LSNetwork

SMART PLANNING OUR SMART CITIES

A BEST PRACTICES GUIDE FOR BUILDING OUR FUTURE CITIES

CANADIAN URBAN INSTITUTE

SMART PLANNING OUR SMART CITIES

BUILD YOUR TEAM

ESTABLISH THE CONTEXT

DEFINE THE OUTCOMES
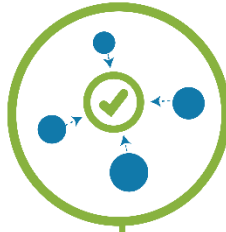
DEVELOP THE PLAN

IMPLEMENT

Phase I

Phase II

Phase III

Phase IV

Phase V

OUTPUTS:
- List of potential collaborators & stakeholders
- Mayor & council support
- Smart City Master Plan Advisory Board/Team
- Smart City Master Plan Champion
- Membership of knowledge-sharing groups
- Global partners

OUTPUTS:
- Established current state & digital maturity level
- Community engagement plan
- List of major community needs based on engagement
- List of existing strategic priorities
- Defined objectives for the Smart City Master Plan
- List of available data and gaps to be filled

OUTPUTS:
- List of desired outcomes of the Smart City Master Plan
- List of available solutions to achieve outcomes

OUTPUTS:
- The local context
- Vision and mission statements
- Roadmap to desired outcomes
- Evaluation framework with KPIs and baselines
- Approach to overcome challenges of smart city planning

OUTPUTS:
- Implementation plan by strategy
- Innovative funding & financing
- Solution procurement
- Monitoring & communication
- Embedded Smart

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ACKNOWLEDGEMENTS

GLOSSARY

Artificial Intelligence
The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.[1]

Big data
A combination of an approach to informing decision making with analytical insight derived from data, and a set of enabling technologies that enable that insight to be economically derived from at times very large, diverse sources of data.[2]

Connected Devices
Nonstandard computing devices that connect wirelessly to a network and have the ability to transmit data.[3]

Cybersecurity
The practice of protecting systems, networks, and programs from digital attacks. These attacks are usually aimed at accessing, changing, or destroying sensitive information; extorting money from users; or interrupting normal business processes.[4]

Data Privacy
Concerns the collection, protection and dissemination of personal or private information about individuals or organizations.[5]

E-government
The application of Information and Communication Technologies (ICTs) to government functions and procedures with the purpose of increasing efficiency, transparency and citizen participation.[6]

Hackathon
A sprint event where people come together around a problem or idea and collaboratively create a unique solution from scratch.[7]

Inclusion
The idea that everyone should be able to use the same facilities, take part in the same activities, and enjoy the same experiences, including people who have a disability or other disadvantage.[8]

Information and communications technology (ICT)
technology for input, storage, processing, transmission, and output (display and printing) of information and is divided into hardware (such as computers and peripheral devices) and software (such as information processing systems).[9]

Internet of Things (IoT)
A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies.[10]

Interoperability
The ability of systems to communicate and exchange data across organizational boundaries.[11]

Open Data
Digital data that is made available with the technical and legal characteristics necessary for it to be freely used, reused, and redistributed by anyone, anytime and anywhere.[12]

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[1]http://claimvantage.com/artificial-intelligence-ai-what-is-it-and-how-does-it-work/

[2]http://bigdata-madesimple.com/what-is-big-data-definitions-from-40-thought-leaders/

[3]https://internetofthingsagenda.techtarget.com/definition/IoT-device

[4]https://www.cisco.com/c/en/us/products/security/what-is-cybersecurity.html

[5]http://lexicon.ft.com/term?term=data-privacy

[6]http://portal.oas.org/portal/sector/sap/dptodemodernizaci%C3%B3ndelestadoygobernabilidad/npa/sobreprogramadeegobierno/tabid/811/language/en-us/default.aspx

[7]https://www.evergreen.ca/downloads/pdfs/2018/tech-and-data-msc.pdf

[8]https://dictionary.cambridge.org/dictionary/english/inclusion

[9]https://www.jica.go.jp/jica-ri/IFIC_and_JBICI-Studies/english/publications/reports/study/topical/approaches/pdf/information_02.pdf

[10]https://www.itu.int/en/ITU-T/gsi/iot/Pages/default.aspx

[11]https://www.exchangewire.com/blog/2016/01/26/interoperability-why-it-must-become-the-new-industry-standard/

[12]https://www.toronto.ca/city-government/data-research-maps/open-data/what-is-open-data/

International Open Data Charter (ODC)

A collaboration between governments and experts working to open up data. It was founded in 2015 around six principles for how governments should be publishing information. The aspiration was that data should be open by default, timely and interoperable.[13]

Sensor

A device that responds to a physical stimulus (such as heat, light, sound, pressure, magnetism, or a particular motion) and transmits a resulting impulse (as for measurement or operating a control).[14]

Smart City Master Plan Advisory Board/Team

A team of diverse stakeholders led by city staff with involvement of industry leaders and public representatives, organized to develop the Smart City Master Plan.

'Smart' (in Smart City)

State-of-the-art ICT coupled with human capital (research universities, knowledge intensive companies and public institutions).[15]

Small- and Medium- sized Enterprises (SME)

As defined by the Government of Canada:

Small enterprises have 1-99 employees; and medium enterprises have 100‑499 employees.[16]

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[13]https://opendatacharter.net/who-we-are/
[14]https://www.merriam-webster.com/dictionary/sensor

[15]https://www.journals.elsevier.com/technological-forecasting-and-social-change/call-for-papers/understanding-smart-cities-innovation-ecosystems-technologic
[16]http://www.ic.gc.ca/eic/site/061.nsf/eng/Home

INTRODUCTION

This is a practical guide intended to assist municipalities, provinces and solution providers in developing Smart City Master Plans for communities across Canada. It outlines key strategies for plan development, along with examples of global best practices.

Background

The rapid rise of urbanization has, in recent years, coincided with a massive growth in connected devices (or things that talk to the internet). Cisco predicts 50 billion connected devices will exist by 2020[17]. With this steady expansion of the Internet of Things (IoT), along with the kickoff of Infrastructure Canada's Smart Cities Challenge, there is significant opportunity for Canadian municipalities to empower their communities through information and communications technology (ICT) and connectivity.

To be competitive and prepared to respond to emerging urban challenges and opportunities, cities should be investing in their capacity to employ this connectivity to support smarter, healthier, and more equitable and sustainable communities.

Done properly, technological investments in essential infrastructure can lead to substantial community benefits. But the full potential of connected devices, with an increasing array of technology choices, may be difficult for municipalities to navigate.

Developing a comprehensive **smart city master plan** can be a proactive process for municipalities to identify their specific needs, unite stakeholders, and outline a roadmap for achieving effective and beneficial deployment of these solutions. This type of planning is focused on building a smart city from the ground up, to ensure technology is used to improve overall quality of life at home, work, and play, and to address local challenges faced by people.

Defining a Smart City

Defining 'smart city' is often unique for each community, tailored to the specific conditions and needs of each. Although early smart city initiatives were largely driven by technology, cities are beginning to shift the authority to decide on a city's technology needs to its citizens and capture this in the evolving definitions. A smart city approach should leverage technology to improve services and is driven by the community need rather than technology. Building a smart city ideally happens from the ground-up, empowering citizens without technology pushing the agenda.

Having no globally recognized definition can add to the complexity of smart city adoption. For the purpose of this guide, **'smart city' is generally understood as a term that refers to improving overall quality of life for people at home, work and play through the use of data and connected technology integrated throughout the built environment.** In this conception of a smart city, technology is used to provide opportunities for economic development and enhance urban services, resource conservation and cost effectiveness. These solutions are built on a foundation of high-speed broadband and open data with policies for data inclusion and data privacy.

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[17]https://www.cisco.com/c/dam/en_us/about/ac79/docs/innov/IoT_IBSG_0411FINAL.pdf

Municipalities often categorize these opportunities into key focus areas. Currently, many Canadian communities are looking to the framework outlined in Infrastructure Canada's Smart Cities Challenge, which includes the following six focus areas:

- **Economic Opportunity**: supporting the community with a thriving local economy by fostering innovation, improving competitiveness and creating and attracting talent.
- **Empowerment & Inclusion:** identifying who the vulnerable population is and what strategies will empower them so all residents have the opportunity to participate in the community.
- **Environmental Quality**: achieving a sustainable and healthy environment through resource conservation and renewable supplies.
- **Healthy Living & Recreation**: providing opportunities that encourage and support active and healthy lives.
- **Mobility**: advancing transportation to move freely throughout the community.
- **Safety & Security**: providing a safe and secure environment for all residents.[18]

This smart city definition is mapped out in Figure 1 above.

Master Planning our Future Cities

Historically, planning information and communications technology (ICT) systems in communities has commonly been led by private industry, rather than urban planners. However, within the last few years, select municipal governments have started using smart city master planning as a practice to leverage their networks as platforms for smart cities in support of municipal goals. For example, the Cities of New York and Barcelona are known for their early, industry-leading plans, both beginning in 2011. In Canada, municipalities including Calgary, Kitchener, St. Albert, Montreal, Edmonton and Vancouver have developed a digital strategy for their communities within the past five years.

Ultimately, a smart city master plan is a strategic intervention tool that builds on the evolution of early e-government initiatives. The plans prioritize true community needs and identify ICT solutions to overcome the identified challenges.

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[18] https://impact.canada.ca/en/challenges/smart-cities/applicant-guide

Figure 1: Visualization of a smart city and its six focus areas

The Value Proposition

Developing a Smart City Master Plan is a proactive method for municipalities to harness the unfolding digital revolution as a driver for improved quality of life and economic growth. A Master Plan positions a municipality to take advantage of opportunities, while identifying pitfalls to avoid. Strategies outlined in a Plan will prepare a municipality to leverage routine asset renewals as opportunities to integrate technology and connectivity, while mitigating risks of privacy issues, smart solutions in search of problems, technology dead-ends, etc.

Developing a Smart City Master Plan is also part of future-proofing governance and ensuring community services are continuously benefitting residents to create a high quality of life. With the pace of ICT innovation and adoption across Canada, it is expected that all communities will inevitably become 'smart'. According to the National Research Council Canada, all infrastructure will be 'smart' by 2030[19].

Not planning for this technology transformation, means communities will be reactive and unprepared

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[19] https://www.nrc-cnrc.gc.ca/obj/doc/about-apropos/corporate_overview-

vue_ensemble/NRC_Smart_infrastructure_and_cities_of_the_future_EN_web_version_2017-10-11_Revised_MMJ.pdf

to leverage the full benefits. A Smart City Master Plan brings the city closer to residents by adding value to the community proactively instead of reacting to needs as they emerge.

Developing and implementing a Smart City Master Plan is often not driven by short-term economic gains, as it will require additional funding, resources, and, often, in-house capacity building. What makes it worthwhile are the social and environmental returns that will improve the economy and community in the long-term. Building a smart city also engages a diverse and extensive stakeholder group, including municipal agencies, industry insiders, academia, community leaders, and others. A Smart City Master Plan unifies these separate groups, breaking down information silos—which, in turn, allows thorough exploration of the potential social and environmental benefits.

Furthermore, citizens themselves are arising as a main driver, putting city authorities under growing pressure to deliver efficient and convenient services in line with what they expect as digital customers.

Case Study: Barcelona, Spain

As a pioneer in smart city planning, Barcelona has demonstrated significant economic benefits to integrating smart city solutions. The city's first Smart City Strategy was a top-down approach involving major urban infrastructure projects in streetlighting, transportation, energy, and water. By 2014, Barcelona was saving $58 million a year from its smart water initiative, and it had increased parking revenues from multistory car parks by $50 million and had created 47,000 jobs. [20]

But not all projects were successful. Occupancy sensors put in street parking were found to be triggered by underground subways and ultimately unused by drivers. By continuously reviewing and revising its plan, Barcelona is now approaching its strategy with a citizen-centric focus—looking at what technology can do for the people to solve real problems. [21]

Although smart city master planning is now more commonly recognized as a valuable tool for strategizing how digital technologies will be deployed in our future cities, no coherent method has been demonstrated for plan development. This guide has been developed based on reviews of well established global smart city master plans and best practices, input from industry leaders and identifies high-level key steps to development.

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[20]https://www.forbes.com/sites/connieguglielmo/2014/01/07/ces-live-cisco-ceo-chambers-to-deliver-keynote/#4b936596b1d4

[21] https://www.ft.com/content/6d2fe2a8-722c-11e7-93ff-99f383b09ff9

PHASE I: BUILD YOUR TEAM

Solutions implemented through a Smart City Master Plan will impact a wide-range of stakeholders, not just those with a focus on technology. To develop an effective and championed master plan, information and agency silos need to be overcome to build internal and external partnerships and foster collaboration.
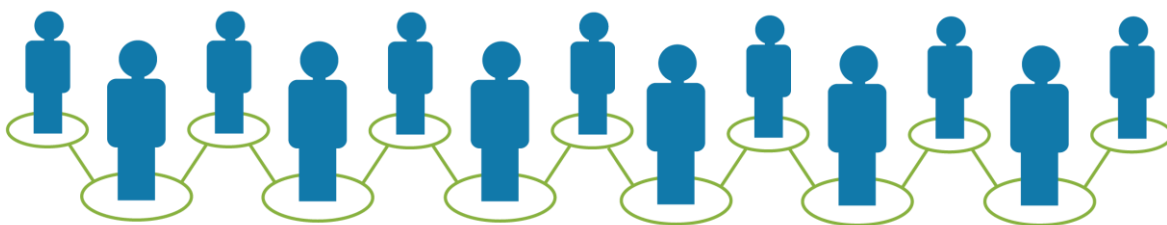
Phase I outputs:
- List of potential collaborators & stakeholders
- Mayor & council support
- Smart City Master Plan Advisory Board/Team
- Smart City Master Plan Champion
- Membership of knowledge-sharing groups
- Global partners

i.i Identify Potential Collaborators

The first step in developing a smart city master plan is identifying the key stakeholders from who will become the project team (can be called the Smart City Master Plan advisory board) and champions. A successful master plan is dependent on it being an interdisciplinary planning initiative. The design and implementation of early smart city solutions has too often been solely championed by the technology sector, despite solutions promising to address borader social, economic, technological and environmental issues. To avoid this incomplete approach requires collaboration of cross-sectoral internal and external stakeholders.

Preliminary engagement should be widespread within the local government, as well as in other levels of government and the tech and design community.

Efforts should be made to inform and engage most or all of the following stakeholders (this will vary by community):

a. *The Mayor and Council*

A Smart City Master Plan will need to demonstrate that it has strong political leadership, so the Mayor and Council should be engaged early and throughout the process.

b. *Chief Digital/Transformation/Technology Officer*

If not already an existing role, a municipality will often appoint a Chief Digital/Transformation/Technology Officer to champion smart city programs. They should have the industry knowledge and vested interest to drive the initiative, particularly if they have prior experience in the private sector.

c. *Privacy Commissioner*

Privacy is emerging as a common public concern. Although, most communities have ensured smart city solutions are not collecting personal data and specifically much less than common social

media platforms, the public can be averse to the idea of the government collecting information. To mitigate concerns. Data privacy and transparency experts should be engaged early-on to consult on the development or revision of the local governance's privacy policy. Provincial and territorial privacy laws should be reviewed and the commissioner consulted where appropriate.

d.   All major municipal department heads

With the cross-cutting impacts of smart city solutions, all municipal departments should, at minimum, be made aware of these efforts. Engaging multiple departments will, not only generate collaboration, but also help identify the full extent of potential benefits that may not be realized if investigated only through one department. Departments to engage may include:

- Corporate Services
- Economic Development
- Culture and Tourism;
- Energy Services;
- Emergency Management;
- Fire Services;
- Environment;
- Forestry and Forestry Services;
- Housing and Shelter;
- Parks and Recreation;
- Police;
- Public Health;
- Traffic management and mobility;
- Water Supply; and
- Waste Management.

Case Study: London, United Kingdom
The development of the 2013 Smart London Plan was driven by a large and diverse advisory board chaired by academic leaders and restructured on multiple occasions as the objectives of the Plan changed. Preliminary engagement focused on internal stakeholders, with meetings held with every department in the Greater London Authority to gain each of their inputs.[22]

e.   Industry insiders

Industry insiders can include local or international digital thought leaders and technology business executives who will have the interest, capacity and skills to develop smart city projects. It is valuable to have a mix of local and international talent on the team – engaging locals can help understand the local context and issues, while foreign talent can help bring expertise, viewpoints and best practices from elsewhere. These stakeholders should contribute to championing ideas events such as hackathons and design competitions. They may also be a sponsor or source additional external funding.

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[22]https://marroninstitute.nyu.edu/uploads/content/Working_Paper_25_Digital_Master_Planning.pdf

f. Academic Institutions

It is important to have buy-in from local academia, specifically universities and colleges. With the technology revolution, the success of smart city solutions is allied with knowledge and skills training. Much of this will be coordinated through or by schools. Furthermore, as these solutions are implemented to solve community-specific challenges, innovation is key. Universities and colleges can be an instrumental resource in researching and developing unique solutions without requiring funding from the municipality.

Case study: Milton Keynes, United Kingdom

Milton Keynes' smart city initiative MK:Smart was led by City Staff with a coalition of 21 partners. Open University – the largest public distance learning university in the United Kingdom, is the main project partner and responsible for the data management and data architecture development.

g. Utility Providers

It is important to engage local utility providers in the early stage of developing a Smart City Master Plan. Many of the high impact smart solutions affect energy and water use, such as, smart metering, district energy and smart grids. These applications will require some form of participation from the utilities to, for example, gain access to the networks and to ensure reduced resource use is captured in cost savings.

Case study: Canada

Converting to LED streetlights integrated with networked adaptive controls is one of the more common smart city applications being adopted across North America for the significant energy savings and establishing a city-wide communication network. However, due to flat rate tariffs of many utilities and controls not being certified by Measurement Canada, cost savings have been more difficult to realize. An early adopter of this technology, the City of Mississauga worked with its local utility to develop a method for demonstrating the metering integrity of its streetlight controls for more accurate billing.[23]

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[23]https://static1.squarespace.com/static/56cdde5262cd94f3e9cffd8e/t/58b49d7db3db2baa89981914/1488231809314/LightSavers.IntelligentLighting.2017.pdf

h. *Citizen and local business advisory group(s)*

To identify true community needs and establish the context, residents and local businesses must be heard. Citizen advisory groups can aid in ensuring public engagement is inclusive and accessible to all groups and ongoing.

As part of this preliminary engagement, map out the resources that become available to help determine what is achievable and how the smart city strategy might be delivered.

i.ii Build and Task your Team

Identify champions of each stakeholder group to form the Smart City Master Plan advisory board, as well the overall Team Lead for the Smart City Master Plan. The Team Lead is typically from local government, and must be capable of inspiring efforts in economic, social and environmental issues, adaptability to changing responsibilities and championing a clearly defined vision.

The advisory board and team lead should be endorsed by Council. The board will consist of city staff along with external partners who may include industry experts, academia, non-government organizations or others with expertise in technology, public policy and community outreach. Within City Hall, team members should include those with the ideas and energy to drive the initiative forward. Including stakeholders from outside local government in the advisory board has proven to be instrumental for smart city master plan development. Chicago, Barcelona, London and Hong Kong are some of the major cities who have acknowledged internal resources are lacking for smart city master planning, and have leveraged expertise from external consultants, either pro bono or contracted[24].

With the advisory board determined, each member should be assigned a specified role based on the knowledge and resources they are able to contribute.

Each role will be assigned specific tasks to help complete each step outlined in this guide.

Case study: Chicago, United States
To support the development of City of Chicago's Technology Plan in 2013, the City secured the resources of a non-profit to provide pro bono advisors from industry. The City later described these experts as a necessity for completing the Plan.[25]

i.iii Connect to Knowledge Groups

With the smart city concept a relatively new idea for most municipalities, approaches to master plan development and implementation can differ widely. Although smart city strategies are uniquely developed to provide the greatest benefits to the local community, it is valuable for the Smart City Master Plan advisory board to participate in knowledge-sharing organizations that can provide guidance and exchange lessons learned. For Canadian municipalities, regional organizations may include:

Municipal Boards of Trade

Example: Toronto Region Board of Trade
The Toronto Region Board of Trade facilitates a Smart Cities Working group that engages the Board, member stakeholders and the City of Toronto. The group works to foster collaboration in the development of smart city solutions by sharing

[24]https://marroninstitute.nyu.edu/uploads/content/Working_Paper_25_Digital_Master_Planning.pdf

[25]https://marroninstitute.nyu.edu/uploads/content/Working_Paper_25_Digital_Master_Planning.pdf

experience and expertise.
Link: https://www.bot.com/.

Associations of Municipalities

Example: Federation of Canadian Municipalities (FCM)

The advocacy group representing over 2,000 municipalities works to ensure the needs of communities are addressed within federal policies and programs. This includes advocating for opportunities and support for smarter cities.
Link: https://fcm.ca/.

Example: Association of Municipalities Ontario (AMO)

The advocacy of the AMO is similar to that of the FCM in ensuring municipal authority is respected through provincial policies and programs. The association also provides resources on funding programs and knowledge-sharing initiatives. One initiative is AMOpen – an open data platform of datasets relating to Ontario municipalities.
Link: http://www.amo.on.ca/.

Provincial Alliances

Example: Alberta Smart City Alliance

A collaboration of cross-sector partners from local government, community leaders, corporations and academia. For its members, the Alliance:

- Provides research, best practices and news;
- Support for government advocacy; and
- Engagement opportunities at knowledge-sharing events.

Link: https://smartcityalliance.ca/.

Global Networks

Example: Smart Cities Council North America

A network of organizations advised by universities, laboratories and standards bodies to support municipalities in adopting smart, sustainable city applications. The Council provides:

- Guides;

- Financing templates & case studies;
- Policy frameworks & case studies;
- Campaigns; and
- Regional events.

Link: https://na.smartcitiescouncil.com/.
Many of these groups also hold annual conferences to share emerging research and trends.

i.iv   Leverage Global Partners

Through the collaboration and networking of knowledge-sharing groups, municipalities can foster global partnerships that enable more intimate observation, learning and collaboration with their peers. Partnering with neighbouring communities is likely to provide the greatest benefits due to regional strategic alignment and the economic spillover effect of improving economic competitiveness. Partners can be leveraged to exchange ideas and lessons, pool common resources, share infrastructure and address challenges jointly.

Case study: Phoenix, United States

The Institute of Digital Progress (iDP) of the greater Phoenix region initiated a collaboration of municipalities and authorities, along with private partners such as Uber, Intel and Cisco, and Arizona State University, to collectively tackle mobility and congestion issues in the area. As part of this work, the multi-stakeholder team has been awarded a multi-million-dollars Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) grant.[26]

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[26] http://meetingoftheminds.org/smart-regions-5-examples-of-successful-digitalization-strategies-26668?utm_source=Meeting+of+the+Minds+Newsletter +List&utm_campaign=13c25150f2-RSS_EMAIL_CAMPAIGN&utm_medium=email&utm_term=0_cdb 70a5ce7-13c25150f2-57915189&mc_cid=13c25150f2&mc_eid=17fac18563

PHASE II: ESTABLISH THE CONTEXT

Each Smart City Master Plan is unique in its focus areas because every community faces different challenges, is in a different state of readiness and has access to different resources and solutions. By establishing the local context, technology solutions can be planned strategically to result in the highest economic and social returns.

Phase II outputs:
- Established current state & digital maturity level
- Community engagement plan
- List of major community needs based on engagement
- List of existing strategic priorities
- Defined objectives for the Smart City Master Plan
- List of available data and gaps to be filled

ii.i Establish the Current State

Understanding the opportunities and requirements of developing a smart city requires first understanding the current state of your municipality: its readiness and need for change through digital transformation. This assessment should be conducted across the community's service areas (departments) to identify current challenges and successes within each area. The current state will be determined through continued involvement of internal stakeholders, along with extensive community engagement of the public and small businesses and a review of existing municipal initiatives, plans and frameworks (the latter two described in the following sections).

As part of establishing the context, the municipality should have high-level answers for the following questions to help direct engagement efforts:

1. Why are you creating a Smart City Master Plan?
2. What are the overarching challenges and goals of the municipality that the plan will help to address and achieve?

It is also valuable to assess your community's overall current state of digital maturity and benchmark your level against global smart city leaders. Prior to completing the assessment, it is important to review in-house capacity and determine if an industry expert is required to complete the evaluation. Indicators of digital maturity can vary by community and evaluator. Given as an example, the City of Vancouver's 2012 digital maturity assessment used four possible maturity levels as outlined in Table 1.

Table 1: Example digital maturity levels and their indicators[27]

| Digital Maturity Level	Indicators
Absent	• Limited to no capabilities in this area.
Exploring	• Basic capacity in this area & ability to partially integrate with stakeholders • Tasks can be completed but technology would improve performance.
Enabled	• The right systems & processes exist to integrate the majority of internal & external stakeholders. • Consultants consider you a digital city
Connected	• Residents, employees, businesses and government are all connected & serviced through desired channels. • Initiatives are ahead of the curve & leading examples for other communities.

Case study: Vancouver, Canada

As a preliminary study for the development of its 2013-2016 Digital Strategy, the City of Vancouver retained an outside consultant to assess the City's current state of digital readiness. The assessment evaluated the following five digital capability areas: online; mobile; social; infrastructure and assets; and organization. For each, the digital maturity level was determined as either absent, exploring, enabled or connected. The study found that, overall, Vancouver was at a moderate digital maturity level and

benchmarked the results globally. Establishing the current state enabled Vancouver to identify where it excelled in smart city readiness and what areas would require most effort for adoption. The assessment also identified three key themes for an effective and beneficial smart city:

- Design strategically. Deploy tactically.
- Empowered employees support empowered citizens.
- Digital governance results in strategic impact and reduced risk.[28]

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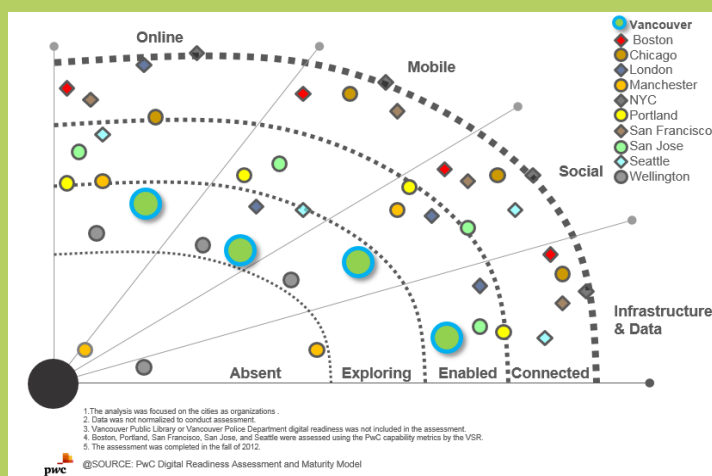
[27]http://vancouver.ca/files/cov/City_of_Vancouver_Digital_Strategy.pdf
[28]Ibid

ii.ii Identify Community Needs

Defining the true challenges of a community is a precondition for determining the most appropriate solutions. A community is first and foremost a collection of people, rather than a collection of buildings, infrastructure and technology. Therefore, to understand these needs requires community-wide engagement of residents, employees and businesses. With the ultimate objective of a Smart City Master Plan being to outline initiatives to improve overall quality of life for the community, it is important to educate and gain buy-in from residents and businesses on the process while also providing a direct and meaningful opportunity for all to provide input and influence decision-making.

The Smart City Advisory Board should develop an engagement plan that is inclusive and effective at reaching the whole community. Below are guidelines to help inform this plan. Local government may also have an existing community engagement strategy to refer to.

a. Create a compelling narrative

The engagement plan should begin with the narrative that clearly outlines:
- Rationale for developing a Smart City Master Plan;
- Need for and objectives of engagement and collaboration;
- What can the community influence and what is not negotiable;
- How each stakeholder group will be kept informed and involved as the plan is developed; and
- The smart city history of the municipality.

b. Consider a Smart City Citizen Advisory Group

In addition to engaging a variety of community interest/advisory groups, it can be beneficial to appoint a citizen advisory group specific to smart city initiatives. Members should be selected to fairly represent all relevant community interests and should reach agreement on a clear mission for the group and expected participation level.

c. Determine Engagement Tools

To strive for inclusive engagement, the tools designed and selected should be established and trusted communication channels both online and off. There should be multiple face to face engagement opportunities that vary in accessible locations and timings.

d. Empower frontline City staff

As part of internal engagement, it is also important to employ broader municipal staff, specifically frontline workers, who will know first-hand what data is available and what are the true needs. Municipal staff can be a valuable resource for identifying challenges and opportunities of smart city solutions.

Case Study: Toronto, Canada
Toronto's Civic Innovation Office was created in 2017 with the mission to disrupt governance from the inside out. The Innovation Office is working with internal and external stakeholders to bridge the digital divide between outside innovators and the City. As one of its first initiatives, the Office hosted a Civic Challenge specifically for City Staff to propose ideas on how to improve community services, gaining insights from staff who may not otherwise have the opportunity to participate in City innovation.[29]

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[29] https://www.civicinnovation.to/

e. Connect with vulnerable populations

If deployed effectively, smart city solutions have the greatest impact on a community's most vulnerable populations, who must be engaged for a municipality to understand their true needs. These populations may include youth, new immigrants, older adults, persons with disabilities, minorities or others. The Smart City Advisory Board should ensure that the engagement plan includes strategies for making the municipality accessible and receptive to participation from all groups.

f. Include SMEs

One of the main objectives of many Smart City Master Plans is to develop an approach to become more economically competitive and increase attraction of Foreign Direct Investment. This growth is achieved by creating pro-business environments that offer advanced services through data and connected technology for new and expanding SMEs. Consequently, SMEs need to be brought into the discussion to help identify the greatest challenges they face. Businesses can be involved through input sessions, roundtables and targeted online surveys.

g. Develop a platform for ongoing engagement

As the Smart City Master Plan is developed, it is important for the community to be informed of the progress and have the ongoing opportunity to provide input. Ensuring there is continued connection between local government and the community will encourage increased buy-in and solutions use by people at home, work and play. As part of Infrastructure Canada's Smart Cities Challenge, many participating municipalities have launched online platforms for updates on their smart city progress and host community engagement portals.

Results of the community engagement will identify the greatest challenges or "critical" issues faced by residents and workers that may be addressed by smart city solutions.

Case Study: St. Albert, Canada
Engagement of residents and businesses was a critical activity for developing City of St. Albert's Smart City Master Plan. The process was conducted over two years and reached over 2,000 stakeholders, being one of the City's largest and most diverse engagement efforts. The City used a variety of strategies and tools including digital, traditional and direct methods. There was significant effort to ensure youth were heard with the City visiting local high school classes and youth associations. From this engagement, 11 top priorities were identified and considered through the development of the Master Plan.[30]

ii.iii Identify Strategic Priorities

For the implementation of the Smart City Master Plan to be actionable and feasible, its objectives should align with the municipality's vision, mission and existing strategic priorities. The Smart City Master Plan team should complete a local Plan and Policy scan to identify the overarching community vision and mission, sustainability goals and governance and

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[30]https://stalbert.ca/uploads/PDF-reports/Smart_City_Master_Plan_-_Full_Version.pdf

service delivery strategies. Regional strategies from other levels of government should also be reviewed for alignment with the Smart City Master Plan. Regional agreement and alignment will encourage widespread support of the Master Plan and may provide opportunities to leverage additional sources of funding.

The Plan and Policy scan should answer the following questions for each document:

1. What is the plan overview?
2. If there was engagement, who was consulted and how?
3. What is the plan trying to achieve and what are its strategic priorities?
4. Which strategies/actions/recommendations relate to smart city solutions?
5. Which smart city focus areas are addressed?

The scan can be completed in consultation with each relevant department head to gain further insight on service area priorities, the understanding of smart city applications and the potential opportunity for implementation.

The scan should also include reviewing local by-laws and provincial and federal legislation to identify any policy barriers that will need to be addressed. Specifically, any policy relating to technology solutions, such as cameras, drones, streetlighting, etc.

Through the review of existing strategic priorities, the Smart City team can confirm the feasibility and relevance of the identified community challenges being addressed through the Smart City Master Plan. This process will help define more specific objectives of the Master Plan.

ii.iv Collect & Assess Available Data

The feasibility of smart cities is largely dependent on the growth and accessibility of big data and its symbiotic relationship with the IoT. Big data enables communities to gain insights on local conditions from large amounts of data collected from diverse sources. Through the IoT, data is used to inform decision-making for the community, either in real-time or long-term planning. As part of establishing the context, the

Smart City Master Plan team needs to understand the existing data conditions of the community, including any data platforms developed. Municipal data platforms are fundamental for ensuring the sharing and availability of data. Platforms enhance efficiency and coordination across various stakeholders and agencies by enabling different groups to connect, standardize and automate processes. For a Smart City Master Plan, a municipal data platform or a plan for developing, implementing and maintaining one is required.

To determine the current state of data availability, the team should conduct a data review to answer:

- What data is already collected?
- Who owns what data?
- How is the data is used, if at all?
- What data is available to the municipality?
- What data is available to the public?
- What are the data gaps, specifically related to the Smart City Master Plan objectives?

Ownership of data typically falls to the municipality, however, in some cases, the municipality will need to collaborate with outside partners to implement required connectivity and technology to collect data.

Examples of community data sources to investigate include:

- Municipally owned sensors;
- Utilities;
- Start-ups;
- Open data; etc.

Open data, or data freely available to anyone without restrictions, is critical for many smart city initiatives across the world. When data is open to the public, novel ideas and perspectives leverage innovative ways for data to be re-used, analyzed and correlated to improve quality of life. The Open Data Charter (ODC) outlines six principles for publishing open data, presented in Table 2.

| Principle	Description
Open by Default	Use of freely accessible open data has significant social and economic value, therefore, data should be open by default unless there are safety or security concerns.
Timely & Comprehensive	Open data is valuable only if relevant to its users and therefore should be provided as accurate, comprehensive and high quality.
Accessible & Usable	Open data must be easily and widely accessible without barriers to deter users, ensuring data is machine readable can help achieve this.
Comparable & Interoperable	The potential effectiveness and usefulness of datasets increases with improved quality and ease of comparison within and between sets over time, aided with compliance to common data standards.
Improved Governance & Citizen Engagement	Open data improves transparency of government decision-making and the community's trust of true needs being identified and addressed.
Inclusive Development & Innovation	Making open data available for all to understand and use will enhance benefits it generates and increase economic development.

Case study: Toronto, Canada

In 2012, City of Toronto launched its open data initiative. In 2018, after consultation with over 100 internal and external stakeholders, the City published its Open Data Master Plan. The Plan presents a framework for the City's open data initiative across four years and is guided by the six ODC principles. By creating this Plan, Toronto identified eight lessons learned to follow with open data:

- Focus on quality over quantity for datasets;
- Create an open data team with both technical and non-technical competencies;
- Data publication must be automated and streamlined to meet increasing demands;
- TO ensure accessibility for all groups, additional measures past releasing data must be taken;
- Partnering with community groups is imperative for capturing true value of data and related programs;
- To balance required resources with value created by users, data releases must be prioritized;
- Estimating the value of open data requires understanding its potential for addressing civic issues; and
- Open by Default should be a requirement supported by senior leadership.[31]

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[31]https://www.toronto.ca/legdocs/mmis/2018/ex/bgrd/backgroundfile-110740.pdf

PHASE III: DEFINE THE OUTCOMES

A Smart City Master Plan is a roadmap to achieve specific outcomes that are determined based on internal and external consultation and are areas where technology solutions would be effective and beneficial.
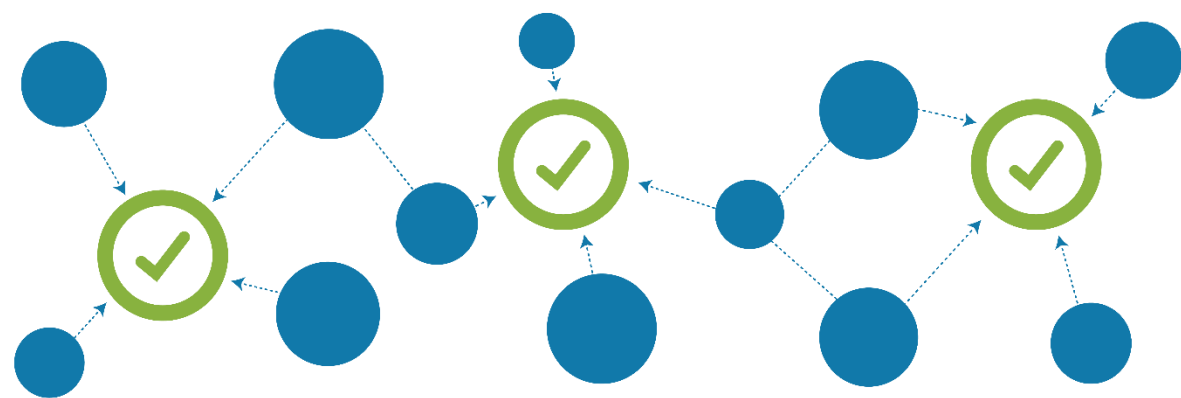
Phase III outcomes:
- List of desired outcomes of the Smart City Master Plan
- List of available solutions to achieve outcomes

iii.i Identify Desired Outcomes

By understanding the greatest challenges and areas of strength within a community by establishing the context, the Smart Master Plan team can identify desired outcomes of the Plan for each municipal service area. Outcomes describe what the community aims to achieve through the deployment of smart city solutions. As outlined by Infrastructure Canada, outcomes should be measurable, ambitious and achievable[32].

Outcomes are determined based on which of the "critical" issues (or those requiring significant improvement) of each service area could be improved through connected technology. Example desired outcomes provided by Infrastructure Canada, as part of the Smart Cities Challenge, are shown in Table 3.

Table 2: Example desired outcomes for Smart City Master Plans[33]

Service Area	Desired Outcome
Housing & Shelter	Every person without a home has access to nightly shelter and any relevant municipal services, activities and programs.
Environment	Reduce risk of flood damage by 40 percent.
Police	The neighbourhood with the highest crime rate will be safer than the national average.
Public Health	Chronic disease will decrease with residents becoming 50% more active and healthy.

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[32]https://impact.canada.ca/en/challenges/smart-cities/applicant-guide

[33]Ibid.

iii.ii Review Available Solutions

The complexity and diversity of available solutions is continuously advancing, and the most appropriate solutions for your community will change over time. Consequently, a Smart City Master Plan should not be prescriptive in specific technology solutions, but rather focus on outlining the desired outcomes and general strategies expected to achieve them. However, conducting a review of currently available solutions can help determine the feasibility of achieving these outcomes and inform the development of smart city strategies. As an example, the 2016 report *Analysing the Potential for Wide Scale Roll-out of Integrated Smart Cities and Communities Solutions*, commissioned by the European Commission, categorizes solutions across nine main types within three pre-defined vertical priority areas. The nine solution types are summarized in Table 4 along with example technologies of each.

Table 3: Smart city solution types as outlined by the European Commission 2016 report[34]
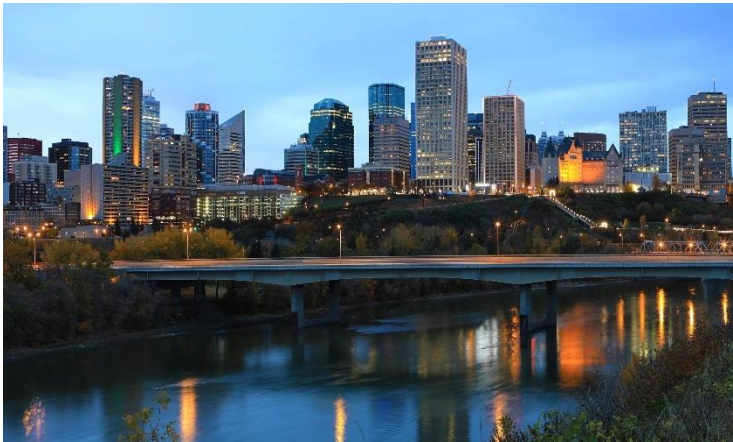
Vertical Priority	Solution Type	Description	Example Technologies
Sustainable Urban Mobility	*Real-time road user information*	Real-time traffic information communicated to road users.	• Variable message signage for parking & traffic information • Digital bus stop signage with local route information • Integrated mobile applications showing cost & time of all transit options
	Intelligent Transport Systems (ITS) for public transit	ITS used by public transit to support asset management and enhance its service delivery to users.	• Contact-less public transit cards • Public fleets organized through the sharing economy • Mobile applications for payment
	ITS for traffic monitoring, management & enforcement	Data collection and processing to adjust traffic flows.	• Traffic monitoring sensors (such as cameras, automatic traffic counters or satellite imaging) connected to central traffic control centres
Sustainable Districts & the Built Environment	*Smart technologies for the built environment*	ICT solutions that monitor and manage assets and resources within the built environment.	• Smart water & energy meters • Smart streetlighting • Sensor-based waste collection & route optimization • Environmental monitoring (such as sensors for air quality, noise & weather) • Drones for facility management • Electric vehicle (EV) charging stations • Bike sharing
	Sustainable districts	District-wide geographic scope with district energy systems, energy efficient neighbourhoods &	• District-wide building energy management solutions • District heating & cooling • Smart wastewater networks • Decentralized energy sources • Technologies for urban development that re-qualify entire districts

[34]https://ec.europa.eu/energy/sites/ener/files/documents/d2_final_report_v3.0_no_annex_iv.pdf

		eco-urban developments.	
	Place making	Community engagement approaches to increase communication between public entities & the single resident.	• Accessible engagement platforms (such as 24/7 online portals and voice-first digital signage) • Mobile applications for civic engagement & empowerment
Integrated Infrastructure & Processes	*Data platforms*	Platforms that integrate large amounts of data collected by distributed sensors & used by decision-makers to guide smart city development.	• City-wide ICT platforms that collect and analyze data (such as smart streetlighting hosting a pervasive communication network with sensors)
	Smart city services	ICT-enhanced public service provision mechanisms	• Open data hubs • Geographic information system (GIS) applications for interactive mapping of local amenities & services • Artificial intelligence (AI) for 311 city services
	Smart grids	ICT applications to address energy issues.	• Modernization of distribution networks • Automated networks with smart meters at the household levels • Parallel energy markets to reflect real-time demand & supply • Advanced energy storage (such as in EV charging stations)

The European Commission report also outlines three best practices for achieving the highest impact of a smart city solution based on a review of 300 examples:

- Involve a diverse and large group of coordinated actors and stakeholders in the development and implementation of solutions;
- A single solution address one prevailing issue with the flexibility to scale and differentiate its outputs; and
- Each solution is interoperable with other technologies to ensure actors do not work in silos. [35]

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[35]https://ec.europa.eu/energy/sites/ener/files/documents/d2_final_report_v3.0_no_annex_iv.pdf

Case study: Edmonton, Canada

The City of Edmonton's 2017 Smart City Strategy outlines three overall goals to become:

- **A Resilient Centre** that is adaptive, well-planned and flexible to withstand external shocks.
- **A Livable Community** in which citizens are healthy, engaged in the community and actively minimize their environmental footprint.
- **A Workable City** that connects citizens through advanced mobility, broadband, academic institution and smart infrastructure.

The Strategy then outlines smart city initiatives that will be or are implemented to achieve each outcome but does not commit to a specified technology. A sample of solutions presented in the Strategy are listed in Table 5.[36]

Table 4: Desired outcomes and associated smart city initiatives from City of Edmonton's Smart City Strategy

Desired Outcome	Smart City Initiative
Resiliency	- Open data - Online engagement - Youth Council - Startup Edmonton
Livability	- Health City Initiative - CITYlab - Involving infill
Workability	- Smart Bus - Autonomous vehicles - Open Science - Open city Wi-Fi

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[36]https://www.edmonton.ca/city_government/documents/PDF/Smart_City_Strategy.pdf

PHASE IV: DEVELOP THE PLAN

An effective Smart City Master Plan mobilizes stakeholders around a vision and lays out a roadmap of strategies to achieve the community's desired outcomes. It draws on information on the current state, community engagement, strategic priorities and available data.

Phase IV outputs:
- The local context
- Vision and mission statements
- Roadmap to desired outcomes
- Evaluation framework with KPIs and baselines
- Approach to overcome challenges of smart city planning

Key steps to developing a Master Plan are outlined below. These are based on a review of the planning process used in municipalities across Canada and internationally.

iv.i Describe the Context
As part of the introduction to your community's Smart City Master Plan, it is important to the set the context to generate buy-in from the public and businesses.

a. Forward
The Smart City Master Plan forward should be a strong, championing message from the Mayor.

This immediately establishes that the document has strong political leadership and buy-in. The message should state the intention of the strategy and its importance for the future. The mayor should focus on the citizen-centric aspect of the strategy and describe what it hopes to achieve for the community. This is also an opportunity to acknowledge that the municipality needs to build skills and capacity to deliver the Plan's aspirations. Finally, the message should demonstrate existing widespread support for the smart city initiative by acknowledging major partners and contributors to the plan, including the public.

b. Introduce the local context
The Plan should describe unique characteristics of the community, including, its strengths, strategic growth areas and major industries. Based on this local setting, it is also valuable to outline how the

community connects to the regional and national contexts to identify overall strategic alignment early-on.

c.   Define your 'Smart City'

Because the understanding of 'Smart City' varies between communities, the introduction must include what a smart city means to your community. As recommended in the first section of this Guide, develop a citizen-centric definition that focuses on using ICT and data analytics in the transformation of services and infrastructure to improve the lives of people at home, work and play.

d.   Demonstrate past efforts

Finally, setting the context can be an opportunity to demonstrate your community's past or existing efforts in the smart city space. For example, many communities across Canada have already begun deploying free Wi-Fi in public spaces – an initiative generally seen as fundamental for supporting an inclusive smart city and improving overall equity of the community.

Case study: Newcastle, Australia

In the Newcastle City 2017-2022 Smart City Strategy, setting the context includes providing information on the city's defining characteristics, background and reasoning for the strategy development; and past smart city initiatives locally and within Australia. Some of the interesting facts communicated include:

- Newcastle has the highest number of artists per capita of an Australian city;
- The strategy is part of Council's Newcastle Smart City initiative to revitalize and transform the city into an internationally recognized center for technology innovation; and
- The federal government has committed $1.1 billion over four years to initiatives that drive the smart city concept and boost the economy.[37]

iv.ii Define Vision & Mission

A Smart City Master Plan should describe a clear vision and mission to spur change within local government and across the community. The vision and mission should tie to the vision and mission of the corporation, and be ambitious yet achievable to build momentum, broaden the base of supporters and mobilize local innovators.

When creating the vision and mission statements, communities should draw on the overarching objectives of the community's smart city initiative,

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[37]http://www.newcastle.nsw.gov.au/getmedia/392db4be-d418-48d8-a593-7a17a4b482bb/2752_Smart-City-Strategy-FINAL-WEB.aspx

which align with the visions of other community strategies. A global review of smart city strategies conducted in 2017, found smart city ambitions typically follow one of three core themes:

- **Economic**: using technology to advance services and develop efficiencies, while boosting economic development and becoming more competitive for international investment;
- **Social**: encouraging transparent, inclusive, trusted and citizen empowerment of communities; or
- **Environmental**: achieving environmental sustainability.[38]

The review also noted that, over the past five years, communities are shifting their emphasis from economic ambitions to social and environmental, building a stronger alignment with the citizen-centric definitions of 'smart city'.

To further integrate the vision and mission into the Plan, the Smart City Master Plan Team can identify specific desired outcomes under each local focus areas (i.e. empowerment and inclusion, economic opportunity, mobility, healthy living and recreation, environmental quality and safety and security) that are aligned with the overarching Vision and Mission. In some cases, the Team may create a vision statement for each area.

Case study: Columbus, United States

The vision of the Columbus Smart City Application is: to be a community that provides beauty, prosperity and health for all its citizens. From this, three vision statements are defined:

A beautiful city provides clean transportation options that serve the mobility demands of the city and reduce the impacts on the environment.

A healthy city provides safe and inviting opportunities for non-motorized travel and smart technology with a complete digital network that links people to services, such as healthy food and health care.

A prosperous city connects workers to jobs and employers to workers, gets goods to market, supports world-class institutions, and provides reliable travel options affordable to a range of household budgets.[39]

iv.iii Develop the Smart City Roadmap

The fundamental element of a Smart City Master Plan is the roadmap, or action plan, that lays out the smart city strategies that will be implemented to achieve the desired outcomes. In developing the action plan, the Smart City Master Plan Team should consider that the team (or teams) who will be implementing the strategies will likely differ from the Master Plan team. To address this challenge, the roadmap should avoid being prescriptive in specific technologies or solution

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[38]https://marroninstitute.nyu.edu/uploads/content/Working_Paper_25_Digital_Master_Planning.pdf

[39]https://www.transportation.gov/sites/dot.gov/files/docs/Columbus%20OH%20Vision%20Narrative.pdf

providers to be used, which will also help future-proof the Master Plan by being flexible and adaptable.

Very generally, the smart city action plan should outline the following for each desired outcome:
- The **Smart City Strategy** to achieve the outcome;
- The **Actions** of the strategy;
- Any **Policy Strategy** required;
- If **Partners** are required and to what extent;
- The **Implementation Method/Tool** of the strategy;
- The expected **Timeline** (i.e. short-, medium- or long-term);
- The expected **Budget** range; and
- The expected **Funding Source**.

Continued internal and external engagement will be required to fill out these components. Involvement of major tech companies and startups may be valuable for identifying what smart city strategy is expected to be most effective, however, the action plan should try to avoid prescribing specific technology or solution providers. At a high-level, the potential value created by a strategy can be estimated based on its:
- Replication potential;
- Simplicity;
- Citizens' involvement;
- Economic impact;
- Environmental impact; and
- Social impact.[40]

Setting and committing to implementation targets and timelines for each outcome is important for the success of a Smart City Master Plan. Many of the identified solutions and strategies will span a municipality's council term, which creates the potential for key stakeholders to change. The action plan is a way to keep the planning team and implementation team accountable and measure the Plan's progress and success. It can be effective to outline a small set of quick wins to help build momentum with stakeholders and within the community.

With a Smart City Master Plan's broad objective of improving overall quality of life, the action plan will likely include an extensive set of action and strategies. To better focus the Plan, the strategies can be prioritized into high, medium and low. The prioritization method should be developed by the Master Plan Team and reviewed by stakeholders to approve the Team's justifications.

Finally, the Master Plan Team should consider creating a separate version of the roadmap for the public facing document. This is typically less detailed than what is developed internally. In some cases, it only includes the Master Plan's actions and overall timelines, without the specific schedule for implementing each strategy.

Case study: St. Albert, Canada
The St. Albert Smart City Master Plan includes a detailed action plan of 22 strategies with 65 supporting actions. The strategies are divided into focus areas based on the Master Plan's key priorities and are grouped by high, medium or low priority. More details on St. Albert's prioritization method are available online: https://stalbert.ca/dev/smart/masterplan/.

The layout of the action plan is presented below with example strategies.[41]

[40]https://ec.europa.eu/energy/sites/ener/files/documents/d2_final_report_v3.0_no_annex_iv.pdf

[41]https://stalbert.ca/uploads/PDF-reports/Smart_City_Master_Plan_-_Full_Version.pdf

Strategy & Action	Policy Link	Estimated Timing	Estimated Cost	Funding Source
F.1 Civic Sensor Array & Connected Assets				
F.1.1 Civic Sensor / IOT Array	N	Short (+)	$$$A	Project Charter(s)
F.1.3 Vehicle and Asset Tracking	N	2016 (+)	-	Existing Resources
E.2 Emergency Response & Safety Technologies				
E.2.3 Crime Analytics & Surveillance	Y	Med (+)	$$	Bus Case / Proj Charter
E.2.4 RCMP Pilot Community	N	Short (+)	-	Staff Time & External

The action plan provides the following guidance:

- Estimated Cost (Est. Cost): New financial investment required by the municipality to support the proposed action.
  - $ = < $50k; $$ = $50k – $100k; $$$ = $100k - $1M; $$$$ = > $1M.
  - A = potential for partnerships and/or grants which could significantly reduce municipal capital or operating cost over time.
  - B = potential for revenue generation which could significantly reduce municipal capital or operating cost over time.

iv.iv Outline Evaluation Frameworks

Evaluation frameworks must be developed alongside the Smart City Master Plan to establish the credibility and accountability of the proposed strategies. These frameworks should include self-assessment tools and quantitative measures of success. For some outcomes of smart city initiatives, it can be challenging identify quantitative metrics of success, consequently it may be up to the Smart City Master Plan Team to develop outcome-specific indicators. For example, to measure the well-being of a community, the Team may develop a Well-being Index based on multiple metrics relating to the health and happiness of an individual or community. Results of the evaluation frameworks are used to communicate progress within the municipality and externally, and to specify the process for updating and revising the Smart City Master Plan going forward.

Many existing frameworks are criticized for not being standardized, with a stronger focus on metrics relating to implementation and investment, rather than the actual outcomes and impacts of smart city strategies. To create an effective and meaningful evaluation framework, Key Performance Indicators (KPI) should be defined and baselines established, as described below.

a. Define Key Performance Indicators

Key performance indicators should be defined for each desired outcome of the Smart City Master Plan, as well as the smart city strategies outlined in the action plan. KPIs are a set of values against which to measure progress. The municipality will track the KPIs to demonstrate that the Master Plan is or is not achieving its goals and meeting targets and timelines.

The Smart City Master Plan Team can develop unique KPIs specific to the Plan's action plan or can leverage standardized approaches provided by national or international standards bodies. A preliminary review of existing KPIs used by the community should be completed to identify opportunities for their application to the outlined smart city strategies.

If developing unique KPIs, the metrics should be selected to be:

- Comprehensive (covering all aspects of the outcome);
- Comparable (data can be compared between communities and over time);
- Available (historic and current quantitative data should be available or easy to collect);
- Independent (overlap of KPIs should be avoided);
- Simple (understanding and calculating the indicator should be straightforward); and

- Timely (indicators should be relevant to emerging smart city issues). [42]

The International Organization of Standardization (ISO) and the United Nations Economic Commission for Europe (UNECE) are example bodies who provide standardized KPIs for smart cities. The ISO currently has two potential standards for evaluating smart cities using a uniform approach to what is measured (KPI) and how it is measured:

- **ISO 37120** was developed in 2014 as the first ISO International Standard on city indicators. It outlines smart city indicators across 17 sectors that are organized as high, medium and low priorities.[43]
- **ISO/TS 37151** is a technical standard developed in 2015 that outlines principles and requirements for performance metrics of smart community infrastructures and provides recommendations for assessment methods.[44]

In 2017, UNECE published the *Collection Methodology for Key Performance Indicators for Smart Sustainable Cities* as part of the United for Smart Sustainable Cities (U4SSC) initiative. This document provides communities with a methodology for collecting data and information from KPIs developed by the U4SSC. It outlines key information for each KPI including: the definition; rationale; methodology; unit; data source; and reference.[45]

b. *Establish the Baselines*

To measure the performance of smart city strategies, there must be an understanding of the normal operating conditions, without the proposed improvement. This point of reference is the baseline. Each defined KPI should have an established baseline to track change. Representative baselines are typically calculated

as a weighted average of the low baseline value and the high baseline value. This requires accessible historic and current data, demonstrating the importance of KPI metrics being 'available'. Establishing baseline measures for projects and outcomes is considered a best practice for demonstrating validity and progress.

Understanding the metrics and data required for defining KPIs and establishing their baselines may be outside the scope a municipality's capacity. A Smart City Master Plan Team can leverage the knowledge and skills of industry experts to complete these tasks.

Evaluation frameworks, although necessary for analysis of the desired outcomes, can vary with each smart city initiative and are largely dependent on the timescale of the Plan. For a long-term document without intended revisions, a separate evaluation toolset should be developed.

Case study: Dublin, Ireland
For Dublin's Digital Master Plan, created in 2013 as a longstanding document, a Digital Maturity Scorecard was developed in parallel. The Dublin City Council developed the scorecard in collaboration with Intel Labs Europe, the Innovation Value Institute and NUI Maynooth. The scorecard ranks efforts on a scale of 1-5 based on how technology innovation is improving sustainability, economic growth and quality of life. The scorecard also allows benchmarking of the city regionally and internationally.[46]

[42]http://oro.open.ac.uk/48228/1/__penelope_mcsusers_Staff_spc24_SMART%20cities%20%26%20communities_Conference_Communication%20on%20Smart%20Cities%20in%20Smart%20Regions%20Final2017.pdf
[43]https://www.iso.org/files/live/sites/isoorg/files/archive/pdf/en/37120_briefing_note.pdf

[44]https://www.iso.org/news/2015/10/Ref2001.html
[45]https://www.unece.org/fileadmin/DAM/hlm/documents/Publications/U4SSC-CollectionMethodologyforKPIfoSSC-2017.pdf
[46]https://digitaldublin.wordpress.com/two-innovative-toolsets/

Plans with scheduled updates integrate self-assessment as part of each frequent revision to demonstrate progress and impacts of the planned smart city strategies.

Case study: New York City, United States
New York City was one of the first municipalities, globally, to publish a Smart City Master Plan in 2011, titled Road Map for the Digital City. Along with this, a mayoral mandate for annual updates was created. In 2012, New York City's Digital Roadmap: Progress and Innovation was published and, in 2013, New York City's Digital Leadership: 2013 Roadmap. By 2013, New York reported that all objectives outlined in the 2011 roadmap had been completed. New York no longer develops its smart city initiatives in a standalone document, but has advanced to embed them within the city's core vision and strategies.[47]

To ensure updates and assessment occur regardless of political shifts, municipalities can enact a statutory requirement for Plan review and revision at regular intervals, as is done in San Francisco and Hong Kong.

iv.v Set Principles
The strategic intervention of smart city master planning can introduce novel and complex challenges.

This type of planning integrates new technology and data flows with already intricate physical infrastructure, and has commonly been directed by inexperienced regulatory authorities. Based on a review of literature and documented past experiences from smart city champions, we identify common challenges to smart city initiatives and how they can be overcome.

a.   From visioning to planning to reform
Smart city master planning often requires a paradigm shift in municipal governance. The implementation of smart city strategies to achieve the Plan's vision often requires changes to regulation and institutional reform, particularly with how a municipality conducts business. The success of some past Smart City Master Plans has been attributed to the Plans remaining visionary without identifying specific technologies or solution providers for implementation. This can be effective for inciting change in thought that, in turn, leads to the design and implementation of individual projects that help reach the overarching vision.

It is also important to establish ownership of both the Plan and continued implementation process, to ensure it does not remain a static document. Due to cross-departmental nature of Smart City Master Plan actions, the process should be owned at the corporate level, i.e. by the Executive City Manager's office.

b.   Planning for technology obsolescence
The newness of the IoT is a challenge for smart city planners because solutions are used to address emerging use cases and follow continuously evolving technology standards. There is a risk that technology solutions procured today will soon become technologically or functionally obsolete. Planners must accept that in the fast moving IoT market, obsolescence will occur and it

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[47]https://www.nycedc.com/blog-entry/new-york-citys-digital-leadership

will not be effective to attempt to outguess the future or overbuy technology for replacements. Addressing obsolescence will be most successful through a lifecycle management strategy that maximizes flexibility and options while mitigating risk. As part of a visionary Smart City Master Plan, this approach should be listed as a general recommendation for implementation, along with a requirement for interoperable solutions, as described in the following section.

c. Interoperability of solutions

Interoperability is required to future-proof smart city solutions by ensuring long-term viability and cost-competitiveness of products. If different information systems, community networks and technologies are interoperable, they are able to communicate and exchange data and use this shared data in a secure and effective way. Currently, there is no national or international interoperability standard that is compulsory for solution providers. Interoperability can be addressed through a Smart City Master Plan by including it as a guiding principle for all smart city strategies, by requiring technology providers comply with a voluntary standard such as the Smart City Protocol of the TALQ Consortium[48] and/or by requiring solutions to be non-proprietary.
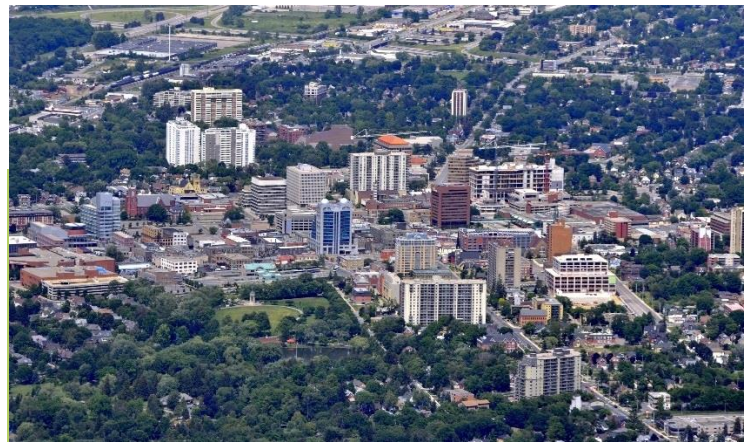
d. Digital inclusion

Technology can only improve quality of life if it engages, informs and empowers all groups of a community, including those most vulnerable, through digital inclusion. Part of this is understanding who is left behind currently and the required measures to bring them forward and enable them for the future. Ensuring digital inclusion often requires:

- Investing in advancing digital literacy skills;
- Harnessing technology for economic growth;
- Providing better digital access through efforts such as Open Data and free public Wi-Fi; and

- Continued community engagement to build awareness and connections.

Smart city initiatives must promote digital inclusion. A Smart City Master Plan can include a statement that commits the municipality to each of the provisions listed above, and any others specific to the community, along with the approach. The Smart City Master Plan Team should work with local institutions (schools, public libraries and other local groups) to define the municipality's role and how this will be addressed in the Plan.

Case study: Kitchener, Canada
The City of Kitchener is currently working to establish a service level standard for digital inclusion that will be implemented in the City's smart city initiative, Digital Kitchener. The municipality is partnering with Kitchener Public Library and other community stakeholders to create a framework for digital programs and standards to help make information accessible for everyone.[49]

e. Cybersecurity & data privacy

Collecting big data and releasing it through open data platforms is crucial for innovation of smart city solutions, as well as digital inclusion. However, it presents a new risk of cyberattacks or breaches to privacy and data security. If not

[48]http://www.talq-consortium.org/

[49]https://www.kitchener.ca/en/city-services/digital-inclusion-standards.aspx

properly secured, public and private control systems can be vulnerable to outsiders retrieving private information and impeding the ability to restore data. Furthermore, the increased adoption of IoT solutions introduces new points of potential vulnerability. When managing data and adopting new solutions, local government must prioritize citizen protection, ensure they are informed of general privacy issues and that security concerns are addressed.

Cybersecurity strategies vary between authorities but typically align in their involvement of technology, people and governance. The American Public Transportation Association (APTA) outline the following four pillars of cybersecurity:

- **ICT Infrastructure**: leveraging hardware, software and configurations to establish a multilayers network security.
- **Operations**: establishing policies, procedure and processes to implement, enforce and achieve cybersecurity.
- **People**: delivering education, training and awareness programs to influence behavioral and cultural mindsets around cybersecurity.
- **Facilities**: protecting from threats to physical hardware of the ICT infrastructure.[50]

With new pressures and greater vulnerabilities, municipalities often require collaboration with external partners to develop and maintain their cybersecurity strategies. Partnerships can help overcome challenges that a municipality is unable to control with its existing resources. It is recommended that municipalities identify these challenges early-on and engage the necessary stakeholders. For example, a geographically widespread community with low density may be challenged with implementing security services that reach its full boundaries, but can be supported by a telecommunications partner.

A municipality's primary objective is to serve its citizens, which includes protecting their digital rights, privacy and data, along with providing equal and accessible access to data and digital solutions. Alongside a Smart City Master Plan, the municipality should be developing data and privacy policies so these are in place prior to implementing smart city projects. Within the Plan, a municipality can outline its commitment to cybersecurity, including these policies, strategies and education programs.

f.   *Redundancy & resiliency*
Redundancy and resiliency are critical for the success of networks, and an important strategy for cybersecurity. Redundancy provides a backup up if the primary solution fails, however, can still be compromised through a single event. Resiliency strengthens redundancy by providing the ability to recover, converge and self-repair. Cyber resilience will ensure ICT systems continue delivering services through a security breach. A best practice example is distributing redundant hardware across various locations. Ensuring redundancy and resiliency plans for smart city solutions should be outlined in a Smart City Master Plan as a requirement for implementation.

Addressing these challenges throughout the Plan development, either by including specific principles within the document or developing associated frameworks, helps create a robust and valid Smart City Master Plan.

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[50]http://www.apta.com/resources/standards/Documents/APTA%20SS-ECS-RP-001-14%20RP.pdf

PHASE V: IMPLEMENT

Developing implementation plans as part of or in conjunction with a Smart City Master Plan is critical to ensuring the Master Plan is sustainable and actionable. To achieve effective and beneficial adoption of smart city strategies, implementation often calls for innovative procurement and funding options.
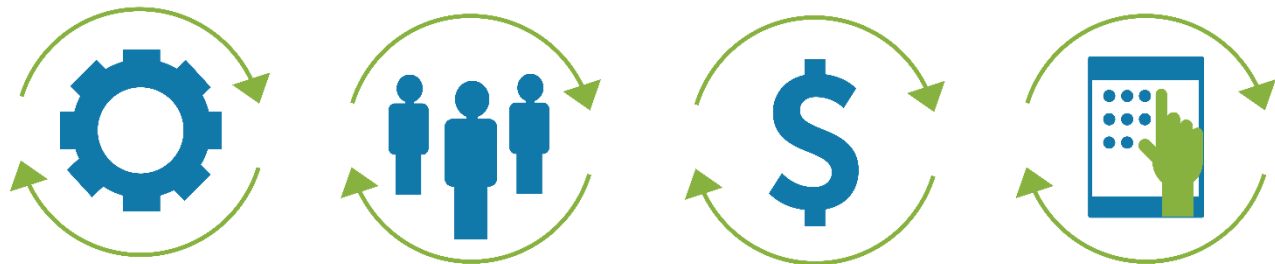
Phase V outputs:
- Implementation plan by strategy
- Innovative funding & financing
- Solution procurement
- Monitoring & communication
- Embedded Smart

The approach to implementing Smart City Master Plans varies between jurisdictions. Based on our review of plans, best practices to consider for effective implementation are summarized below.

v.i Implement by Strategy

A Smart City Master Plan addresses multiple challenges with unique strategies that are planned over different schedules and involve diverse stakeholders. To be most effective, municipalities should implement the Plan as smaller strategic initiatives, either by each individual action or by small groups of actions. This reduces the initial capital and resources required, and provides an opportunity to evaluate and refine goals throughout the process. Furthermore, because a Smart City Master Plan is often not prescriptive in technology or solution

providers, each strategy will require a complete implementation process from securing funding and financing to procurement, monitoring and reporting. A champion with decision-making authority should be appointed for each strategy. The champion must be committed to leading institutional change as part of the technology revolution. Understanding the social, economic and environmental opportunities of smart city solutions is key to the champion effectively communicating the value proposition to gain buy-in from stakeholders and the public. The champion will coordinate a Project Team of internal and external stakeholders who will participate in implementation or who will be impacted by the strategy. In many cases, team members will be engaged across various department and agencies. The project team will:
- Build the business case with consideration of social, environmental and economic returns;
- Determine which funding or financing method is most appropriate and secure financial resources;
- Foster valuable relationships with stakeholders who will have to change their operations or billings to accommodate new initiatives, such as utilities;
- Conduct values-based procurement, identifying appropriate specifications, as required; and

- Carry out project delivery and commissioning.

v.ii Secure funding and Financing

Implementing a Smart City Master Plan will require significant funding, which may be required at different stages of implementation or by initiative/strategy. Smart city infrastructure should be addressed in municipal asset management plans that identify the agreed level of service for operations and maintenance, along with required and prioritized investments. Planning for innovative solutions presents opportunities for innovative funding and financing options. In each case, governments should be leveraging partnerships with local business, academic institutions and other stakeholders to develop a broad funding base and harness expertise of various groups on implementation of initiatives.

Most importantly, a smart city should generally only invest in technology if it can be demonstrated that it can solve a problem. Typically, municipalities already have a long list of problems to solve, some of which already have a solution but no funding and therefore it is important to prioritize investment.

Potential funding and financing options include:

a. Self-funding and financing

Municipalities may use their annual capital budgets to fund initiatives in the Smart City Master Plan. All municipal departments that will benefit from any given initiative should ideally contribute to its development and implementation. Sources of municipal funding can include property taxes, business taxes, and user fees - fees paid by choice for certain services such as road tolls, EV charging stations or Wi-Fi hotspots.

Communities can also opt to use debt financing to fund smart city solutions, such as by issuing municipal or green bonds, or by borrowing from commercial banks or institutional lenders.

b. Public-private partnerships (PPP)

In a PPP model, a municipality grants a long-term license to the private sector to perform some combination of design, implementation, financing and/or operating an infrastructure asset. Advantages of a PPP model include the ability to benefit from private sector expertise in designing, installing and operating a system and the ability to transfer the risk for the integration of these functions, as well as the ability to defer the costs of system purchase. A potential challenge of a PPP model is the complexity and cost of the transaction. Financial, legal and performance requirements must be established to ensure the project meets the municipality's needs over the contract term. The costs of establishing these are usually only financially viable on larger projects.

Case Study: Dublin, Ireland

The MAN project in Ireland is an example of a public private partnership used to deliver smart community infrastructure. The project was developed to serve areas without adequate private sector broadband. It included installation of a network of over 1,000 km of ducting, sub-ducting and high-capacity fiber-optic cable throughout 66 towns in Ireland. A public procurement process was held in 2004 which resulted in e|net being selected as the Managed Services Entity (MSE) to manage, maintain and operate two phases of the MAN program for a period of 15 years. The open-access telecommunications infrastructure remains in State ownership. The investment of EUR 170 million was publicly funded with local and regional authorities providing 10%, European Regional Development Fund 45% and the balance funded by the Irish Government.[51]

Photo credit: Nao Okawa on Flickr

Case Study: New York City, United States

A consortium of investors, including Sidewalk Labs has been installing digital kiosks, as part of the Link network in New York, London and Philadelphia to replace aging payphones. The Link kiosks, which deploy public Wi-Fi and other features such as wayfinding, transit information and environmental sensors, are entirely privately financed. Advertising revenue is used to underwrite digital services for consumers. In the case of New York, LinkNYC will generate over $500 million in revenue for the City. The Link network is looking to expand to Chicago, Charlotte, Dallas, Houston, Los Angeles, Minneapolis, Pittsburgh, New Jersey, San Francisco, and Seattle.[52]

c. Private Investments

Some infrastructure solutions can be provided through direct private sector investment. To make these investments viable, the private sector will require some form of revenue to offset the costs of development. Revenue sources typically include advertising revenue or use charges and tolls. Even for projects that are entirely private sector funded, a municipality should still be involved in project development to ensure alignment with the community's broader smart city goals.

d. Government Infrastructure Financing

Federal and provincial government funds may also be available for municipal capital investments in infrastructure. For example, Infrastructure Canada is running the Smart Cities Challenge to help communities develop and implement smart cities initiatives. The Challenge will include three rounds over 10 years with awards of up to $80 million in prizes in the first competition. Finalists will receive support to develop their smart cities proposals. Winning communities will be awarded with prize money to help implement them.

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[51] https://www.itu.int/ITU-D/finance/work-cost-tariffs/events/tariff-seminars/Japan-13/documents/Sess8_BroadbandPPP_Bernal.pdf

[52] https://apolitical.co/solution_article/new-york-city-profit-500m-providing-free-public-wi-fi/

Municipalities may also obtain government funding for smart city initiatives that align with other government priorities such as carbon reduction and energy conservation. For example, Natural Resources Canada maintains a thorough inventory of energy efficiency incentives, some of which could be applicable for smart city projects[53].

Communities that are successful in obtaining one source of funding may be able to leverage the grant to attract additional grants and private sector investment. As well, the process of developing the vision for the application can help clarify the smart city vision and attract additional funders and investors.

Case Study: Columbus, United States

In June 2016 the City of Columbus, Ohio received a $40 million grant from the US Department of Transportation as part of the Federal Smart City Challenge and $10 million from Vulcan Industries. The Columbus Smart City initiative now has approximately $500 million in committed funding, comprised of investments from local utilities, academic institutions and private sector investors. Columbus credits existing partnership such as those established through Columbus Partnership – a non-profit, membership-based CEO organization of more than 65 CEOs from Columbus' businesses and institutions – and the strength of its vision in helping it leverage the Federal grant to attract significant additional funding.[54]

v.iii Procure Solutions

Procurement of smart city solutions may be unfamiliar for some municipalities. To overcome this challenge, communities should leverage industry knowledge and willingness to demonstrate new technologies to build capacity and support informed decision-making. To develop knowledge of innovative and potentially unfamiliar smart city solutions, a municipality should:

- Engage potential solution providers early-on through meeting, working groups, market-soundings and information forums;
- Engage other municipalities who have implemented similar strategies;
- Request demonstration tests;
- Review lessons learned from existing applications around the world;
- Issue Requests for Information (RFIs); and
- Leverage local community knowledge through civic tech nights, hackathons and other innovation events.

The European Innovation Partnership on Smart Cities and Communities, supported by the European Commission, makes the following recommendations when undergoing procurement of these solutions:

- Establish robust economic frameworks that acknowledge the necessity of low-carbon economies built through innovative public procurement;
- Mobilize various municipal agencies with collective objectives to organize collaborative procurement processes;
- Ensure procurement frameworks are flexible to enable innovation;
- Require interoperability either through global standards or community-built standards;
- Keep the public informed early-on and throughout of the proposed solutions and provide opportunity for feedback prior to installation;
- Require manufacturer warranties that cover the expected life of solutions; and
- Adopt any clauses, principles and terms and conditions outlined in the Smart City Master Plan.[55]

Municipalities should also favour fair and transparent procurement and partnership processes to build trust

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[53]http://www.nrcan.gc.ca/energy/funding/efficiency/4947
[54]https://www.bizjournals.com/columbus/news/2018/03/08/here-s-how-50-million-in-smart-city-investments.html

[55]http://www.sustainable-procurement.org/fileadmin/templates/sp_platform/lib/sp_platform_resources//tools/push_resource_file.php?uid=42abe812

and consensus among stakeholders and citizens. Creating a level playing field also helps attract innovative and new solution providers.

Timing of procurement for smart city solutions is also important to consider in the planning process. Outlining strategies in a Smart City Master Plan enables cities to be proactive in identifying the relevant department for each, as well as where strategies can be integrated with other implementation projects. Those managing smart solutions may not be the same as those managing the associated infrastructure, requiring early discussions between stakeholders and potentially development of formal partner agreements. By knowing what you want in advance of securing financing, a municipality is prepared to leverage fast-moving procurement opportunities in the future without sacrificing thorough evaluation and design of solutions.

Lastly, smart city procurement should not be viewed as a traditional public-sector procurement. Smart cities should advance to becoming their own market place. Communities create the setting and the citizen-centric vision for the digitalization of society with the public sector being only one partner. The longevity and sustainability of smart cities will rely on various working partnerships, leveraging novel business architectures to ensure projects are not solely dependent on public sector budgets or technical expertise.

Case Study: San Francisco, United States
San Francisco is currently in the procurement phase of implementing its smart city initiative of providing affordable, high-speed internet to every home and business. To minimize risks and costs of implementing a new utility, the city will own the network with installation and management being managed through a PPP. The city has also mandated net neutrality, requiring the selected partner to adhere to principle that ensure all traffic to legal websites is treated equally. Other terms included are subsidies for low-income residents and privacy agreements for customer data. This initiative was driven to bridge the digital divide by connecting the 100,000 residents that currently do not have internet at home.[56]

v.iv Monitor & communicate

For the validation and widespread adoption of the smart city concept, it is critical to monitor and communicate results. A Smart City Master Plan will need to be revised and adapted over time to maintain relevance with the progress of the community and digital innovation. Agencies involved in Smart City Master Plans from initiation to implementation should record results throughout and prepare methods for knowledge-sharing. Having defined KPIs and established evaluation frameworks to monitor them in the Smart City Master Plan is instrumental for this phase and enables stakeholders to benchmark projects against others globally. Sharing lessons learned from innovative smart city initiatives ultimately advances the smart city concept by increasing understanding and familiarity within governments and the public, leading widespread adoption and a higher quality of life for all.

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[56] http://www.govtech.com/network/San-Francisco-Asks-Vendors-for-Citywide-Broadband-Proposals-Mandates-Net-Neutrality.html

v.v Embed Smart

'Smart' will become the new norm, expected as part of every community service and embedded in core strategies. In the future, "smart" initiatives will not be considered separately from other municipal services or assets or described in distinct Master Plans. This transformation requires a cultural change with a different way of working and thinking about community resources. Smart initiatives break down information and agency silos and require iterative interaction between government and citizens. Embedding the smart city concept promotes an open and collaborative decision-making process that increases the pool of intellectual capital and builds a strongly connected and engaged community.

APPENDICES

A.   Example Smart City Master Plans & Strategies

City	Initiative	City	Initiative
Barcelona, Spain	Barcelona Ciutat Digital (2016)	Montréal, Canada	Montréal Smart and Digital City (2014)
Birmingham, United Kingdom	The Roadmap to a Smarter Birmingham (2014)	Milton Keynes, United Kingdom	MK:Smart (2014-2017)
Chicago, United States	The City of Chicago Technology Plan (2013)	Newcastle, Australia	Newcastle City Council Smart City Strategy (2017)
Dublin, Ireland	Digital Dublin (2013)	Ottawa, Canada	Smart City 2.0 (2017)
Edmonton, Canada	Smart City Strategy (2017)	St. Albert, Canada	City of St. Albert Smart City Master Plan (2017)
Kitchener, Canada	Digital Kitchener Strategy (2017)	Toronto, Canada	Open Data Master Plan (2018)
London, United Kingdom	Smart London Plan (2013)	Vancouver, Canada	City of Vancouver Digital Strategy (2013)
	The Future of Smart (2016)	Yinchuan, China	Yinchuan Special Report: Smart Cities (2016)
	Smarter London Together (2018)		

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