Smart Cities of the Future

Policy Brief
Economic Policy Series – October 2012

Introduction

On October 24, 2012, the Canadian Chamber of Commerce and the Calgary Chamber of Commerce joined forces to present *Smart Cities of the Future*, a conference that brought together some of Canada's top opinion leaders and decision-makers from the private sector, government and academia to discuss how to design better, smarter and more sustainable cities.

Eighty per cent of Canadians reside in urban areas, up from 60 per cent in 1950. The United Nation predicts that by 2050, 86 per cent of Canada's population will live in an urban area. Urbanization is not unique to Canada. More and more people are clustering in urban areas across the globe, in both developed and developing countries.[1]

Cities are a primary driver of economic growth, innovation and opportunity. They are powerful magnets for highly skilled and educated workers and gateways for new immigrants. They are centres of business, generators and suppliers of financial capital, important trade hubs for both goods and services, and the focal points of global commerce. They house substantial infrastructure assets and major institutions that power regional prosperity and the nation's quality of life. These critical characteristics make cities strategic leverage points for strengthening the national economy and competitiveness.

1 United Nations, Department of Economic and Social Affairs, Population Division. "World Urbanization Prospects: The 2011 Revision." April 5, 2012.

The Canadian Chamber is committed to fostering a strong, competitive and profitable economic environment that benefits all Canadians. This paper is one of a series of independent research reports covering key public policy issues facing Canada today.

We hope this analysis will raise public understanding and help decision-makers make informed choices. The papers are not designed to recommend specific policy solutions, but to stimulate public discussion and debate about the nation's challenges.

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Cities also confront significant challenges. The scale and pace of urbanization is straining physical infrastructure, fiscal capacity and natural resources. Mass urbanization is challenging institutions and governance structures that often lack the capacity and flexibility to respond to fast-paced growth.

Many cities around the world have launched "smart city" initiatives to support sustainable urban development. The term "smart city" has been applied to a variety of concepts but is generally used to describe a city that has deployed and integrated on a large scale advanced information and communications technology (ICT), including wireless and broadband connections, advanced analytics software and intelligent sensors to achieve significant improvements in efficiency and in the quality of life, and to help change behaviour among residents, businesses and government so cities can grow in a more sustainable way. Many of the most important innovations will lie below the skin of the city, and they will be in a state of constant evolution. They will be expensive to implement; however, properly done, the benefits generated can dwarf the costs involved.

This report focuses on the evolving role of cities in the global economy, how cities are transforming themselves to attain a competitive advantage and why being "smart" is key to sustained economic growth and prosperity.

The Urban World Is Shifting

The scale and pace of urbanization is transforming the world's economy.

In 2007, 600 cities worldwide accounted for 60 per cent of global GDP.

- Half of global GDP came from 380 cities in the developed world (with more than 20 per cent of global GDP coming from 190 North American cities alone).
- The 220 largest cities in developing regions contributed 10 per cent of global GDP.[2]

By 2025, one of every three cities in the developed world and one out of 20 cities in emerging-market economies that were part of the 2007 list will no longer make the top 600. By 2025, 136 new cities are expected to enter the top 600, all from the developing world and most—100 new cities—from China. Companies looking for the most promising markets will find another different list of potential urban hot spots.[3]

By the year 2025, more than 20 of the world's top 50 cities ranked by GDP will be located in Asia, up from eight in 2007.[4]

"By 2025, the City 600 will be home to an estimated 310 million more people of working age—and account for almost 35 percent of the expansion of the potential global workforce. Almost all of this increase is likely to be in the cities of emerging-markets—and two-thirds in the leading cities of China and India."[5]

Cities, particularly those in the developed world, will require new ways to stay competitive and attractive to skilled labour, entrepreneurs, businesses and investors.

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2 Dobbs, Richard, Sven Smit, Jaana Remes, James Manyika, Charles Roxburgh and Alejandra Restrepo. "Urban World: Mapping the Economic Power of Cities." McKinsey Global Institute. March 2011.

3 Ibid.

4 Dobbs, Richard, Jaana Remes and Sven Smit. "Urban Economic Clout Moves East." McKinsey Global Institute. March 2011.

5 Dobbs, Richard, Sven Smit, Jaana Remes, James Manyika, Charles Roxburgh and Alejandra Restrepo. "Urban World: Mapping the Economic Power of Cities." McKinsey Global Institute. March 2011.

The Fortunes of Cities Will Depend on the Strategies They Adopt

Rapid urban growth creates new challenges for local governments across the globe. Many cities have outgrown the capacity of their infrastructure, the design of their transportation systems and their ability to deliver adequate public services, making it difficult to get things done effectively and efficiently.

"Cities that under-invest in infrastructure and fail to keep pace with their expanding population and their demands—or that invest inefficiently or in the wrong capacity—can hit barriers to growth. Conversely, if cities manage their capacity building well, there is a huge opportunity not only for the world's investors but also to lock in more productive, less costly and environmentally friendlier operations for decades."[6]

Cities that provide well functioning and efficient environments for businesses and individuals will be more able to attract and retain skilled workers and sustain more productive and profitable businesses.

6 Dobbs, Richard, Jaana Remes, James Manyika, Charles Roxburgh, Sven Smit and Fabian Schaer. "Urban World: Cities and Rise of the Consuming Class." McKinsey Global Institute. June 2012.

Cities Are Transforming Themselves to Attain a Competitive Advantage

Many cities are exploring the "smart city" concept to improve efficiencies, optimize how they use largely finite resources and become better places to live. They are deploying new information and communications technology to strengthen services across different sectors and to build an intelligent digital nervous system supporting urban operations. "This instrumentation creates brand new data points about, for example, the efficiency of a city's water or transport systems. In addition to being instrumented, different parts of a city's systems can be interconnected, so that information flows between them. With the greater digitization and interconnection of a city's core systems, the newly gained information can be used for intelligent and informed decision making."[7]

Additionally, "ICT approaches, including e-governance, enable access to information and time-saving convenience for citizens. When properly deployed and managed, these technologies allow cities to save capital expenditures while transforming government personnel and citizen behaviour to become more sustainable over time."[8]

By incorporating information and communications technology and strategically exploiting the vast amounts of data they generate, smart cities can make buildings more efficient, reduce energy consumption and waste, and make better use of renewable energy. They can manage traffic intelligently, monitor how infrastructure performs, provide better communications infrastructures, deliver services much more efficiently, and enhance citizens' access to government.

The important thing about the smart city concept is that it uses intelligent systems to manage common services. The infrastructure needs to be sufficiently flexible so that it can be constantly updated—the very essence of intelligent technologies is the speed at which they evolve. Many of the technologies being put in place today may soon become obsolete.

According to ABI Research, $8.1 billion was spent globally on smart city technologies in 2010. Spending is projected to reach $39.5 billion by 2016. ABI Research expects $116 billion in cumulative spending on smart city technologies from 2010 to 2016. Currently, smart grids account for the bulk of spending on smart city technologies, but ABI Research foresees a significant increase in investments on smart transportation technologies and smart governance systems going forward.[9]

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7 Dirks, Susanne and Mary Keeling. "A Vision of Smarter Cities: How Cities Can Lead the Way Into a Prosperous and Sustainable Future." IBM Institute for Business Value. June 2009.

8 United Nations. "Shanghai Manual: A Guide for Sustainable Urban Development in the 21st Century." 2010.

9 ABI Research. "$39.5 Billion Will Be Spent on Smart City Technologies in 2016." *Press Release*. September 8, 2011.

Smart Cities of the Future

New Songdo City

New Songdo City near Seoul, South Korea is perhaps the most ambitious smart city project currently underway. The mostly privately financed project is being constructed on reclaimed land. It will be home to 65,000 people when completed in 2015 and will boast many of the latest green technologies.

Smart homes are at its heart. Front doors, lighting, air-conditioning, heating, security systems and even blinds and curtains can be controlled by electronic devices such as smartphones, PCs, tablets and touch-screen pads. Residents have access to telepresence units for video conferencing friends and family, businesses, government offices, hospitals, schools, shopping centres and banks.

Fibre optic broadband threaded throughout the city connects residents and sends a constant data stream to the computer processors that help operate Songdo. Sensors in the roads measure vehicle loads, adjust traffic measures and dim the LED-lit streets when no one is around. Radio frequency identification tags on cars send location data to a central hub, identifying black spots (sections of road with a high occurrence of accidents) and tweaking signals to ease congestion. Homes are equally efficient as power companies monitor the use of electrical appliances to better understand how residents use energy and set the grid to adapt.

Around 40 per cent of Songdo is green space. Rooftop vegetation helps to reduce storm water and soak up the sunshine during hot spells, which in turn helps cool the city. Rainwater traps and recycled grey water from sinks and dishwashers dramatically reduce the need for fresh water. Refuse is automatically collected by a network of vacuum pipes.

Masdar City

Perhaps the best-known smart city in the world is Masdar City—a planned development in Abu Dhabi in the United Arab Emirates. While the Abu Dhabi government is organizing the project, many local and international firms are helping design and plan the city. Masdar is being built to diversify Abu Dhabi's economic base and create an indigenous, technology-exporting knowledge economy. When it is completed by 2025, the city will be home to 40,000 residents and 1,500 businesses—most specializing in green technology and clean tech products.

The entire city is being built on a platform. Below the platform sits the smart infrastructure—a Personal Rapid Transit system (driverless pod-shaped vehicles powered by solar electricity and guided by magnetic sensors), a Light Rail Transport system, utility services, waste management and recycling facilities, and a fibre optic network for communications.

One of the levels below the city's platform will accommodate a Freight Rapid Transport system that will operate on a dedicated magnetic guideway and will make up to 5,000 trips per day delivering goods to the city's businesses and residents.

There will be no need to dig up city streets to undertake repairs—all infrastructure hardware will be easily maintained via full height access points under the city's platform. Electronic sensors will notify of service problems and faults.

Eighty per cent of water used in the city will be recycled, with grey water used for crop and landscaping irrigation. Storm water will be collected in pools.

Above the platform, the city will showcase many kinds of green technology—in its energy-efficient buildings, its production systems, its educational and research institutions, its open spaces and recreation areas. The city will rely entirely on solar energy and other renewable energy sources (wind, geothermal and hydrogen power). It will use 75 per cent less energy than a similar sized city of typical construction.

PlanIT Valley

PlanIT Valley is a sustainable city development near Porto, Portugal that will be home to 225,000 people when it is completed in 2015. Much of the city is being built using prefabricated parts that come with the smart technology pre-installed. The city will operate with a virtually non-existent carbon footprint.

The entire city and its buildings will be monitored around the clock by 100 million sensors that will transmit data on anything from traffic levels, power consumption, water usage, waste processing and infrastructure condition and performance. "When you leave your home to go to work, the temperature will be automatically turned down so as to avoid wasting energy. If your bathroom leaks, your new-generation automated domestic system will call a plumber to report the problem. And if you're in your car, looking for somewhere to park, an on-board computer will automatically inform you of the available nearby spaces."[10]

PlanIT Valley will integrate research universities focused on emerging smart technologies. The city is also being designed as a living laboratory for businesses to showcase new technologies and to test out emerging smart innovations. The project is mostly privately financed.

Making an Existing City Smart Is More Challenging

Grand designs are possible only when building a city from scratch. Retrofitting existing infrastructure with smart technologies can be complex, disruptive and expensive. Moreover, there are multiple parties, stakeholders and processes involved, requiring clear sighted orchestration and oversight. Cities also face budget constraints, and governments funds are already committed or assigned to other purposes.

Some cities are undertaking smart revitalization initiatives, one step at a time.

10 Sustainable-Mobility.Org. "PlanIT Valley - The New Smart City in Portugal!" May 16, 2012.

Amsterdam Metropolitan Area

The Amsterdam Smart City, a public-private joint venture, is held up as the example of how to retrofit a city, step-by-step, to fuel sustainable economic growth and a high quality of life. Businesses, government, research institutions and the people of Amsterdam have partnered to develop the metropolitan area into a smart city. In essence, the metropolitan area has been turned into an urban living laboratory that allows businesses to both test and demonstrate innovative products and services. The most effective initiatives can then be implemented on a larger scale.

Thirty projects, focusing on energy transition and open connectivity, have been launched: 300 power hook-ups have been installed to recharge electric cars; solar panels have been installed on Amsterdam's historic townhouses; infrastructure upgrades allow households to sell energy from small-scale solar panels and wind turbines back to the city's electricity grid; data on energy consumption is sent to consumers via mobile phones; smart meters have been installed in hundreds of businesses and homes; billboards are powered by solar energy; and sea vessels can hook up to shore power stations that allow green energy to replace noisy, polluting diesel generators.

Rio de Janeiro

Smart technologies are bringing efficiencies to this large city beleaguered by serious operational problems. "What is happening here reflects a bold and potentially lucrative experiment that could shape the future of cities around the world."[11]

In December 2010, Rio inaugurated its city operations centre, a citywide system that fully integrates data from 30 city agencies, all under a single roof. "City employees in white jumpsuits work quietly in front of a giant wall of screens—a sort of virtual Rio, rendered in real time. Video streams in from subway stations and major intersections. A sophisticated weather program predicts rainfall across the city. A map glows with the locations of car accidents, power failures and other problems."[12] By leveraging real-time information, they are able to anticipate problems, coordinate available resources and respond quickly.

In addition to using all the information gathered to manage the city, the data is shared with the population on mobile devices and social networks so they can better manage their daily lives. The virtual operations platform also integrates information that comes in from citizens and city employees via phone, radio, e-mail and text message.

The operations centre will continuously evolve to integrate more city departments and information.

Stratford, Ontario

It may come as a surprise that a very small city in Southwestern Ontario tops the global charts in the smart city category. In 2012, for the second year in a row, the Intelligent Community Forum ranked Stratford as one of the top seven cities in the world for creating uniquely powerful innovation ecosystems on a foundation of information and communications technology. Two other Canadian cities, Quebec City and Saint John, made the Top Seven Intelligent Communities of the Year list.[13]

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11 Singer, Natasha. "Mission Control, Built for Cities." *The New York Times*. March 3, 2012.

12 Ibid.

13 The other four cities are Austin, Texas; Oulu, Finland; Riverside, California; and Taichung City, Taiwan.

With an underground fibre optic grid already in place, in 2010, Stratford completed deployment of a high-performance wireless network to meet energy conservation objectives as well as provide high-speed connectivity to the entire community to increase inclusiveness and stimulate economic growth. The city now has the digital infrastructure of a major metropolitan area.

Stratford is reaping the benefits of its dual-purpose network strategy. Its smart metering initiative is helping the city and its customers reduce both electricity consumption and utility bills. Energy consumption data is collected and transmitted to end-users wirelessly in real time. Customers can adjust their schedules to take advantage of off-peak, lower rate periods during the day and night. It also helps to reduce the potential of brownouts during peak usage hours.

The same network that is helping to conserve energy also offers ultra high-speed Internet access to residents, city workers, businesses, visitors and government agencies. The network has excess capacity to support additional applications.

The network is publicly-owned and managed by the city's data infrastructure company (Rhyzome Networks) and its electrical utility (Festival Hydro). Both are wholly owned by the City of Stratford. Rhyzome rents fiber and wireless broadband capacity on the network to local carriers and internet service providers who deliver the services to the Stratford community. This also provides the city with an additional revenue stream. It is a "means of capitalizing on a valuable city-owned asset."[14]

Cities like Stratford recognize that "innovation in intelligent communities brings together business, government and institutions in a dynamic partnership that produces results ranging from better and cheaper service delivery to citizens, to the birth and growth of entrepreneurial businesses and vital new institutions."[15] This is evident in Stratford.

- The Stratford Institute for Digital Media (a new partnership of universities, governments, business and the creative sector) was established in late 2010 to help define and advance Canada as a digital nation.
- The University of Waterloo recently opened a satellite campus in Stratford with a focus on digital media. Stratford was considered the perfect setting for the new campus because of its great mix of digital infrastructure and creativity.[16]
- The Waterloo Stratford Campus is one of the anchor hubs in the Canadian Digital Media Network, a national Centre of Excellence for Commercialization and Research.
- Two secondary schools in Stratford now offer major programs in digital media and information technology.
- Stratford is the centre of a four-hospital regional partnership. They lease fiber from Rhyzome Networks and other providers to connect physician groups and family doctors in the area. The network also connects health care laboratories and specialized care units to serve hospitals, clinics and medical professionals to deliver timely and better quality health care services.

14 Beitz, Michael. "Venture Offers Stratford the Switch." *Stratford Beacon Herald*. November 20, 2011.

15 The Municipal Council of the Corporation of the City of Stratford. "Stratford City Council Agenda." *4396th Meeting Regular*. May 14, 2012.

16 Haddrall, Lynn. "UW Joins Stratford on Road to the Digital Future." *The Record.com*. October 6, 2012.

- Some of Canada's largest banks have located critical data, IT and loan processing centres in the community.

- Global technology giants—both domestic and international—are using Stratford's high-speed wireless network and underlying fibre optic grid to pilot technology. Indeed, many of the investments made in Stratford have taken place because it is being used as a test lab. "These companies have discovered in Stratford a forward-thinking populace, creative business culture, and leading edge infrastructure offering manageable size, with enough critical mass to yield meaningful results, yet scalable for global markets."[17]

- "An organic technology-centric culture has been emerging with founding of startups, IT and tech commuters calling Stratford home."[18]

Few Canadians are aware of the changes that have been made in Stratford. Significant as they are, they are incremental, not revolutionary. Stratford's experience suggests that smart technologies are equally relevant in smaller communities, although they may be used in different ways, such as for distance learning, telecommuting or telemedicine.

Richard Florida's 3Ts

According to Richard Florida, one of the world's leading urban studies theorists, cities that will come out on top will be those that fare best in terms of the 3Ts—technology, talent and tolerance. "Each is a necessary but by itself insufficient condition for prosperity; for real innovation and sustained economic growth a place must offer all three."[19]

Florida adds that "tolerance—or, broadly speaking, openness to diversity—provides an additional source of economic advantage that works alongside technology and talent. The places that are most open to new ideas and that attract talented and creative people from across the globe broaden both their technology and talent capabilities, gaining substantial economic edge."[20]

In essence, he writes, cities "act as giant petri dishes, where creative types and entrepreneurs rub up against each other, combining and recombining to spark new ideas, new inventions, new businesses and new industries."[21]

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17 Mathieson, Dan. "The Triple Helix Model: Stratford's Public/Private/Education Partnerships." *The Economic Development Journal of Canada*. 2012.

18 Canada 3.0 Digital Media Forum. "City of Stratford – The Festival City Makes Intelligent Moves." *City of Stratford Backgrounder Final 2012*. April 2012.

19 Florida, Richard. "The Rise of the Creative Class." *10th Anniversary Edition*. New York: Basic Books. 2012.

20 Ibid.

21 Florida, Richard. "The Joys of Urban Tech." *The Wall Street Journal*. September 1, 2012.

In Summary

Until the mid-twentieth century, the study of economic growth largely revolved around firms and nations. Little emphasis was placed on the importance of location. Economic thinking has progressed considerably since then. We have come to recognize that "places give rise to a variety of talents and specialties, the broad diversity of which is vital to spur innovation… Cities just don't get bigger in size; they become multifaceted and differentiated" and in doing so, they "are the well-spring of new innovations that generate new work and the new branches of industry."[22] In other words, cities have become the engines that drive innovation, economic growth and living standards.

Cities attract people because of the economic and social advantages they offer. Rapid urbanization presents a wide range of challenges for cities, not only to their economic performance but also to the quality of life of their residents, sustainable resource use, fiscal performance and governance. Future growth and prosperity will depend on how well cities manage these challenges.

At the same time, the balance of global economic power is shifting to cities in the developing world, particularly toward Asia where new economic urban dynamos are emerging and existing ones are expanding rapidly. "China's economic transformation resulting from urbanization and industrialization is happening at 100 times the scale of the first country in the world to urbanize—the United Kingdom—and at ten times the speed."[23] Cities, particularly those in the developed world, will require new ways to stay competitive and attractive to skilled labour and businesses.

Cities that embrace innovation—including smart technologies that enable well-functioning and efficient environments for their citizens and businesses—can position themselves to thrive. They can attract talent, new business development and investment and significantly increase their competitiveness.

When it comes to building the smart cities of the future, partnerships are the key to success. "Cities need to deploy common platforms across multiple service layers to drive economies of scope and scale, and to generate a unified and coherent 'customer experience' for its citizens. This will increase the complexity of the urban ecosystem of digital services, driving a greater than ever need for effective partnerships and clear sighted orchestration to align the large number of stakeholders."[24]

The private sector can be a source of funding, ideas and innovation and can share lessons learned from other projects. It can work with local governments to deploy and integrate advanced information and communications technology that will help cities achieve maximum performance and sustainable economic growth. It can also provide for real-time oversight and management of projects.

"In this era of tight governmental budget constraints, capital efficient solutions delivered by highly competitive public private partnerships are likely to be the business model that wins favour with municipal buyers."[25]

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22 Florida, Richard. "Who's Your City?" Random House Canada. 2008. See also Ellerman, David. "Jane Jacobs on Development." *Oxford Development Studies 32*. December 4, 2004.

23 Dobbs, Richard, Jaana Remes, James Manyika, Charles Roxburgh, Sven Smit and Fabian Schaer. "Urban World: Cities and Rise of the Consuming Class." McKinsey Global Institute. June 2012.

24 GSMA and Accenture. "Smart Mobile Cities: Opportunities for Mobile Operators to Deliver Intelligent Cities." April 2011.

25 Ibid.

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