

ESSENTIAL INFRASTRUCTURE FOR THE SMART ECONOMY

ICTC Smart Cities Roundtables: Smart Infrastructure





The Information and Communications Technology Council (ICTC)

ICTC Smart Cities Roundtables:
Smart Infrastructure

Policy Brief
February 2020

About ICTC

As a not-for-profit, national centre of expertise, ICTC strengthens Canada's digital advantage in a global economy. Through trusted research, practical policy advice, and creative capacity-building programs, ICTC fosters globally competitive Canadian industries enabled by innovative and diverse digital talent. In partnership with a vast network of industry leaders, academic partners, and policy makers from across Canada, ICTC has empowered a robust and inclusive digital economy for over 25 years.

About the Smart Cities Project

ICTC is leading a multi-year national research initiative on smart cities. Under this project, ICTC investigates the development of smart cities across Canada and internationally, with the ultimate goal of understanding the labour, technology and societal needs and opportunities of Canada's future communities. To guide and shape this research, ICTC has coined the following areas as central smart city pillars: Smart Infrastructure, Smart Mobility, Smart Energy & Environment, Smart Health & Wellbeing, Smart Government, and Smart Regulation. During the course of this study, ICTC is hosting policy roundtables on each of these pillars. The first roundtable was on Smart Infrastructure and took place in November 2019. These roundtables engage a variety of stakeholders across Canada to uncover specific policy needs and put forward recommendations that can support a smart future for our cities.

To Cite this Brief

Cutean, A., Farmer, T (February 2020), ICTC Smart Cities Roundtables: Smart Infrastructure, Policy Brief. Information and Communications Technology Council. Ottawa, Ontario.

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INTRODUCTION

Toward a Smart Future, Together

The world is becoming increasingly urbanized. With more than 55% of the world's population living in urban centres, the World Bank estimates that [cities are responsible for over 80% of global GDP](#). The story is no different for Canada, where cities are expected to generate the majority of economic activity and job growth in the coming years. In fact, by 2023, ICTC estimates that under a moderate economic growth scenario, the [demand for talent across the digital economy will reach 305,000](#), and much of this labour will be rooted in urban centres around the country. Ensuring that our urban spaces are equipped with the necessary physical and digital infrastructure to effectively respond to and capitalize on these changes is key for a smart future that prioritizes economic growth, environmental sustainability, and technological progress.

The first in a series of five Smart City Policy Roundtables, ICTC hosted a Smart Infrastructure Roundtable in November 2019. The roundtable engaged with 30 thought leaders from across Canada, with areas of expertise in physical infrastructure, digital infrastructure, security and privacy, regulation, and talent readiness. The following central topics were explored during this roundtable: physical infrastructure, digital infrastructure, key regulatory concerns and considerations, and talent needs.

This brief highlights lessons learned and important recommendations, with the purpose of supporting policy directives that can enable strong and sustainable infrastructure in Canada's smart cities.

Setting the Stage

Insights from Thought Leaders in Physical and Digital Infrastructure

To set the foundational groundwork for the questions and policies discussed during the roundtable working groups, participants had the opportunity to attend presentations by William Gagnon, (former) Green Buildings Specialist at [Ecology North](#); and Sanjay Khanna, Director of Information Technology at [The Shaw Group Limited](#). These presentations provided context for physical infrastructure considerations related to climate-neutral and sustainable cities, and for digital infrastructure considerations, such as blockchain, that can play a role in our changing economy.

Incentivizing Climate Solutions Through Innovation: How Physical Infrastructure Plays a Central Role

A Conversation with Will Gagnon, Green Buildings Specialist at Ecology North

Climate change is a current-day reality that creates significant challenges for our way of life, and threatens core supply chains, including access to resources and food. While the immediate impact of climate change may not be explicitly evident in every part of the country, it is very visible in some areas, namely the North. The impact of climate change in northern Canada is already severe, with consequences that include significant ice thinning and ecological degradation. Recent studies have shown that globally, approximately [one million species are at risk of extinction](#), largely due to loss of natural ecosystems. At home, the impacts of climate change are especially pronounced, with a recent report finding that [northern Canada is warming at three times the global average](#).

In Canada, and especially the northern part of the country, much of the physical infrastructure is integrated directly into its natural environment. A well-known example in the Northwest Territories is ice roads, which are key pieces of infrastructure needed to transport large vehicles that deliver goods and resources. For some communities, these ice roads are essential links in the winter months. Currently, the ice on these roads is thawing at a faster rate, making them increasingly unreliable and causing serious concerns for these northern, mostly Indigenous, communities.

Alvin Fiddler, grand chief of the Nishnawable Aski Nation, emphasizes the gravity of this crisis, asserting that [these roads are essential to the survival of the 49 Indigenous communities](#) that the Nation represents. Although some mitigation strategies may exist, including the development of all-season land roads, each comes with its own undesired consequences. In the case of land roads, this can mean further loss of biodiversity and destruction of natural habitats, as well as a hefty price-tag. For one community considering this option, the cost is estimated to be approximately [\\$150 M for a 97-kilometre gravel road](#).

These are critical concerns impacting livability and, as a result, must take centre stage. It is time for innovators to focus on climate regeneration through nature-based infrastructure solutions. This can range from large infrastructure projects like the construction of [living buildings](#) and [vertical farms](#) to the generation of energy alternatives like [biochar](#), or even small initiatives like community gardens. As Will put it, there is no Planet B, and “More sustainable does not exist.”


Digital Solutions and Smarter Infrastructure for Cities

A Conversation with Sanjay Khanna, Director of Information Technology at the Shaw Group Limited

Digitalization can enable infrastructure to be “smarter” by providing data associated with the development and usage of physical space. At the same time, the increased use of data brings concerns about how this kind of infrastructure is managed and, especially, about how data is safeguarded.

[Data for Good](#) is a movement that aims to transcend organizational boundaries and use data to empower communities. An important consideration is how the data collected by smart cities is used. For example, while smart sensors can be designed to analyze air quality or noise levels with the goal of improving quality of life in communities, they can also [innocuously extract private information about citizens](#) in the process. A related issue is the [lack of standardization in design and challenges of interoperability](#) with current-day IoT devices. Although new developments like the [Zigbee Alliance](#) are attempting to pave the way for global standardization of IoT, the increasing provenance of digital infrastructure must come with solutions that ensure privacy, data security, and uphold the principles of data sovereignty.

Explained by Sanjay, blockchain technology could provide a solution. As a digital and distributed (decentralized) ledger of transactions and information, blockchain can improve data integrity, transparency, and—largely due to its decentralized nature and requirements for data validation—security and privacy. City information that could be effectively managed on blockchains include asset registries, inventories, health records, and land titles. While not without challenges, including issues like [transaction visibility that can ultimately reveal information in 'encrypted' data](#), blockchain may be one digital infrastructure solution to safeguard the data collected from a multitude of sensors and IoT devices in our cities.



“Ensuring that our urban spaces are equipped with the necessary physical and digital infrastructure to effectively respond to and capitalize on these changes is key for a smart future that prioritizes economic growth, environmental sustainability, and technological progress.”

ICTC Smart Infrastructure Roundtable

Key Takeaways and Recommendations

Following introductory presentations from Will Gagnon and Sanjay Khanna, the policy roundtable participants were split into groups of four to six. A [World Café conversation followed](#), where each group spent 20 minutes discussing a table topic, before moving on to the next table. The table topics were physical infrastructure, digital infrastructure, regulation, and talent. Insightful feedback and important insights were presented during each of these sessions. The following represents key takeaways and policy considerations that came to light during these working groups.

Physical Infrastructure: Eco-Friendly Buildings, “Low-Tech” Solutions, and the Inevitable Intersection of the Physical and the Digital

To guide the discussion on physical infrastructure in the context of smart cities, the following questions were presented to participants:

- *Who should build our city’s smart physical infrastructure?*
- *How do we distinguish physical vs. digital infrastructure?*

Based on these questions, the following concepts and essential considerations emerged:

Eco-Friendly Physical Infrastructure is a Must, and a Focus on Existing Assets is Essential

Roundtable participants emphasized the need for physical infrastructure that is eco-friendly and carbon neutral. The concept of living buildings as well as developments like vertical farms—both of which are relatively common in other parts of the world such as Europe and Asia—was highlighted as an important infrastructure consideration for Canada. However, a critical point that was raised in this discussion revolved around the need to not only build new infrastructure with these considerations in mind, but to leverage and improve existing infrastructure and assets. In short, it is critical to consider a city’s current portfolio of assets (and assess how they can be improved) before committing resources to new developments.

Using an analogy provided by one participant, the manufacture of cement for concrete currently accounts for about 5% of Canada’s carbon emissions, but that does not mean that all concrete buildings should be dismantled. Instead, energy

alternatives—for example, solar panels—could be added to existing residential and commercial infrastructure to improve environmental outcomes. New cleantech advancements on the horizons could also be incorporated into existing infrastructure. [Carbon Engineering](#), for example, is working on direct-air carbon capture technology that aims to convert carbon dioxide in various products, including a carbon-neutral jet fuel.

Augmenting existing physical infrastructure with clean technology innovations, like carbon-capture solutions, is key.

Physical Infrastructure is Inherently Tied to Digital Infrastructure

Overwhelmingly, participants agreed that physical infrastructure cannot be divorced from digital infrastructure. For example, a traffic light is a piece of physical infrastructure, but mount a [NearSky sensor](#) on top of it, and suddenly it becomes an IoT digital canopy that collects data on anything from vehicle traffic flow, cycling activity, air quality, and more. At this point, the streetlight is no longer *just* a piece of physical infrastructure.

Another growing consideration, as more and more physical infrastructure becomes digitally equipped, is the need for effective connectivity and data infrastructure. The impending rollout of 5G is on the minds of many people. For some advanced traffic solutions like autonomous vehicles—particularly when operating in traffic, collecting and uploading data in real-time and connecting *with* infrastructure—5G will be mission critical. Yet in other cases, other solutions may be just as effective. [Low Power Long Range \(LoRa\)](#) technology is just one example of a very viable alternative for many IoT devices that do not need real-time data transmission and are often collecting simple data (“open” or “closed,” “in use” or “not in use,” etc.). Although many businesses like Canada’s own [Eleven-X](#) already make use of LoRa to offer smart solutions, roundtable participants lacked knowledge in 5G alternatives like LoRa, including their cost and availability.

Physical and digital infrastructure is inherently linked. Since 5G may not be mission critical for all smart city activities, more information on alternatives like LoRa should be provided and emphasized in the effort of simplifying deployment.

Digital Infrastructure: The Constructs that will Supercharge our Future Cities

To guide the discussion on digital infrastructure, the following questions were presented to participants:

- *What digital infrastructure is needed to enable smart cities?*
- *What are the biggest roadblocks to the success of this digital infrastructure?*

Based on these questions, the following concepts and essential considerations emerged:

Sensors are Key But Standardization Must be a Top Priority

Roundtable participants agreed that sensors and IoT are and will continue to play a central role in our future smart cities. GE estimates that in 2020 the average [cost of a sensor will fall to under 0.50 cents](#). Cost-effective sensors, coupled with their ability to capture a variety of data points about a city and the activities within it will play an increasingly important role in IoT development as cities become more connected, more data-driven and “smarter.”

However, a central concern arose in relation to standardization—both in design and use. First, there is a need to develop standards in the actual development of sensors themselves to ensure a guaranteed level of quality and interoperability. Next, use standards need to be crafted, ensuring an acceptable code of conduct for data collection (intended or innocuous) as well as the use and treatment of that data. In the case of facial recognition, many questions arise about how facial recognition will evolve in Canada. Does it matter that the data collection tools that enable it—like sensors or cameras—are widely used but manufactured by different parties, each with varying standards and processes? Many roundtable participants felt that it does. The creation of Canadian, and eventually international, standards in this area was a stated essential need for the near future.

Sensors and IoT will become more important and more widely used in smart cities as their cost declines. The development of standards around IoT design and use will be key to ensure effective and reliable practices.

Bridging the Digital Divide Goes Hand in Hand with Competition in Telecommunications

Connectivity—and more specifically, fair and distributed connectivity—was another component seen as critical to smart digital infrastructure and smart cities. Yet, different regions and even neighbouring cities can face varying connectivity realities, especially when looking beyond our biggest urban centres. A [recent report](#) found that, overwhelmingly, rural and remote communities in Canada face challenges accessing affordable high-speed internet. This was seen as their biggest barrier to economic development. The problem is especially pronounced when comparing internet speed between urban and rural households in Canada. Less than 40% of rural households stated having access to 50/10 Mbps, compared with 97% of households in urban areas. The digital divide between urban and rural communities in Canada is persistent, severe and will remain a key roadblock to the development of smart regions—not just cities—in the future.

Overcoming these challenges is far from easy, with competition in the telecommunications sector being a central issue. Roundtable participants suggested a bottom-up approach is needed, focusing on a public push to bridge this gap. This could include, as one participant put it, “Opening up issues that are not typical ballot box problems.” This debate could extend to the state of competition in the telecommunications sector, or be informed by research into how certain communities and demographic groups (particularly Indigenous communities) are impacted—both socially and economically—by poor connectivity.

Bridging the digital divide between urban and rural communities must be a priority in our collective smart future. The digital infrastructure to support economic development across cities cannot be divorced from a conversation about access to reliable and affordable internet. A bottom-up approach, including active citizen campaigns for free and fair competition in critical sectors like telecommunications is key.

Regulation: Supporting, Enabling and Encouraging Innovative Infrastructure Solutions

To guide the discussion on regulation for smart infrastructure, the following questions were presented to participants:

- *Who is responsible for enacting policy and regulation tied to smart infrastructure?*
- *What specific aspects of smart infrastructure require regulation?*

Based on these questions, the following concepts and essential considerations emerged:

Cities Should Take the Lead: Regulation from the Core

While the question of who, when and how to regulate can often be difficult to answer, roundtable participants largely felt that the regulation of smart infrastructure should fall within city jurisdiction, with provinces playing a supportive role.

Cities have varying demographics, sizes, and regulatory expertise. This means that they will each face different problems or have different concerns related to smart infrastructure. At the same time, some cities may inherently have more knowledge and capacity when it comes to technology and infrastructure than others. As a result, while cities should be primarily responsible for regulation, roundtable participants asserted that municipal governments, especially the smaller ones, deserved some form of support and guidance from their provincial governments, including access to trusted vendors, relevant market information, or best-practices toolkits.

Resources and toolkits related to smart-infrastructure regulation should be provided to municipalities in order to help them navigate what may be new and uncharted territory. Additional support and opportunities for collaboration should be made available to cities from the provincial level.

Multiple Layers of Regulatory Responsibility Stemming from Smart Infrastructure, But Critical Infrastructure is Paramount

In terms of regulatory priorities, critical infrastructure like roads, hospitals, and government service offices were highlighted as needing the most urgent attention. Cybersecurity infrastructure—whether tied to critical infrastructure or on its own—was another substantial priority.

In the case of roadways, transportation infrastructure is currently a mix of physical and digital constructs, often working hand in hand. Thousands of kilometres of physical roadways can now be monitored and tracked by cameras, sensors and weather stations with the goal of improving traffic flow, safety and efficiency. As municipalities make the slow transition from legacy systems to new technologies on their journey to a smart future, regulation and effective policy is required to ensure that critical infrastructure is not compromised or subject to unintended security concerns in the process.

Regulation related to critical infrastructure for smart cities is of utmost importance. This includes effective regulation and policy tied to cybersecurity infrastructure, particularly as municipalities make the conversion from legacy systems.

Talent: The Fabric Uniting the Development and Success of our Future Cities

To guide the discussion on talent considerations for the development of smart infrastructure, the following questions were presented to participants:

- *Viewing smart infrastructure through the human lens, how do we develop, train, recruit and retain the talent needed to drive smart infrastructure solutions?*
- *How do we view talent from the process lens: Planning, Procurement, Management?*

Based on these questions, the following concepts and essential considerations emerged:

Innovative Talent Recruitment and Training Strategies Must be a Central Priority for Cities

Whether developing a smart city strategy or a [“smart enough” city](#) strategy, talent is highlighted as a key determinant of success. Although aware of the importance of skilled talent, municipalities highlighted challenges in attracting top talent, especially the inability to compete with the wages offered by the private sector.

Although municipalities may not be able to compete with private sector wages, roundtable participants suggested other methods to attract key talent, including focusing on a central goal. Purposeful goals, such as committing to achieving two to three sustainable development goals, can be key to building a common purpose or guiding principles that attracts top talent. Simultaneously, municipalities must learn to leverage in-house talent, including upskilling existing workers that enjoy and are already committed to public service. For example, with some new training and skill development, existing traffic control personnel in Surrey, British Columbia, can be effectively trained to work in the city’s [Traffic Management Centre](#), which responds to automated alerts from signals and sensors. When discussing methods for upskilling, roundtable participants highlighted that this must be done through extensive collaboration between industry and academic institutions of different varieties.

Cities should anchor their recruitment practices in setting common or shared goals and values to attract top talent. Cities should also focus on retraining or upskilling existing talent to meet current-day and future talent needs.

Smart Infrastructure Projects Require Product Managers Not Project Managers

Although the project manager is a role that is currently [in-demand across the digital economy](#), the advent of smart cities will create new demands for different roles.

This is because a smart city and the smart infrastructure that supports it are, in and of themselves, more *products* than they are public services. As a result, the demand for *product* managers is likely to surpass the demand for project managers as smart infrastructure flourishes.

Roundtable participants especially emphasized the importance of the product manager when it came to sustainability. Unlike project managers that focus on delivering a project until its end date, product managers will inherently look beyond the horizon of the project and consider sustainability, integration, and the needs for long-term success.

Municipalities should focus on recruiting, training and retaining product managers to ensure the sustainability and ongoing innovation of smart infrastructure projects. Information showcasing the clear distinctions between the product and project manager should be made readily available to municipalities.

CONCLUSION

ICTC's first roundtable in a series of five Smart City Policy Roundtables took place in November 2019. The topic was Smart Infrastructure, which engaged 30 thought leaders from across Canada, with areas of expertise in physical infrastructure, digital infrastructure, security and privacy, regulation, and talent readiness. This roundtable provided key insights into smart city physical infrastructure, digital infrastructure, regulatory concerns, and the talent needs for advancing infrastructure.

Discussions of physical infrastructure emphasized the need for developing eco-friendly and carbon-neutral infrastructure. Augmenting existing physical infrastructure with clean-technology innovations should be a priority. It was noted that physical infrastructure cannot be divorced from digital infrastructure, which relies on ubiquitous, low-cost sensors for capturing a variety of data points. However, participants also identified the need for sensor development standards to ensure quality and interoperability. Another critical consideration is ensuring an acceptable code of conduct is in place for data collection and use. Fair and distributed high-speed internet connectivity was also identified as a critical component to smart digital infrastructure.

Smart infrastructure regulation should fall within city jurisdiction, most of the participants said, with provinces playing a supportive role. Regulatory priorities should include critical infrastructure such as roads, hospitals, and government services. Cybersecurity infrastructure also needs to be substantial priority. Concurrently, the talent needed for smart city development will be critically important. Municipalities may face challenges in attracting top talent because the private sector can offer higher wages, however, a focus on purposeful goals and leveraging in-house talent, including upskilling initiatives, could level the playing field.

The next ICTC roundtable will take place in the spring of 2020 and will focus on smart mobility.