



The Road to Smart Cities: Considerations for a Templated Approach

A CABA WHITE PAPER

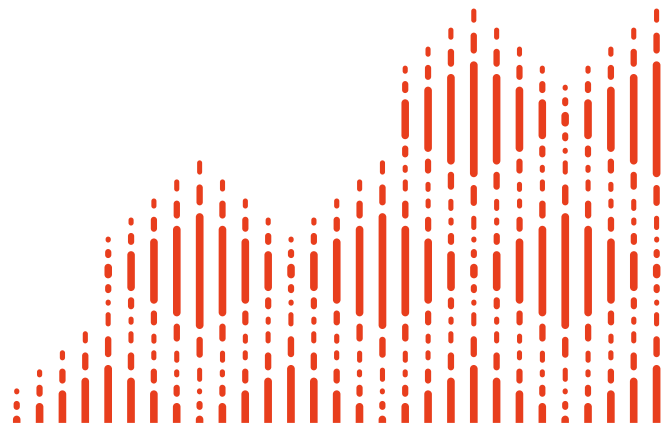
Bill Bryans
Electro-Federation Canada

Roberta Gamble
Frost & Sullivan



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Authors

Bill Bryans

Electro-Federation Canada

Roberta Gamble

Frost & Sullivan

Working Group

Carolina Gallo

ABB

Bruce Rebel

Association of Home
Appliance Manufacturers
(AHAM)

Caroline Twigg

Bristol City Council

Stephen Hilton

Bristol City Council

Katherine Thompson

Canadian Advanced
Technology Alliance (CATA)

Barrie Kirk

Canadian Automated
Vehicles Centre of Excellence
(CAVCOE)

Warren Everson

Canadian Chamber of
Commerce

Francis Bradley

Canadian Electricity
Association

Kevin Tuer

Canadian Open Data
Exchange (ODX)

Peter Halsall

Canadian Urban Institute

Kevin Wong

Canadian Water Quality
Association

Keith Robinson

City of Atlanta

Megan O'Neil

City of Atlanta

Roxanne Kits

City of Edmonton

Grant Coffey

City of Toronto

Jesse Coleman

City of Toronto

Prashant Bhalja

City of Toronto

Susan Viegas

City of Toronto

Ulrica Ho

City of Toronto

Frank Di Palma

City of Vaughan

Ed Tymofichuk

Consultant (Former Manitoba
Hydro)

Bill Belt

Consumer Technology
Association (CTA)

Stephen Brown

CSA Group

Tracey DeLeeuw

Ernst & Young LLP

Daniel Roman

Etron Energy Corp.

David Messer

Information Technology
Association of Canada

Jiri Skopek

JLL

Robert Arnold

National Research Council of
Canada

Simon Backer

National Research Council of
Canada

Noah Goldstein

Navigant Research

Brad DeFoe

Ontario Ministry of Research
and Innovation

Gary Rygus

Retail Council of Canada

Robert Lane

Robert H. Lane and
Associates Inc.

Jesse Berst

Smart Cities Council

Mark McDonald

Smart Cities Management
Consultant

David Katz

Sustainable Resources
Management Inc.

Carl Piva

TM Forum

Sonia Higgins

Unmanned Systems Canada

Working Group: Individuals
who either contributed ideas
and input into the direction
of paper or reviewed the final
draft.

Sub-Committee**Ken Wacks (Chair)**

Ken Wacks Associates

Brittany Hack

Consultant

Dilip Sarangan

Frost & Sullivan

Heather Knudsen

National Research Council

Marek Dziedzic

Public Services and
Procurement Canada

Raphael Imhof

Siemens Industry, Inc.

David Katz

Sustainable Resources
Management

Nikiforos Panorios

Synergy

Sub-Committee: Under the direction of the Sub-Committee Chair, this formal committee reviewed and approved both the initial white paper proposal and final draft.

ABOUT CABA

The Continental Automated Buildings Association (CABA) is an international not-for-profit industry association, founded in 1988, and dedicated to the advancement of intelligent home and intelligent building technologies. The organization is supported by an international membership of over 360 organizations involved in the design, manufacture, installation and retailing of products relating to “Internet of Things, M2M, home automation and intelligent buildings”. Public organizations, including utilities and government are also members. CABA's mandate includes providing its members with networking and market research opportunities. CABA also encourages the development of industry standards and protocols, and leads cross-industry initiatives. CABA's collaborative research scope evolved and expanded into the CABA Research Program, which is directed by the CABA Board of Directors. The CABA Research Program's scope includes White Papers and multi-client market research in both the Intelligent Buildings and Connected Home sectors. www.caba.org

ABOUT CABA'S INTELLIGENT BUILDINGS COUNCIL (IBC)

The CABA Intelligent Buildings Council works to strengthen the large building automation industry through innovative technology-driven research projects. The Council was established in 2001 by CABA to specifically review opportunities, take strategic action and monitor initiatives that relate to integrated systems and automation in the large building sector. The Council's

projects promote the next generation of intelligent building technologies and incorporate a holistic approach that optimizes building performance and savings. www.CABA.org/ibc

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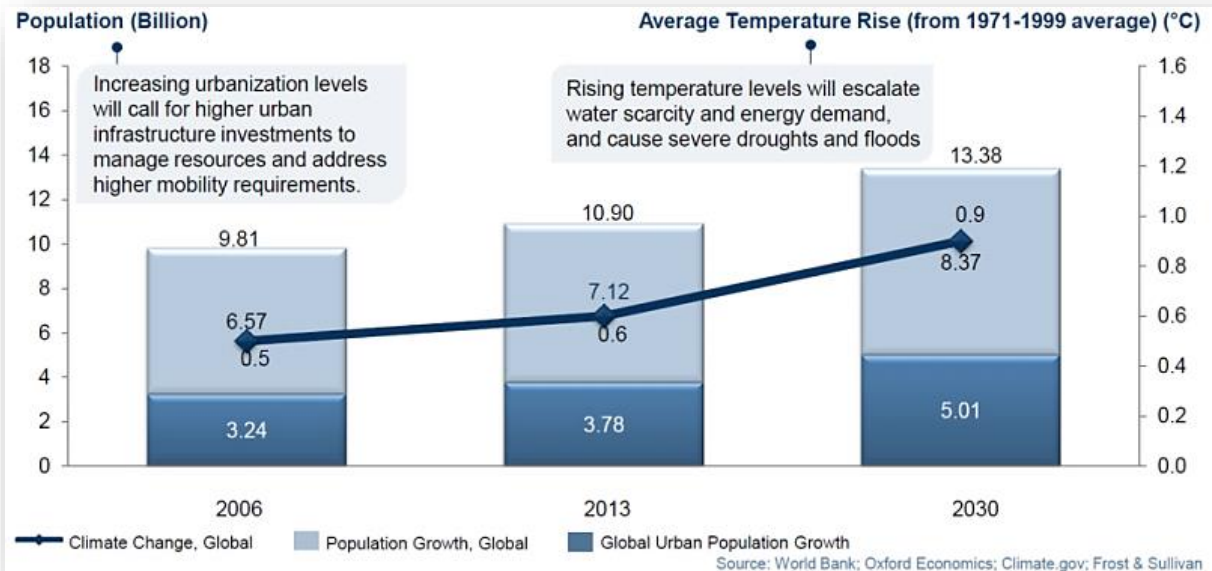
THE INTERCONNECTED OPPORTUNITIES OF SMART CITIES

More than 50 percent of today's ever-growing global population is living in increasingly cramped urban areas, up from 30 percent in the 1950s. The United Nations expects the percentage of urban dwellers to be even more staggering—about 67 percent—by 2050, with Asia and Africa being major growth centers and Europe and North America also experiencing significant increases.

The transition in less than a century from a largely rural and dispersed population to a centralized and concentrated one has been a consequence of many positive societal and economic influences—primarily the rapid increase of cities' contributions to national economies, and the surge of the middle class in emerging countries. However, urbanization does not always breed better lives. Public health and environmental challenges persist: cities are under greater pressure to improve quality of life by reducing crime, traffic, and by increasing access to education, healthcare, technology, and other services. Figure 1 shows the surging rates of population and environmental consequences.

These tasks are monumental, but the opportunities are also tremendous: Frost & Sullivan estimates the potential market for smart city solutions to be more than \$1.5 trillion USD globally by 2025. Cities are incredibly complex, which makes solutions and standards difficult to envision, much less implement.

Figure 1 Population and Climactic Changes Over Time



“...the potential market for smart city solutions to be more than \$1.5 trillion USD globally by 2025.”

But this complexity also connects citizens, businesses, and governments across what would otherwise seem to be disparate points. For example, a city health department could help fund projects that alleviate traffic congestion, which would benefit public health by reducing harmful emissions and improving ambulance response times. Street lights could be retrofitted with technology to provide everything from weather and traffic data to Wi-Fi hotspots. A smart utility grid already is a significant step toward improving energy efficiency, and could be used as a platform for other citywide services or communication.

Disruptive technologies are bringing about the transformation of some industries and the collapse of others. The rate is unprecedented: constant change has become the new norm. All urban stakeholders must be willing to collaboratively respond to, and prepare for, changes in the way cities operate. Businesses and citizens must focus on education and retraining to develop new skill sets. Governments must develop nimble policies to embrace a sustainable and more diverse economy, and use technology to harness data from every source possible because informed decisions in the smart city of the future will rely on both human and artificial intelligence.

THE BENEFITS OF 3GXP3 PARTNERSHIPS

Nowhere is this interconnection more important than in cities and their surrounding economic regions, which continue to draw more people as hubs of capital generation. These urban areas consist of many subsystems that must cooperate in all strategic planning to determine goals and objectives; share funding burdens and accountability; and coordinate deployment and maintenance.

For example, in Canada, municipal governments own nearly 60 percent of the country's core public infrastructure ¹ (defined as roads, bridges, transit systems, water and wastewater operations, and cultural, sports, and recreation venues). The federal share of this ownership has declined over 25 years of divestiture to less than 2 percent. In the United States, city governments will invest approximately \$41 trillion USD over the next 20 years to upgrade their infrastructure to benefit from the Internet of Things ².

Smart infrastructure is the foundation of a smart economy; the creation of smart city hubs can solidify this foundation. Key regions can develop strong, detailed case studies and create templates that enable more cities to quickly learn what is needed and what pitfalls to avoid in building scalable infrastructure systems. We believe such templates can aid urban areas in prioritizing goals and ease their transformation to a Smart City. Key global organizations are also recognizing the need for a guide to modernize the increasingly crowded urban landscape. For example, the International Organization for Standards (ISO) has created ISO/TC 286 to address the concerns for “sustainable cities and communities”.

THE CRITICAL ROLE OF SMART BUILDINGS FOR SMART CITIES

Within smart infrastructure are several key segments, such as power transmission and distribution, water distribution and treatment, transportation, and telecommunications. This latter element of connectivity is necessary to connect and enable the communication elements that define a “smart” city.

However, another critical aspect of a smart city are the buildings – public and private; commercial, governmental and residential – that define a “city.” The very essence of a city is its high density of businesses

and people—a smart city could hardly be considered a city without the buildings, nor smart without buildings that interact with each other and with other aspects of infrastructure.

It is no surprise then that cities who have goals of greater energy efficiency and lower carbon footprint, among other smart city goals, would look to improve building efficiency. The United States Department of Energy (DOE) estimates that the 4.2 billion commercial buildings in the US waste an average of about 30 percent of their energy. Globally, buildings account for about 40 percent of the energy consumption. This is a huge proportion of the world's energy being wasted. Considering the high concentration of buildings in cities, actively working with businesses, residents, and their own city assets in energy conservation efforts can bring strong returns both financially and environmentally.

Cities are quick to recognize this need for smarter buildings in order to reach their efficiency and quality of life goals. The city of Seattle, Washington, is one example of a city leveraging smarter buildings in this regard. The city recently appointed a Smart City Coordinator to help various divisions of the city collaborate. Even before this development, Seattle was an active member of a greater Puget Sound smart project that worked with private, public and non-profit partnership approach that focused on reducing energy consumption from buildings. It also has long offered financial and technical services to medium and large commercial and industrial companies wanting to upgrade existing facilities or build new smart ones in cooperation with municipal utility Seattle City Light, as part of its ongoing smarter city programs.

San Francisco, recognized by a Frost & Sullivan consumer survey as the “smartest” city in the US, now requires municipal buildings to be LEED Gold certified. San Francisco has made being a smart city a priority, having both a Chief Data Officer and a Chief Information Officer. Globally, notable leading smart cities such as Singapore, Barcelona and Amsterdam all incorporate smart and efficient building incentives into their smart city programs.

Cities and their resident buildings can work together to achieve mutual goals, such as:

- More efficient use of resources (energy, water, natural gas) for lower utility costs and better environmental footprint.
- Integration of additional energy generation and management technologies, such as solar PV, energy storage, demand response programs and electric vehicle charging stations.
- Safety and security—for example, Hitachi's smart city installation in Austin leverages private business security cameras for the local police in certain situations that require their intervention (gunshot detection for example, or intruder alerts) while still respecting the public's privacy.
- Sanitation control—cameras and sensors on buildings help the city proactively manage garbage collection.
- As telehealth and telemedicine gain traction, smarter buildings will provide safer and more healthy environments for aging-in-place and those with chronic health conditions.
- At an economic level, smarter buildings can also improve occupant health and worker productivity, thereby helping the city gain a healthier, and potentially wealthier, tax base.

This association between a smart city and smart buildings is a critical concept that is also clear in the minds of city inhabitants and visitors. Frost & Sullivan conducted a consumer survey on awareness of smart cities and how the general public would define the concept. The key hypotheses tested were:

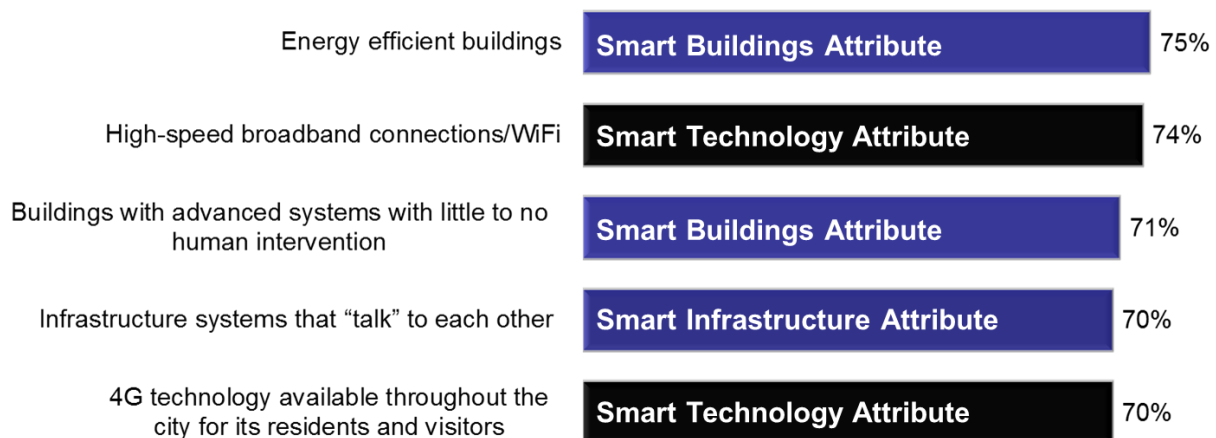
1. The general population had some, albeit limited, awareness of the term “smart city”.
2. Most people would be able to create a definition of “smart city” regardless of whether they had heard of such a term before, implying there was an element of intuitiveness in the term.
3. Most people would identify a smart city as one that has high levels of connectivity available – for example, city-wide wi-fi and advanced telecommunication systems.

The outcome of the study affirmed two hypotheses i) roughly one-third of the general population had heard of the term “smart city – and ii) respondents were readily able to conceive of how they would define a smart city, regardless of whether previously aware of the term.

A third hypothesis proved more interesting results. It confirmed that connectivity is a necessity for a smart city. However, smart buildings were arguably as important as having wi-fi in the eyes of the public. Aside from general “infrastructure” communication, no other aspect of infrastructure – energy, healthcare, water, or transportation – was recognized as readily as connectivity and buildings as the key elements of a smart city. Figure 2 shows the outcomes of the survey across these different categories.

Figure 2

Agreement with Top Defined Smart City Attributes (Strongly agree/Agree): United States, 2014



Base: All respondents (n=1,000).

Q8. Please rate your level of agreement with the following attributes as being characteristic or descriptive of a smart city. - Top two box scores

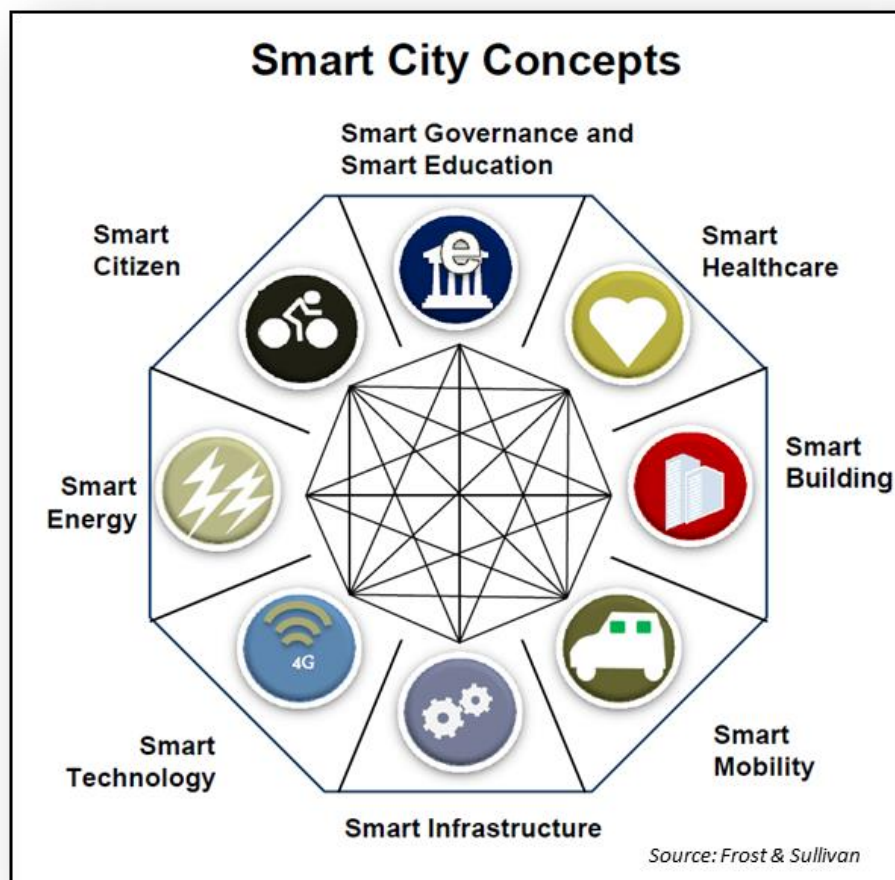
Hence from all angles – from consumer to business, city management to solution provider – smarter cities necessitate an evolution of their buildings in order to reach their goals.

THE ROAD TO THE TEMPLATED SMART CITY

The first step is to establish key goals and objectives based on the founding principles of a smart city hub. A hub must be capable of interfacing with all other smart edge systems for all service utilities (electricity, water, and gas), communication, transportation, residential and commercial buildings, and factories.

A true smart city is one that not only has a high-level of digital connectivity but one in which multiple departments can leverage each other's data, information, platforms, and communication networks for greater efficiency and cost savings. Figure 3, below, shows the key concepts within a smart city that, when leveraged in tandem, can help a city evolve to one that is safer, more efficient, more environmentally sound and more appealing to citizens, businesses and visitors.

Figure 3 Smart City Concepts



THE THREE LEVELS OF GOVERNMENT, BY PUBLIC-PRIVATE PARTNERSHIP (3GXP3), FRAMEWORK

The authors of this paper recommend involving the three levels of government (city, state/province, and federal) in a public-private partnership to create a three-tiered umbrella management consultation forum: 3GxP3.

- **The first tier** would include a task force of city government leaders and key vendors to recommend an overarching framework, in which all consultation for smart systems requiring best practices for networked interoperability would be incorporated. The task force would provide guidance to stakeholder groups involved in the development of smart cities and smart edge systems. The focus would be to not only improve existing infrastructure efficiency, reliability, resiliency, and sustainability, but also to predict the effect of various growth scenarios on a city. For transparency, a management system sustainability template must be created based on ISO 9000/14000 quality and environmental management standards. The management system would be valuable for tracking critical factors such as relationships with contracted service providers, maintenance, funding models, and continuous improvement. Government and business groups would seek input from citizens and engage with academia to determine how to best develop a competitive workforce. Guidance from this group and bidirectional communication with the second-tier group would be critical to bridging the gap between planning and execution.

“For transparency, a management system sustainability template must be created based on ISO 9000/14000 quality and environmental management standards”.

- **The second tier** would coordinate efforts to develop, design, and deploy smarter systems, starting with legacy infrastructure for utilities. Other efforts would examine the development of smart and sustainable residential and commercial buildings and factories, and smarter public and private transportation of people and goods as drivers are replaced by autonomous systems. Guided by the founding smart city hub principles, all infrastructure systems must be integrated to effectively and securely communicate relevant information while respecting privacy of citizens. Infrastructure-based data can be incorporated with soft data from public systems and business performance for further analysis against planning goals and objectives. Technology, communication, and change management roadmaps must be developed and maintained to show how each subsystem will function within a smart system and between smart edge systems. Any gap or conflict between applicable performance-based standards would be identified and resolved. Roadmaps are the most cost-effective and efficient way to ensure that complex systems function as intended.
- **The third tier** would bring together citizen advocacy groups; business organizations such as the Better Business Bureau or unions; environmental groups; visitor/travel alliances; educators; and other grassroots stakeholders to provide valuable insights into the challenges and needs of everyday life in a city.

THE IMPORTANCE OF CONSISTENT, FUNCTIONAL DEFINITIONS

For 3GxP3 to result in a successful smart city hub implementation, definitions must be functional, intuitive, and consistent across all stakeholders in order to advance discussion and action. For example:

- A basic smart system collects and analyzes data from embedded sensors or other sources to determine operational status, efficiency, and other factors. Built-in intelligence reactively adjusts operational parameters. Similar groundwork was laid for transformations in other industries, such as the development of smart grid systems over the last 10 to 20 years to integrate renewable energy, energy storage, and net metering technologies into electric power transmission and distribution networks to increase their efficiency, reliability, and resiliency.
- An advanced smart system monitors operational data and historical trends and proactively adjusts parameters to optimize performance.
- A basic smart city system collects, collates, and analyzes data from city service systems to monitor operational status, efficiency, and other factors. Built-in intelligence reactively adjusts operational parameters within pre-set norms for established hierarchical priorities. An umbrella oversight system collects relevant system data for trend analysis to proactively adjust operational parameters to optimize performance.
- An advanced smart city system can dynamically interface with businesses and citizens in a defined hub, to collect additional input related to city services and distribute performance optimization commands.



A smart street lamp can integrate lighting, cameras and sensors and be solar-powered,

Picture credit: Daniel Roman.

TM FORUM - HELPING CITIES BECOME SMART

Cities can be regional, or even global, knowledge hubs and innovation centers. Those that do this will become better places to live and be better equipped to manage urban challenges. A Smart City will attract talent, create jobs and unleash innovation.

To assist in this process, **TM Forum**, an international non-profit trade association, has been actively enabling Smart Cities. It has created the **City Platform Manifesto**, which **CABA** and a number of other organizations signed Sept. 21, 2017 at the Smart Cities Conference in Yinchuan, China. This Manifesto encompasses the following principles when deploying city platforms, supports the use of Open APIs and common standards. This in turn manages the vast reservoir of data offered by sensor networks, enterprises, city agencies and residents:

1. City platforms must enable services that improve the quality of life in cities; benefitting residents, the environment, and helping to bridge the digital divide.
2. City platforms must bring together both public and private stakeholders in digital ecosystems.
3. City platforms must support sharing economy principles and the circular economy agenda.
4. City platforms must provide ways for local start-ups and businesses to innovate and thrive.
5. City platforms must enforce the privacy and security of confidential data.
6. City platforms must inform political decisions and offer mechanisms for residents to make their voices heard.
7. City platforms must involve the local government in their governance and curation, and are built and managed by the most competent and merited organizations.
8. City platforms must be based on open standards, industry best practices and open APIs to facilitate a vendor neutral approach, with industry agreed architecture models.
9. City platforms must support a common approach to federation of data or services between cities, making it possible for cities of all sizes to take part in the growing data economy.
10. City platforms must support the principles of UN Sustainable Development Goal Making cities and human settlements inclusive, safe, resilient and sustainable.

TM Forum has, through collaboration, also developed [The Smart City Maturity and Benchmark Model](#). This model has been designed to capture the key aspects of a city's transformation journey to become a smarter city. The model allows a city to quickly assess its strengths and weaknesses in five key dimension areas related to city smartness and to set clear goals as how it wishes to transform over the next two to five years.

Another great resource is the TM Forum app made for Smart City Leaders. Anyone running a smart city project would work with various local stakeholders, benchmark progress in your city against best practices and develop a shared vision for the next couple of years. The Smart City Leader invites a handful of local experts to input evidence of progress for their city, into the App. The wider team and local stakeholders are then invited to score progress and set '2-year targets' on the four dimensions of:

- Leadership & Governance
- Stakeholder engagement and citizen focus
- An integrated approach to ICT
- Effective use of data

There are many more resources and activities that TM Forum can provide to people that are interested in understanding or developing a Smart City. You can access these resources at:

<https://www.tmforum.org/smart-city-forum/smart-city-resources/>.

THE ROAD FORWARD: WHY WE MUST CHANGE OUR APPROACH

Exponential technological changes can have far-reaching effects across society, as seen in the last decade with the explosion of social media and instant communication. Success in any industry today will rely on managing and analyzing real-time data from every conceivable source to create intelligence for informed decision-making. A smart city hub is no different: all public and private physical infrastructure and system technology must be able to communicate and interact on multiple levels, and rely on artificial intelligence for actionable insights.

However, the nature of a smart city hub is inherently different than many of its components. While the private sector primarily controls smart grids, smart buildings, smart factories, and smart mobility solutions,

societal and political systems also will oversee a smart city hub. The complex interconnection of disruptive technologies creates opportunities for new and non-traditional players in various markets. The lowest price cannot be the most important procurement criterion in a complex smart city project; assessment criteria must be based on performance objectives.

REFERENCES

1 Source: Renew Canada 2016 March/April magazine

2 Source: Frost & Sullivan



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