

Welcome to this week's presentation and conversation
hosted by the
Canadian Association for the Club of Rome,
a Club dedicated to intelligent debate and action on global issues.

Smart Cities: What are they?

Our speaker today is Peter MacKinnon, currently a management consultant and academic affiliated with uOttawa after career as a scientist, business executive, entrepreneur, bureaucrat, and diplomat. He has been involved in Smart Cities since the mid-1990s. He is also a pioneer in Artificial Intelligence and Big Data. Cities are the nexus of human activity, the transformative centres of human habitation for millennia. Today, cities are undergoing changes enabled by advanced information and communications technologies--the world is moving toward Smart Cities.

In this talk, we will explore the meaning of what Smart Cities are and why they are important.

Peter MacKinnon's presentation will be followed by a conversation, questions, and observations from the participants.



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Smart Cities: What are they?

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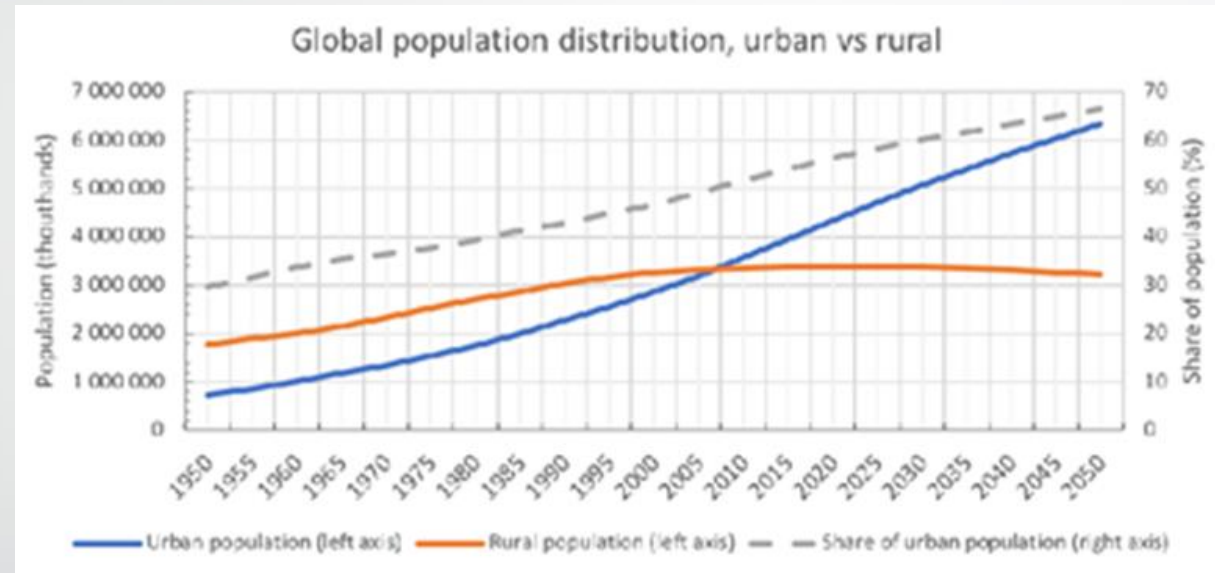
Address to: the Canadian Association of the Club of Rome via Zoom

March 9, 2022

Big Picture Context

- The 19th century was a century of empires
- The 20th century was a century of nation states
- The 21st century is shaping up to be a century of cities, in particular Smart Cities
- Today more than 55% of the world's population lives in cities with UN forecasts to 75% by 2050
- The rate of migration to cities has been increasing up until the 2020 global pandemic
- A major socio-economic reset is coming, as we are not going to return to Business As Usual (BAU) & the future BAU is still unknown in all dimensions (e.g., time, scope, cost)

Trend in Global Population: Urban vs. Rural 1950 to 2050



www.researchgate.net/publication/334961037_Walkability_as_a_sustainable_urban_public_policy/figures?lo=1

Note: overall population growth continues albeit at the lowest rate in the past 70 years, with the prospect of moving from 7.2 billion today to 8.5 billion by 2030

The Rise of the Smart City

- The concept of a city is morphing from a transactional focus to a diverse mix of integrated & interlinked systems of systems all enabled by the appropriate use of - ICT
 - **On the surface** (e.g., Smart Transportation – ICT-based sensors in the roadbed)
 - (i.e., to control traffic lights)
 - **In space** (i.e., GPS for navigation), in-vehicles (i.e., collision avoidance, autonomous operation)
 - **In the hands of citizens** (i.e., smart phones)

What makes a city smart?

- **One way to view Smart Cities is that they are all about 'local'** by providing both essential and non-essential services in close proximity to one's residence & place of work
- **A Smart City uses real-time & archival data & digital technology to assist in making better decisions** across a range of city functions for employees, businesses & citizens benefit of employees, businesses & citizens
 - (e.g., from monitoring & controlling city infrastructures (e.g., utilities), city services (e.g., first responders) & city consultations (e.g., from city to citizens & vice versa) all with a view to improving operations & the quality of city services ultimately leading to improve quality of life for citizens & visitors)
- **More comprehensive real-time data gives cities the ability to monitor events as they unfold**, understand how demand patterns are changing & respond with faster & lower-cost solutions



Defining a Smart City

- **There is no set definition of a Smart City**
 - There are many working definitions often shaped by the view one takes in describing a vision for a Smart City

The Ideal Smart City

Most cities are far from operating in the image as characterized

Major reasons for this are:

- Lack of awareness
- Financial constraints
- The pressures of day-to-day operations in running a city
- As the world moves through a global pandemic the urgency of transforming into a Smart City has increased



Smart Cities: Broad Definitions

- A Smart City is a municipality that uses ICT to add new capabilities to city operations while increasing operational efficiency, share information with the public & improve both the quality of government services & citizen welfare

<https://internetofthingsagenda.techtarget.com/definition/smart-city>

- A Smart City is a municipality that achieves effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous & inclusive future for its citizens

<https://shop.bsigroup.com/upload/283889/PAS-181.pdf> - page 4

Data-driven Definitions

- A Smart City is a municipality in which sensor-driven data collection & powerful analytics are used to automate & orchestrate a wide range of services in the interests of better performance, lower costs & lessened environmental impact

www.techopedia.com/definition/31494/smart-city

- A Smart City is a municipality that adopts scalable solutions that take advantage of ICT to increase efficiencies, reduce costs & enhance quality of life

Working Definition

A Smart City is:

- Citizen-centric
- Has useful real-time knowledge of itself
- Proactively & 'creatively' resolves challenges
- Evolves continuously through gradual innovations in all of its characteristics

Self-described Definitions of a Smart City

- **Toronto:** “A smart city improves access to the information and data a city needs to help it become an economically, socially and environmentally-connected community. Our goal is to ensure that people are easily connected and included in our digital city. This could mean finding new ways for residents and businesses to improve navigating Toronto or accessing City services or even engaging with their local government.”
- **Tokyo:** “Smart city” relates to revolution and environment, meaning a city where technological revolution promotes better living and protects the environment to improve lives of Tokyo’s people.”
- **Singapore:** “A Smart Nation is one where people are empowered by technology to lead meaningful and fulfilled lives. Through harnessing the power of networks, data, and ICT, we seek to improve living, create economic opportunity and build a closer community. A Smart Nation is built not by Government, but by all of us - citizens, companies, agencies.”



Large Scale Challenges for Cities

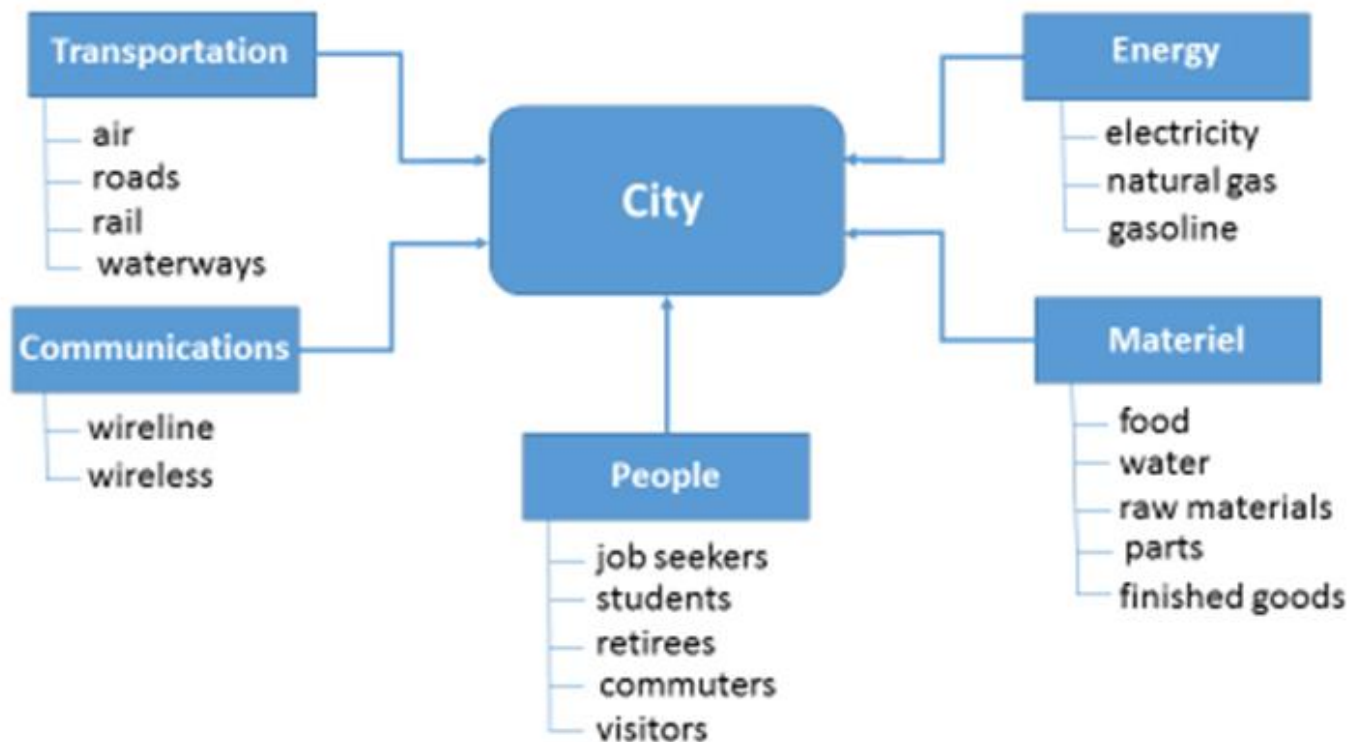
- Moving from Analog to Digital
- Re-designing of Public Spaces
- Re-profiling the Energy Mix
- Achieving Sustainable Growth
- Securing Budgetary Needs

- These issues & others can be mitigated through the adoption of scalable solutions that take advantage of ICT
 - in order to increase efficiencies, reduce costs & enhance quality of life

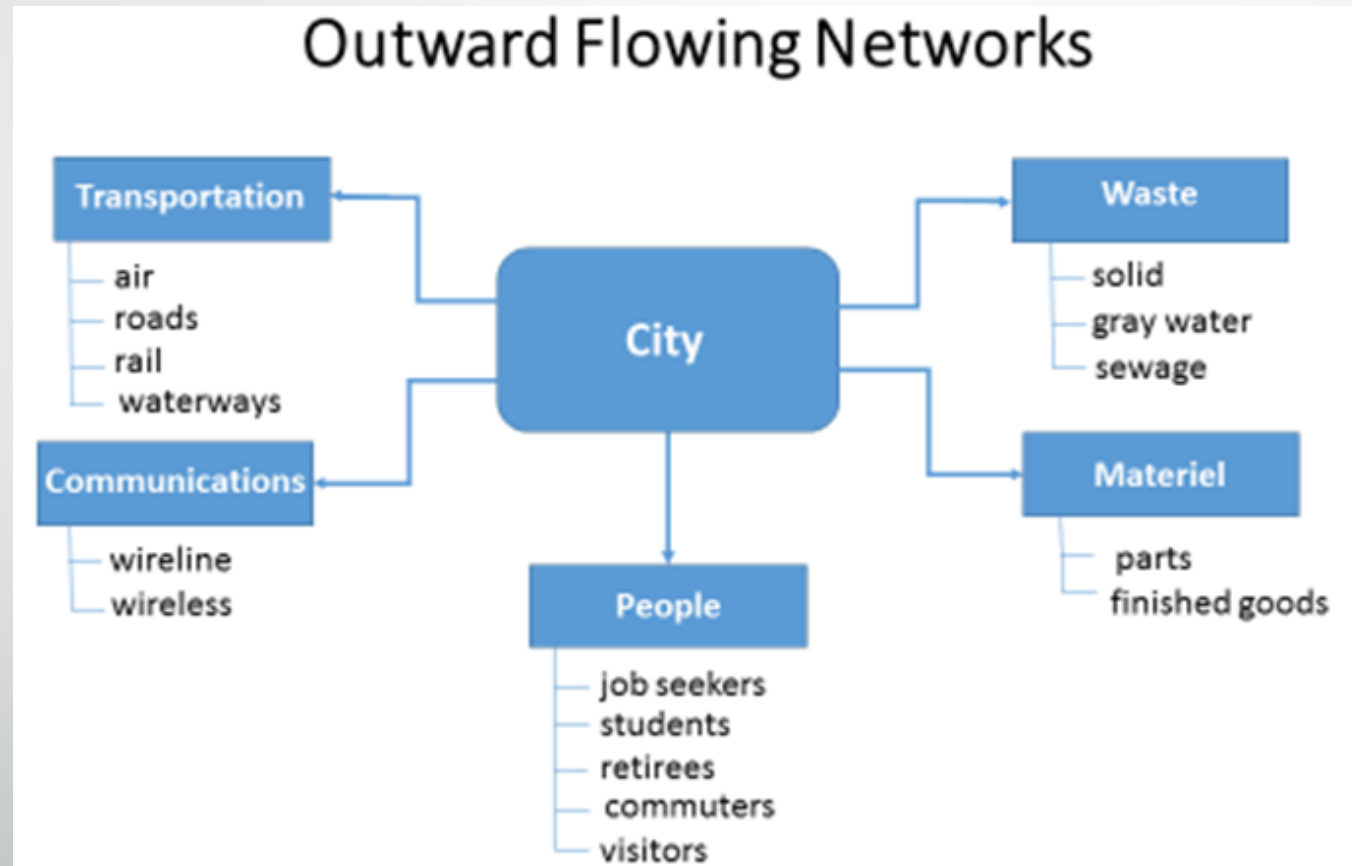
The City as Networks

Inward Flowing Networks

primary source of threat vectors



The City as Networks (2)



The City as Networks (3)

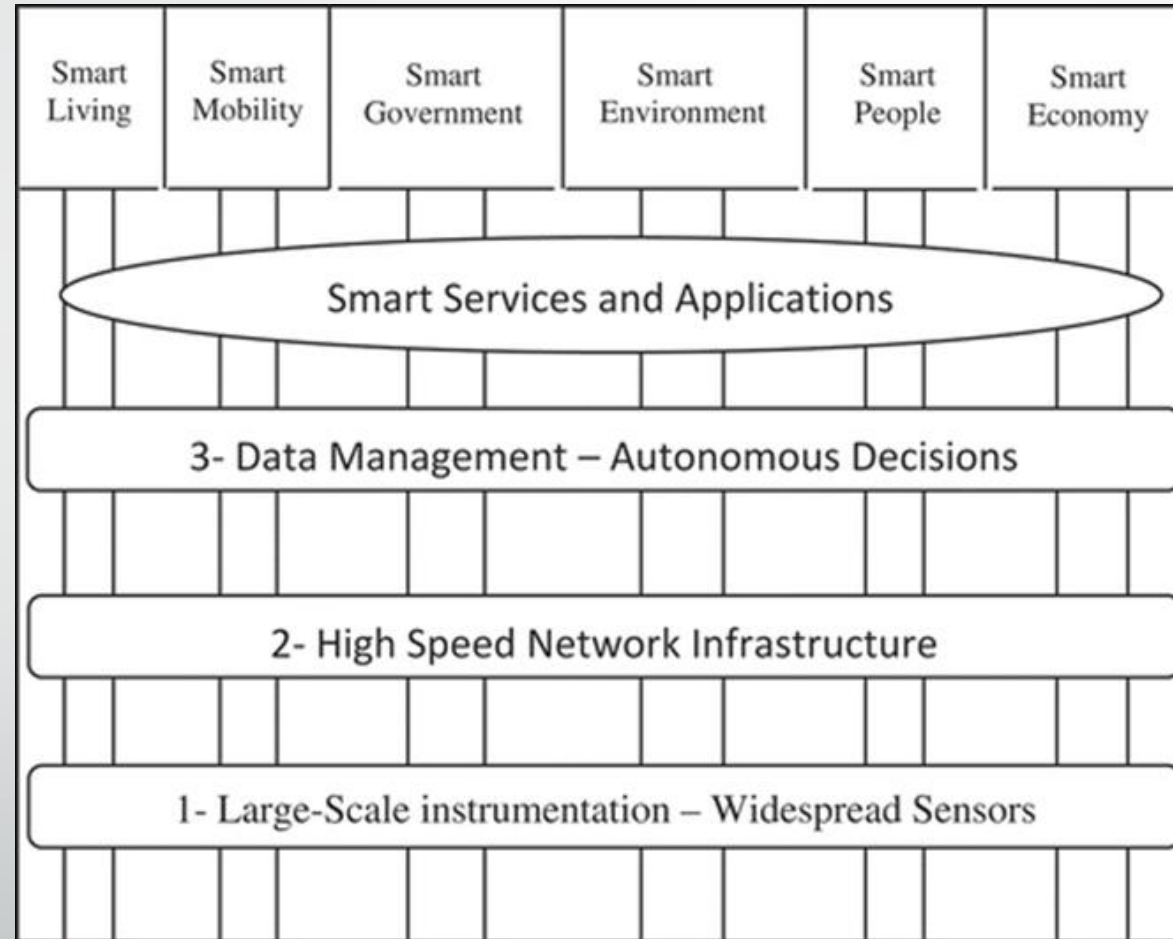
Internal Networks

- Energy
 - electrical
 - natural gas
- Emergency Services
 - police
 - fire
 - medical
- Transportation
 - public transit
 - private transit
- Communications
 - wireline
 - wireless
- Public Services
 - road maintenance
 - traffic control
 - potable water
 - gray water
 - sewage

Viewing a City in Four Layers

- A city is comprised of three physical layers:
 - The surface
 - Underground
 - The space above the city
- The fourth is a virtual layer:
 - Consisting of applications that initially draws data from the other three layers
 - Based on the data & associated applications in the virtual layer, instructions & data are then feedback into the physical layers, often in near real-time
- Thus in a Smart City the 3 physical layers, being interconnected, can share & merge data in new and novel ways that would be impractical in a traditional Transactional City with it silos in operations

The Virtual Layer: ICT Building Blocks





<https://internetofthingsagenda.techtarget.com/definition/smart-city>

Smart City Technologies (SCTs)

- The need to invest in physical assets & maintenance is critical to any city
 - (e.g., SCT can add new capabilities as core components of city infrastructures are upgraded)
- SCTs help cities get more out of their assets
 - (e.g., extensive legacy systems or building from scratch)

Smart City Technologies (2)

These ten technologies are transforming cities

- 5G mobile networks
- Artificial Intelligence (AI)
- Big Data & data analytics
- Blockchain
- Cloud computing
- GPS
- Internet of Things (IoT)
- RFID
- SCADA
- Sensors & sensor networks

Blockchain For Smart Cities

12 Possible Use Cases



Universal ID Cards



Prioritizing Local Commerce



Land, Property & Housing Management



Energy, Water & Pollution Management



Improving Public Transit



Interoperability For Smart Devices



Security For IoT Devices



Rewarding Citizenship



Urban Planning



Departmental Transparency



Universal Data Storage Platforms



Keyless Signature Interface

DISRUPTOR DAILY

Blockchain For Smart Cities

www.disruptordaily.com/blockchain-use-cases-smart-cities/

Technology Components of a Smart City

- **The Concept of 'smart' applies when communications connectivity is added to a passive object leading it to be referred to as 'smart'**
 - (e.g., smart meter)
- Many technologies are interrelated in so far as one technology empowers another
 - (e.g., IoT is intertwined with AI, big data, cloud computing, GPS & wireless sensors)
- Smart City technologies have their origins in areas beyond strictly urban needs
 - (e.g., offer promise in varying degrees as to their applicability to different size communities as they transition to 'smart')

Technology Components of a Smart City (2)

- Technology components that are essential to become a Smart City are:
 - Sensors
 - Networks
 - Data analytics
- SCT must be supported by policies & capabilities that offer:
 - Open data
 - Requisite anonymity
 - Cybersecurity
 - Interoperability
- Collectively these combine in multiple ways to offer a myriad of applications that support city operations & offer services to various interest groups within the community
 - (e.g., residents, businesses & visitors)

Technology Components of a Smart City (3)

- These technologies combine to meet the objective of improving city operations, information & transaction services to the community
 - (e.g., traffic control, first responder operations, utility services, public health, economic development, education, cultural infrastructure & urban planning)
- The future of mobility will be multi-modal systems connected through smart technology
- City leaders see the environment as the top challenge to address through Smart City programs with improved public health & safety as the main benefits
- Funding for Smart City solutions remains a key challenge for most cities



Benefits of Smart City Technologies

From a study based on 136 cities in 55 countries, 750 businesses & 2,000 citizens in 11 cities & looking out 5 years:

- The path to a Smart City future is often unclear to urban leaders
- Without the right vision, plans, talent & funding in place, smart city programs will not reach their full potential of providing economic, social & productivity benefits
- Data are the rocket fuel for Smart City transformation
- By 2021 almost all Smart Cities will draw on IoT and real-time data
- The use of AI applications-generated data will grow exponentially

Benefits of Smart City Technologies (2)

- Predictive data, currently used by 40% of cities, will rise in usage by 63%
- Cloud-based technology, mobile apps, citywide data platforms, IoT/sensors, biometrics & geospatial technology are now used by more than half of the surveyed cities
- The use of both geospatial & behavioral data will rise by 54%
- Keeping up with digital innovation will be essential for Smart City success
- Spending on smart programs rises with Smart City maturity
 - (e.g., cities committed to starting a strategic effort to become a Smart City typically allocate 15% of their capital budget)
- The future of mobility will be multi-modal systems connected through smart technology
- City leaders see the environment as the top challenge to address through Smart City programs & improved public health & safety as the main benefits
- Funding for Smart City solutions remains a key challenge for most cities

More Benefits

The benefits of becoming a Smart City over being a Transactional City include the following:

- More effective data-driven decision-making
- Enhanced citizen & government engagement
- Safer communities
- Improved public & private transportation
- More efficient public utilities
- Reduced environmental footprint
- Better equipped to handle both natural & human induced shocks such as a pandemic, severe weather or a major fire, industrial accident or even a terrorist attack
- Long-term economic savings in operational costs
- New economic development opportunities



Smart City Systems of Systems

- Intelligent Transportation System (ITS)
 - Connected Vehicles
 - Autonomous Vehicles
- eHealth
 - Telehealth
 - Telemedicine
- Smart Grids & Microgrids
 - Dynamic self-regulating, billing & local sharing

The Promise of Smart Cities

- Smart Cities & Smart City technologies can provide solutions to challenges that have long been troubling both city & world leaders, such as:
 - Ways & means to provide affordable housing
 - Reduce poverty
 - Address climate change
 - Deliver quality health care
 - Reduce transportation grid lock

Sustainability

- **UN Sustainable Development Goal 11** advocates for sustainable cities and communities, noting how despite representing engines of economic growth cities:
 - Account for 60% of global GDP
 - Account for 70% of global carbon emissions, and
 - Contribute to over 60% of resource use while:
 - **2 billion** urban dwellers do not have access to waste management services
 - **1 in 4** urban residents live in slum-like conditions
 - **Over 90%** of COVID-19 cases are in urban areas
 - Sustainable cities are about more than just reduced energy costs and emissions, they also aim for the realization of a better quality of urban life for all. New intelligent solutions, underpinned by technology, can improve the safety and well-being of inhabitants

Today Everything is in Transition

- The Pandemic is causing a global reset
- The nature & timeline to a New Normal are unclear
- The cityscape has been thrust into changing – but to what?
- The future of work is foggy due to both technology & disease
- The future of 'a job' as a career is looking uncertain
- The need for adaptation & remediation are increasing due to climate change
- Technologies, especially ICTs, offer a vast range of potential to address the transformation from Transactional Cities to Smart Cities
- Yet the policy & governance implications of many of these new technologies are in their infancy

Mini Case: Smart Cities Technological Responses to COVID-19

- Some cities have managed to whether the severity of the impact of the pandemic by leveraging technology & data to track, contain & mitigate the crisis
- Local authorities are using sensors & data to implement 'high-tech' contact tracing, where others use their CCTV systems and sensor networks to monitor and enforce social distancing measures
- By monitoring the real-time data collected by sensors, local officials have the capacity to identify 'busy' sections of metropolitan areas and act accordingly to limit the possible spread of deadly pathogens
- Integrated mobile applications are used by several countries in association with various tech firms to produce an effective contact-tracing app for COVID-19

Mini Case: Future of the City Core in a Post Pandemic World

- COVID-19 has triggered a vast global change in how humans interact & is forcing cities to change
- Some of this change is driven by population growth & redistribution while the core of cities & the urban networks that feed the core need to change as a consequence of the current & future pandemics
- We can expect significant transformation of city cores from one centre to multiple centres; thus profoundly changing the skyline of cities
- The implementation of ICT and IoT applications and technologies, coupled alongside data analytics to optimize city functions & liability, could drastically impact the nature of city cores & physical urban spaces
- The primacy of skyscraper development today & over the next 5 to 10 years will remain secure within urban centres; but their functions and systems may differ like never before

Mini Case: Future of the City Core in a Post Pandemic World (2)

- To accommodate increasingly dense urban centres, communities will be developed & redeveloped to facilitate close-proximity commercial, residential & business activities
- Smart buildings deliver useful building services in a sustainable, efficient & automated manner
 - e.g. Illumination, thermal comfort, air quality, physical security, sanitation & more are offered at a lower cost & environmental impact over the building's lifecycle
- Smart buildings employ ICT to integrate subsystems into a 'building automation system'
 - e.g., subsystems typically operate independently, however, these subsystems can share information to optimize total building performance

Mini Case: Future of the City Core in a Post Pandemic World (3)

- **Smart buildings mark a significant step forward in meeting LEED standards** as outlined by the U.S. Green Building Council. LEED, which stands for Leadership in Energy and Environmental Design, is the most widely used green building rating system in the world and consists of four levels, ranging from basic to platinum status
 - Getting to platinum requires high sustainable performance in water usage, heating & cooling systems, air quality & power consumption
- **Smart buildings can also communicate with one another**, which marks a significant step toward the goal of creating “microgrids” that stabilize primary grids, compensate for supply fluctuations & reduce overall energy demand
- **As urban areas continue to expand the old central business district model of cities has become less predominant in urban design**
- **Smart Cities often advocate for the development of mixed-use space** that integrates commercial, residential, and business activities into one interconnected community in an attempt to promote functionality and equitability

Conclusions

Context

- **Cities in Canada in general are under more financial stress today,** due to the impacts of the evolving pandemic than at any time in the past century
- **Pre-pandemic long-term municipal plans and budgets are unlikely to unfold as planned for at least the next 5 years,** with long-term implications well into the 5 to 10-year timeframe
- **The pandemic offers municipalities the opportunity to reassess & redesign some city infrastructure & municipal services**
- **Coordinated leadership is required from all levels of government,** the private sector and the public, in order to help shape the direction & pace of change within municipalities

Conclusions (2)

Cities

- **Cities are seen as the nexus of human development & innovation in the 21st century**, as urban populations continue to expand globally
- **Cities that operate in independent silos will miss opportunities to address challenges** produced by the COVID-19 health & economic impacts, as well as other threats, such as climate change & the accelerating growth of the digital economy
- **Ownership & control of infrastructure in a city is often spread across a number of public & private organisations leading to increased complexity in governance, accountability & operations**

Conclusions (3)

Smart Cities

- **The benefits of becoming a Smart City over being a Transactional City include the following:**
 - More effective data-driven decision-making
 - Enhanced citizen & government engagement
 - Safer communities
 - Improved public & private transportation
 - More efficient public utilities
 - Reduced environmental footprint
 - Better equipped to handle both natural & human induced shocks
 - Long-term economic savings in operational costs
 - New economic & social development opportunities

Conclusions (4)

Smart Cities (cont.)

- **Being a Smart City requires extensive collaboration** among community stakeholders & the administrators of core municipal services
- **Cities need to collaborate within a common vision acceptable to community leaders & all levels of city administration**
 - (e.g., from the Mayor's Office to the road maintenance department or first responder services)
- **A municipal "open data" policy is a key factor in providing opportunities to break down administrative silos**
- **Transitioning to a Smart City is a multi-year effort** that is shaped by local priorities, often related to very specific infrastructure needs, such as improving user services in public transit
 - (e.g., adding real-time GPS scheduling & information services)

Conclusions (5)

Smart City Technologies

- **SCTs are fundamentally about transforming city operations & services** by using data & information in structured, convenient & shareable ways, & to do so in a digital form in both real-time & batch contexts
- **Smart City technologies are all underpinned by ICT infrastructure,** which supports applications to enhance the usability & effectiveness of digital data & information resources
- **Evidence to date shows that when deployed Smart City technologies have led to financial savings** while improving the effectiveness of operations



Summary

- Fundamentally the Smart City concept integrates information & communication technology into city operations and services
- The rise of e-commerce highlights the inherent benefits of Smart City connectivity projects
- Smart Cities & Smart City technologies can provide solutions to challenges such as ways & means to provide affordable housing, reduce poverty, address climate change, deliver quality healthcare & reduce transportation grid lock
- A Smart City should be more prepared to respond to challenges than one with a simple 'transactional' relationship with its citizens & community organisations



Thank you – Merci

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Thanks very much for attending this week's presentation;
I thank those who engaged in the conversation
for adding to the richness of this weekly event.

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