telecommunications wires "compete for space under the sidewalk with the ever-expanding network or existing utilities" (p.22).

The *Streetscape Manual* recognizes the disruption to "pedestrian surfaces due to emergency and demand-driven utility work," and therefore has placed a focus on design details to facilitate easy access and repair.

> Each utility requires intermittent maintenance, which usually requires cut repairs if the problem cannot be fixed at an access hole or vault. In the event of necessary repairs, dry-laid construction unit pavers will not compromise the functional and aesthetic appearance of the initial installation, as the unit pavers can be removed to allow excavation and repairs to be carried out. Following the maintenance/repairs, the original pavers are relayed on a new base (p.22)

Perhaps one of the most relevant documents in regards to telecommunications infrastructure, the *Streetscape Manual* provides high-level information in regards to utility infrastructure placement. As mentioned, the guide serves as a reference tool, with clear influence from the proceeding document the *Vibrant Streets Guidelines.*

The Municipal Consent Requirements

The Municipal Consent Requirements (MCR) presents the requirements for all permit applications "pertaining to installation within the City of Toronto." The information in this document applies to all utility companies, and is intended to protect "the interests of the City of Toronto, the community, and utilities occupying the right-of-way". Specific urban design details in regards 'ICT' infrastructure 'equipment' are presented in Appendix V of the MCR.

MCR Appendix V: Universal Equipment Placement Guidelines

The *Universal Equipment Placement Guidelines* are intended to “eliminate poorly placed equipment within the streets and boulevards that detract from the enjoyment of the public realm” (p.4). The guidelines state that they intend to “provide consistent placement of above and grade level utility infrastructure” (p.4).

The guidelines were developed with internal and utility stakeholders intended to protect the interest of the City of Toronto, and various communities and utility companies that are required to place equipment on the right-of-way. The guidelines are based on the *Vibrant Streets Guidelines,* but place specific attention on the placement of above and grade level utility equipment.

The *Universal Equipment Placement Guidelines* emphasize the importance of preserving site lines and avoiding the clustering of equipment which is defined as two or more pieces of equipment. Aesthetic treatment is to be applied when clustering, to all three boxes and is to be “consistent in nature and allow the equipment to blend into its surroundings” (p.6). The document provides examples and technical equipment location clearances from the MCR.

The document provides the clearest and most in-depth information in regards to telecommunications infrastructure. The document provides visual examples and some technical placement information but is focused on the urban design placement of equipment.

The document, although it is stated to be based on the *Vibrant Streets Guidelines,* also borrows from the *Streetscape Manual.* To reiterate, the *Vibrant Streets Guidelines,* although it does not make reference to telecommunications, is a reference tool that guides the design, construction and maintenance of sidewalk and boulevard improvements. The *Streetscape Manual* is a reference tool that was developed to guide the design, construction and maintenance of sidewalk and boulevard improvements.

C. Urban Design Field Observations in the City of Toronto: A Case Study

The physical infrastructure of ICT should be considered an issue of urban design. Once installed, ICT infrastructure is likely to remain in place for decades, which may affect the arrangement and appearance of communities. The lack of design concept, the consideration of orientation, materials, and usage of space can affect the arrangement and appearance of communities. I will argue that the physical implementation of telecommunications infrastructure and urban design are of importance to the future Smart City, because of the significant material impact on the urban landscape.

Methodology

During the review of the urban design guidelines and policies, the pertinent information to ICT was extracted and compiled in an Excel format. This consolidated urban design information was used as a rubric for critical evaluation of whether the policies and guidelines were reflective in the physical form.

Three common themes were found during the review of the urban design guidelines and policies specific to ICT infrastructure. The themes were; designing plant placement to ensure the minimal negative impact on pedestrian surfaces, attention to aesthetics, and efficient access for maintenance and repair. These themes will act as headings, organizing the interpretation and analysis of field observations.

Five sites with ICT builds by five different companies were chosen using T.OINview, an interactive map of planned infrastructure construction, available publicly through the City of Toronto website. Considering five of these companies provided me with a representative cross-section to planning and designing ICT. The five sites were listed as active infrastructure projects, all installing new cable infrastructure.

This section presents my research, which explores the physical execution of the Smart City, ICT infrastructure implementation and the role of urban design policy, using the City of Toronto as a case study. This research aims to answer the question; are design standards being implemented specifically in the placement of ICT infrastructure in Toronto? Field observations were conducted throughout June 2019.

Interpretation and Analysis of Field Observations

i. Minimal Negative Impact on Pedestrian Surfaces

Consistent across all sites which I visited was new equipment or plant installed at grade level. Equipment was placed in the public right-of-way, including roads, sidewalks and boulevards within the city. All the above-ground plant observed at the five sites visited was installed in locations which could obstruct pedestrian ease of use. The placement of the plant across the five sites was observed to be of potentially negative impact on pedestrian surfaces.

In regards to utility placement, The *Official Plan* asserts that sidewalks and boulevards are to be designed to provide above all safe spaces for pedestrians by locating and designing utilities within streets stating, “in a manner that will minimize negative impacts on the natural pedestrian and visual environment” (Toronto,2019). The *Universal Equipment Guidelines* provide further detail and direction in regard to the placement of the plant. The *Universal Equipment Guidelines* state that the preference for the above-ground plant and equipment is that it be installed at grade level as well as be flush to the surface. The *Universal Equipment Guidelines* also state a preference for the location of equipment to be installed in the outer boulevard (between the sidewalk and curb). The *Streetscape Manual* states that the sidewalk zone must be designed to provide safe, efficient and accessible pedestrian movement. Based on my observations, although all new equipment was installed at the grade level, the equipment installed caused uneven and disrupted pedestrian spaces. *Figures 1 and 2* illustrate above-

ground plant installations not flush to grade on sidewalk zones, potentially restricting access to all users, including pedestrians.

The *Streetscape Manual* mentions that there exist difficulties in the placement of shallow utilities like telecommunications, which often are installed under sidewalks. Regardless of sidewalk or street installations, utilities in the City continue to compete for limited space in the right-of-way. Utility congestion, both above and below ground, is stated to be a major problem throughout the City and poses a challenge to the design of equipment placement. The lack of space within a municipalities right-of-way will continue to pose multiple problems, and as it inevitably decreases, the placement of new infrastructure will require further attention to design and placement.

Figure 1. Grade level plant installed on sidewalk installed not flush to the ground. Toronto, Ontario. June, 2019.

Figure 2. Installation observed to restrict access to pedestrian space. Toronto, Ontario. June, 2019.

Further observations revealed new equipment installed with no regard to providing safe spaces for all users of the sidewalk zone. *Figure 3* displays a lack of design consideration in the placement of installed equipment in the sidewalk zone.

Considering the *Official Plans* statement for sidewalks and boulevards to be designed to provide, above all, safe spaces for pedestrians by locating and designing utilities within streets, the site observations I conducted do not support this statement, and in fact, were contrary to the *Official Plans* statement. The sites I visited revealed that the impact of ICT infrastructure did impact negatively the pedestrian space.

Figure 3. Grade level installations in a pedestrian zone. Toronto, Ontario. June, 2019.

ii. Attention to Aesthetic

Reiterating the *Official Plan,* the *Complete Streets Guidelines* states that the overall objective is that streets are "planned designed to provide safe access and efficient operation for all street activities and function" (Toronto,2017c). Additionally, the *Complete Streets Guidelines* present information on the vital role of telecommunications utilities as an element in creating an attractive public realm and in placemaking. Further, the *Universal Equipment Guidelines* provide detail on suggested equipment placement to ensure the "preservation of aesthetic view" which includes not only the placement of equipment to preserve site lines from windows and front doors, but also the role landscaping plays to "mitigate aesthetic concerns".

The *Universal Equipment Guidelines* also state that the clustering of equipment is to be avoided to ensure neutrality in a residential area. I observed the clustering of equipment during only one site visit, in which the equipment was located behind a residential parking space as shown in *Figure 4*. The *Universal Equipment Placement Guidelines* state that "curb appeal" is

very important to both homeowners and pedestrians in the community, therefore special design should be considered.

Figure 4. Clustering of equipment with no aesthetic treatment. Toronto, Ontario. June, 2019.

Figure 5. Existing above-ground equipment without aesthetic treatment, tagged with graffiti. Toronto, Ontario. June, 2019.

My field observations concluded that only some existing above-ground equipment had an aesthetic treatment applied. The type of aesthetic observed included varying types of decorative covers and equipment placement in the inner boulevard, but I did not witness any landscaping used as an aesthetic treatment. The sites I visited revealed that the application of aesthetic was not consistent across all sites (see *Figures 5 and 6)*.

Although I believe that aesthetic treatment such as covers and painting do not need to be consistent across all sites, I do believe that if a treatment is to be applied, it should be sensitive to the context and aware of its role in placemaking. I also believe that landscaping could benefit the majority of the sites I visited.

The *Municipal Consent Requirements* states that the applicant is responsible for an aesthetic treatment, which requires the General Manager to evaluate the suitability and potential impact. Furthermore, the *MCR* states that the maintenance of aesthetic treatment is the responsibility of the application. The *Universal Equipment Guidelines* states that aesthetic treatment can include; placement of minimal visual impact, landscaping around the plant, painting the plant; decorative covers etc. The guidelines require that three or more pieces of equipment must have an aesthetic treatment, including landscaping or decal.

Figure 6. Different aesthetic treatments applied to Grade Level equipment. Toronto, Ontario. June, 2019.

The site observation in *Figure 7* displays a site where existing equipment was located diagonally opposite of each other. This aesthetic treatment of the equipment, painting and decorative cover, was noticeably lacking a cohesive design.

The placement and aesthetic treatment of such street elements, like the equipment, are important components that contribute to placemaking. The chosen 'natural' aesthetic treatment to the grade level box was observed to obviously lack context, *Figure 8*. The chosen aesthetic highlights the very 'unnatural' nature of the equipment, a lack of design, and ultimately creates an ugly and 'un-coordinated' street corner. During this particular site I visited, I felt a distinct disconnect between the chosen aesthetic and the particular space. It was evident to me as a pedestrian at this site, that there was no thought of connecting the chosen design with the local context, which again, in my opinion, does impact the user's experience of a space.

The Complete Streets Guidelines makes reference to the importance of sidewalks and their role in serving as a vital public space. The *Complete Streets Guidelines* state that by

ensuring the attractiveness of sidewalks as public spaces, it is of importance to apply attention to elements like utility placement.

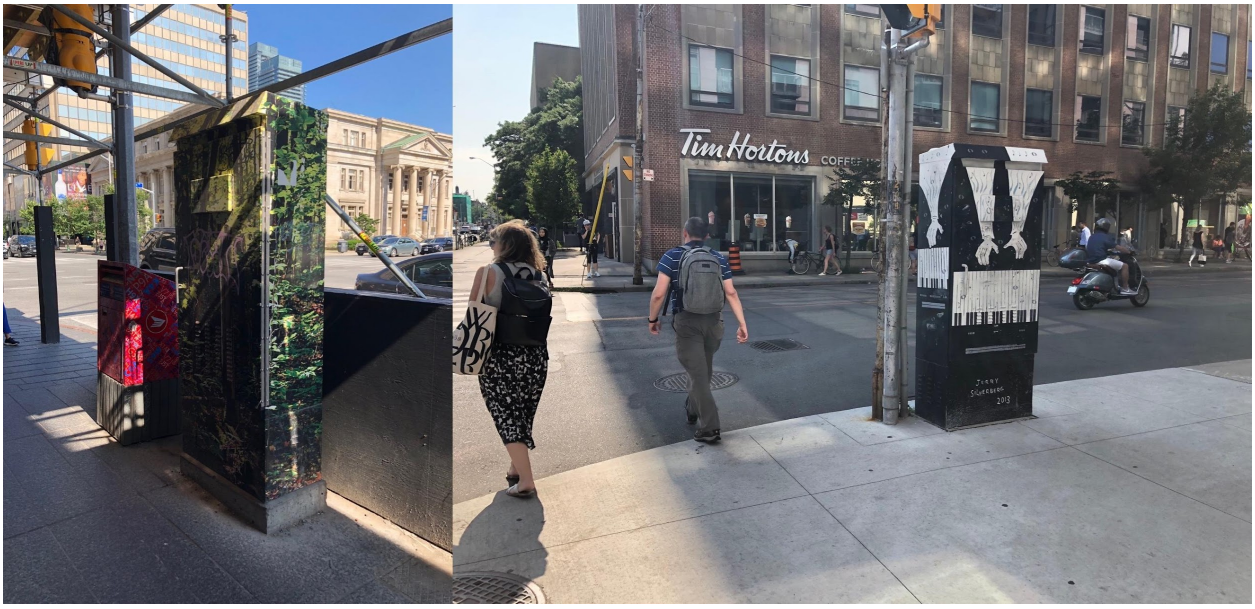

Figure 7. Above ground equipment located diagonally opposite, both pictured with aesthetic treatment. Toronto, Ontario. June, 2019.

The *Vibrant Streets Guidelines* and *Streetscape Manual* state the importance to ensure unobstructed and ample pedestrian space with well-designed and thoughtfully placed street furniture as an ongoing effort to improve aesthetics.

Attention to detail in locating furniture on Toronto streets will enhance and improve the overall pedestrian realm, as suggested by the policies. Based on my observations, the placement of telecommunications equipment is often utilitarian in design. In my opinion, the design of equipment placement should consider the impact it has on the public realm. Although in general, I observed that the majority of the equipment was placed at grade level, further attention to the design of equipment location is recommended for better integration of equipment 'aesthetically' in the public realm.

Figure 8. Above ground equipment with a ‘natural’ design applied as a decorative cover. Toronto, Ontario. June, 2019.

iii. Efficient Access for Maintenance and Repair

All sites visited were observed to have equipment placement designed and installed with the intention to accommodate easy access and repair. I observed that certain sites had multiple access points to equipment within relatively short distances of each other. Most sites had new grade level equipment installed in locations that either straddled the sidewalk and boulevard or

installed directly in the pedestrian sidewalk. The *Complete Streets Guidelines* make specific reference to the requirement for utility coordination, “the location, use, and maintenance of utilities need to be coordinated early on in street projects, to ensure pedestrian clearway needs are met for universal accessibility.” Utility coordination is noted across the design documents, as a solution for well-designed sidewalks and to minimize conflicts among utilities. As stated, utility congestion, both above and below ground, is stated to be a major problem throughout the City and poses a challenge to the design of equipment placement.

The *Streetscape Manual* states that the sidewalk zone must be designed to provide safe, efficient and accessible pedestrian movement while balancing competing demands for limited space, including the placement of utilities (2019d). As utilities require regular maintenance, which the *Streetscape Manual* does acknowledge with equipment design suggestions, the site observations revealed otherwise.

Further, in regards to access for year-round maintenance, during the field observations, I observed that equipment placement indeed was designed to facilitate efficient year-round maintenance. Although the design guidelines and policies did not provide detail on equipment maintenance itself, general maintenance of the above-ground equipment was observed to be lacking. *Figure 9* reveals the existing state of the installed plant in the public right-of-way.

Figure 9. (Left) Grade level equipment is camouflaged by natural overgrowth and weeds. (Right) Above ground equipment covered in graffiti vandalism. Toronto, Ontario. June, 2019.

In regards to construction and maintenance, the *Streetscape Manual* provides specifications for construction and maintenance of sidewalk and boulevard improvements and states that construction for utilities should not compromise the function and aesthetic appearance of pedestrian surfaces. *Figure 10* shows a site visited with potentially temporary paving, yet reveals the compromise of the function and aesthetic appearance of pedestrian surfaces. Generally speaking, during my site visits I observed that the equipment placement was installed for efficient maintenance and repair.

Figure 10. Image of temporary paving, awaiting resurfacing after maintenance/installation. Toronto, Ontario. June, 2019.

Chapter 4: Perspectives on Urban Design for ICT Infrastructure in the City of Toronto

This chapter considers the perspectives of urban design, urban planning, infrastructure planning and city planning professionals on urban design policy and guidelines for ICT infrastructure in the City of Toronto.

A. Discussion of Outcomes

The aim of the interviews was to gain an understanding of whether there is a consensus on the importance of urban design standards in policymaking for Smart City infrastructure in Toronto. There were two main findings from the analysis of interview data. First, there is a significant difference between the public and private sectors' understanding of urban design policies and guidelines for ICT infrastructure. This reveals a potential breakdown in communication and brings to light the question of whether the existing urban design information reads well for the target audience.

The review of the documents in Chapter 3 revealed that although telecommunications are governed by Federal jurisdiction, the role of implementation for wired infrastructure remains in the hands of the Municipality. Although Municipalities have a role in managing the implementation, telecommunications being a “critical utility” governed by Federal jurisdiction requires Municipalities to allow telecommunications companies access to the public right-of-way. Do the power dynamics of this relationship affect the understanding of urban design policies? Are telecommunications companies only focused on their project delivery?

Further, the review of documents in Chapter 3 did reveal that there was in fact only one document exclusively dedicated to the urban design and placement of ICT, *The Universal Equipment Guidelines.* Although the other documents reviewed did make mention of ‘utilities’

‘furniture’ and or ‘telecommunication,’ it is possible these documents are not used in the design and implementation process as they present a broad scope of information. *The Universal Equipment Guidelines* an appendix to the *Municipal Consent Requirements* has the potential for further details to be shared, including further examples of ideal placement and design challenges.

The most striking result conclusion from the data is a consensus among both sectors on the importance of urban design guidelines and policies for ICT infrastructure. This conclusion validated the research. It is important to note that there is further work required to ensure both the understanding and use of design guidelines in the City of Toronto, but this result has further strengthened my confidence that ICT infrastructure for the Smart City should be regarded as a problem of urban design.

Further, many of the design guidelines made note of the importance of coordination in planning the design of ICT infrastructure, which will inevitably increase as space in the right-of-way decreases for new infrastructure.

All of the interviewees, from both public and private sectors, stated that they were generally familiar with ICT infrastructure, with the exception of one private sector interviewees stating that they were not aware. In regards to specific details of urban design guidelines and policies for ICT infrastructure, all of the interviewees claimed they were unaware, but had worked with urban design guidelines and policies in some capacity.

All interviewees were asked to rate how important they viewed urban design standards and guidelines to be, with respect to ICT, on a scale of 1 to 10. The answers ranged from 8 to 10, with one interviewee not stating a numerical rating, but rather stating ‘important.’

B. Perspectives on Urban Design Policy and Smart City Requirements

Public Sector

The public sector viewed the guidelines as supporting in the organization and building of the public realm. The perspectives of those in the public sector were aligned, mostly in regard to the intentional design of the public realm being of importance. Indeed, the role of urban design guidelines and policies for ICT infrastructure by these interviewees was rated as very important.

Mainly, the opinion shared was that the urban design guidelines and policy "control the public realm" and "guidelines are always requested to be used by applicants, and the city will always try and impose guidelines." As one interviewee stated, "chaos is not nice."

For example, we discussed how the organization of street furniture has an influence on how the pedestrian and cyclist feels and experiences the space. During this discussion, College Street was brought up as exemplary not only for the placement of street furniture, but also for the integration utilities. It was also mentioned that water infrastructure and fire hydrants were well designed, integrated, and assisted in producing a vibrant streetscape for the pedestrian.

Further, the public sector shared some perspective in regards to the Federal jurisdiction of telecommunications and the role of the Municipality, including the Municipalities challenge with its crowded right-of-ways. One interviewee expressed the opinion that more balance is required to manage the multiple wants and needs of the public right-of-way, stating that "there exists a constant tension between accessibility, by-laws, and urban design." The public-right-of-way, particularly in downtown areas, is crowded and has limited space and capacity for new infrastructure. This presents design challenges to both those implementing and those permitting the infrastructure, and also creates disruption to users of sidewalks and roadways. The majority of shallow utilities, like telecommunications, are found under sidewalks, whereas deeper utilities are often found under roadways.

The opinions regarding ‘aesthetic’ shared from the public sector were focused on the urban design of the public realm. My interest in the role of ‘aesthetic’ has to do with both the placement and appearance of the telecommunications equipment required for the Smart City. The equipment generally used in the public right of way, in my opinion, can only be expressed as an ‘eyesore’ and simply being ‘ugly.’ The role of urban design to assist in the placement, coordination and beautification of the required infrastructure is of interest to me. One interviewee suggested the need for further integration. They stated, “integration within the public right-of-way, where the dominance of public utility is designed in a less dominant way.”

The perspectives of the public sector made comment on the importance of coordination and of review during both the design and implementation process for ICT infrastructure. One public sector interviewee even proposed an increase in more specialized attention of application reviews, suggesting the “use of more architectural perspectives, like ‘architecture consultants’ to review multiple aspects of a job.”

Private Sector

The predominant view of the private sector interviewees was that all City documents guiding the permitting process for infrastructure were above all for safety measures. Indeed, the private sector viewed the role of the urban design guidelines also as safety measurements. As one private sector interviewees stated, “the guidelines, which exist in my opinion, are there to ensure safety.” Another interviewee shared a similar view, and stated that “yes, effective for access, safety, manholes, all to be done correctly.”

Although the private sector, in general, agreed that design guidelines and policies are “necessary”, the consensus was that the policies and guidelines negatively affected timelines and ultimately the project delivery. One interviewee remarked that “they ensure safety, but the way that you get something approved is not efficient, for customers and service.” Similarly, another interviewee stated that “the guidelines that exist are too cumbersome.”

The private sector interviewees were in general aware of City guidelines, but the analysis of opinions shared made clear that the focus remained centred on business performance and the delivery of service to the customers, not the urban design of ICT.

Again, the private sector opinion, in general, viewed urban design guidelines and policies from the City as delaying the delivery of ICT projects. One private-sector interviewee remarked specifically, “I had a city project which was delayed by the city itself!”

Opinions on the subject of ‘aesthetic’ and equipment placement of ICT infrastructure were voiced in all interviews. Again, my interest with ‘aesthetic’ was related to the look and placement of the equipment required for the Smart City. The opinions shared on the subject of ‘aesthetic’ and equipment placement were not all positive. For example, one private-sector opinion shared stated that “yes, we pay attention to aesthetic when designing, but the guidelines which exist in my opinion are more of a nuisance.”

Interestingly, the private sector opinion on the design, placement, and location of ICT infrastructure was noted as a “problem,” and “often seen as a problem” only when it affects their personal neighbourhood. One interviewee remarked, “aesthetics, sure, I often see them as a problem, but experienced more on a personal level.”

The public-sector interviewees agreed that the above-ground equipment used is ‘ugly’ but their concerns were not generally focused on the urban design and placement of the equipment.

Chapter 5: Conclusions

The physical infrastructure of Information and Communication Technologies (ICT) should be considered an issue of urban design. The physical implementation of telecommunications infrastructure and urban design are of importance for the future Smart City, because of a material impact on the urban landscape. This paper demonstrates that, although keen on becoming a Smart City, the City of Toronto has not sufficiently considered the urban design implications of ICT infrastructure.

The Smart City paradigm has received much academic attention in the past decade, as it has gained popularity in becoming a leading future city model encompassing multiple urban strategies around ICT and new infrastructures to mitigate the problems generated by rapid urbanization (Chourabi, 2012; March, 2016).

Understanding the Smart City has become an issue of critical academic focus, as cities are becoming more wedded to the notion that they must become connected to become ‘smart' (Grossi,2017; Hollands,2008; Shelton et al, 2014; McNeil,2015).

This ‘digital revolution’ has most cities using the Smart City paradigm as a project with an aim to retrofit the existing urban socio-technical fabric by way of adding a new layer of technology or digital skin to the built environment, and this includes the City of Toronto (Batty,2012; March, 2016 p.1696).

Toronto is too becoming more wedded to the notion that it must become connected to become ‘smart', and has embarked on becoming a Smart City. With corporate telecommunications building the foundation with high capacity broadband infrastructure, the City seems to have taken a “positive and rather uncritical stance towards urban development” (Hollands, 2008).

The case study on urban design field observations in the City of Toronto revealed that the placement of ICT infrastructure is subject to urban design standards in Toronto, but those

standards are not being implemented. This contributes not only to the City of Toronto becoming a Smart City in a 'fractured way,' but also implies the idea that by just 'adding' something to the 'urban space' is enough (Aurigi,2013; Shelton et al,2014).

The lack of current urban design guidelines applied to ICT infrastructure in Toronto results in a lack of coordinated and aesthetically pleasing spaces. The negative impact on pedestrian surfaces as well as a lack of attention to aesthetic was observed during all field observations. This result is significant, as it suggests that ICT implementations do not take urban design issues into account. Further, the design for efficient access for maintenance and repair of equipment was observed, implying that the Canadian telecommunications design is only utilitarian.

The analysis of the interview data revealed two findings. First, there is a significant difference between the public and private sectors' understanding of urban design policies and guidelines for ICT infrastructure. Second, that both sectors viewed urban design guidelines and policies as important. Although there is consensus on the importance of urban design standards in policymaking for Smart City infrastructure, the City of Toronto has not sufficiently considered the urban design implications of ICT infrastructure.

Future Research Directions

This research has raised many questions in need of further investigation. First, future work should concentrate on the role of Federal jurisdiction of wired telecommunication on urban design policies. This is an important issue for future research as there is an existing power dynamic. Future studies should examine if this power dynamic has an effect on the execution of ICT infrastructure as well as an effect on the use and monitoring of urban design policies in the field.

Second, further work should concentrate on enhancing the quality of existing urban design guidelines for ICT infrastructure. As mentioned, my research findings include a significant difference between the public and private sectors' understanding of urban design policies and guidelines for ICT infrastructure. This reveals a potential breakdown in communication and brings to light the question of whether the existing urban design information reads well for the target audience. For example, *The Universal Equipment Guidelines* an appendix to the *Municipal Consent Requirements* has the potential to be developed to become more robust and clear.

Third, research into understanding the coordination and relocation of utilities is underway, but the problem of the crowded right-of-way in the City of Toronto more broadly requires further research.

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