ITAC Whitepaper– Seizing the Internet of Things Opportunity

RECOMMENDATIONS TO GOVERNMENT

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As Canada's national ICT business association, the Information Technology Association of Canada (ITAC) champions the development of a robust and sustainable digital economy in Canada. A vital connection between business and government, we provide our members with the advocacy, networking and professional development services that help them to thrive nationally and compete globally. A prominent advocate for the expansion of Canada's innovative capacity, ITAC encourages technology adoption to capitalize on productivity and performance opportunities across all sectors. A member-driven not-for-profit, ITAC has served as the authoritative national voice of the $170 billion ICT industry for 60 years. More than 36,000 Canadian ICT firms create and supply goods and services that contribute to a more productive, competitive, and innovative society. The ICT sector generates one million jobs directly and indirectly and invests $4.9 billion annually in R&D, more than any other private sector performer.

A Letter from the President and CEO

The Internet of Things (IoT) is moving technology off our desktops and into our everyday lives. From wearable devices that alert health professionals to medical issues before they happen, to smart factories that maximize production efficiency, no new class of technologies has the potential for broader social, economic and environmental benefit than IoT.

The deployment of connected devices is still in its early stages, but Canada's technology sector is well positioned to become a global leader in IoT - projected to deliver up to $11.1 trillion globally in economic value by 2025.[1] However, to realize these opportunities, it is vital that government's across Canada act now to set the right policy foundations. The goal of this report is to set out a path for how governments can achieve this.

This report sets out 13 actionable recommendations for what the government can do to make Canada an IoT leader. While the report is primarily directed at the federal government as it develops its *Innovation Agenda*, many of the recommendations and suggested strategies are equally applicable to provincial and municipal governments.

IoT holds the possibility to make the last generation's science fiction the next generation's reality. ITAC hopes the proposed recommendations in this report will continue the dialogue with government and inspire strong actions so Canada can *seize the IoT opportunity!*

Robert Watson
President and CEO
ITAC | Information Technology Association of Canada

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[1] McKinsey Global Institute, *Unlocking the Potential of the Internet of Things*. June 2015.
http://www.mckinsey.com/business-functions/business-technology/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world

Introduction

The rapid growth of connected and sensor enabled technologies, an ecosystem often referred to as the Internet of Things (IoT), is dramatically changing the ways we live, work and interact. As IoT devices become increasingly ubiquitous, vast amounts of new data will provide insights that allow for businesses and governments to work more efficiently and effectively. IoT enabled devices in the home and networked across "smart cities" will improve convenience and quality of life for citizens. Along with massive opportunities presented by IoT, it is also presenting new scenarios where governments may need to provide guidance or regulation to foster trust and protect the public interest.

In August 2015, ITAC released a whitepaper that explored some of the pressing policy challenges created by the emergence of IoT, recommending the federal government hold a national discourse to establish consensus on the policy approach moving forward.[2]

The goal of this follow-on report is to take government thinking about IoT to the next level. Canada has the potential to become a world leader in IoT, but to realize this potential, governments across the country have a vital role to play in creating the right social, policy and economic conditions to support this growth. While this paper is not an exhaustive analysis of every policy question impacting innovation in Canada, it is hoped that the recommendations brought forward will support a dialogue with industry around some of the pressing policy issues that could support or unnecessarily inhibit the growth of IoT.[3]

What is the Internet of Things?

In general, IoT refers to a network of uniquely identifiable end points, or "things," that communicate through the internet, WIFI or other wireless protocols (e.g. radio frequency, Bluetooth). These connected assets are rapidly replacing traditional ones in consumer homes and in enterprises with the promise of cost savings, increased process visibility and higher productivity. It is a capability that requires a range of technologies to collect data from the environment, transport it, protect it, analyze it and respond.

It is also not particularly new. Device to device communication, whether wired or wireless, has existed for decades. What is new, however, is that sensors, bandwidth and processing power have reached the point where it is affordable and practical for individuals, government and

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[2] See: ITAC, *The Internet of Things: Time for a National Discourse. 2015.* http://itac.ca/wp-content/uploads/2012/09/The-Internet-of-Things-Time-for-a-National-Discourse.pdf

[3] ***Note:*** The aim of this report is to to deliver specific recommendations on what governments can do to support the growth of IoT in Canada. Policy discussions on IoT often expand to include a wide range of topics related to Canada's innovation policies (e.g. R&D tax credits, access to capital, the ability of firms to scale, tax rates, temporary foreign workers, etc.). To keep tight focus on IoT, and to avoid an inadequate analysis of these complex policy areas, many of these broader topics have been excluded from this particular report. ITAC will be providing specific analysis on several of these areas in subsequent whitepapers. For further information, please contact David Messer at dmesser@itac.ca.

businesses of all sizes to add millions of 'smart' and connected devices into their daily lives.

In 2008, the year that the global number of internet connected devices first outnumbered the human population, the US National Intelligence Council declared that IoT would be a disruptive technology by 2025. Since then, that estimate has been revised forward; Gartner estimates that there are over 3.8 billion connected things on the planet today and that by 2020 that number will climb to 25 billion. At that point, IoT devices will generate $8 trillion in annual revenues. Apart from its sheer size, this economic activity will touch virtually every human on the planet. In Canada, IDC predicts 21% market growth from 2013- 2017; IDC also predicts that IoT will be a $21 billion market in Canada by 2018.

Potential Benefits of IoT

The market for sensors, endpoints and networks are only part of the picture. The real opportunity from IoT comes from how data generated by connected devices can be analyzed and acted on to improve business efficiency and enable entirely new business models. McKinsey estimates that IoT enabled efficiencies could have a potential global economic impact of $4 to $11 trillion a year in 2025.[4]

Potential Transformative Applications of IoT	
Agriculture and Food Processing	- Remote monitoring of soil conditions and plants - Real time monitoring of livestock health and well being - Remote monitoring of vehicles transporting fresh or frozen foods to monitor temperature and avoid spoilage
Manufacturing	- Predictive maintenance of machinery - Automated processes through machine-to-machine communication - Inventory optimization - Connected wearable devices that coordinates workers' activities in real-time
Cities	- Video, cellphone data and vehicle sensors to monitor traffic and optimize flow - Sensors to monitor energy and water use and atmospheric pollution - Connected assets that collect, sort and share public data with citizens (open data in smart cities)
Homes	- Smart thermostats to ensure comfort and reduce energy waste - Autonomous devices to automate chores - Smart appliances to track food preparation and refrigerator inventory

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[4] McKinsey Global Institute, *The Internet of Things –Mapping the Value Beyond the Hype*. June 2015

Retail	- Automated checkouts that can charge customers as they walk out of the store - Customer tracking to enable improved customer care - Layout optimization based on analysis of in-store customer behavior - Real-time personalized promotions based on location, purchase history, etc.
Healthcare	- Wearable devices to allow for remote or real-time monitoring and managing of chronic illnesses, reducing the need for hospital visits and allowing for individualized care - Field triaging and supported treatment of victims by first responders
Environment	- Remote monitoring of greenhouse gas emissions from factories - Remote monitoring of water quality which could quickly alert downstream users to changes in water conditions or new pollutants - Unmanned monitoring of seismic activity, avalanches and tsunamis

Public Policy Challenges of IoT

While the potential benefits of IoT are substantial, the emergence of a more connected, data-driven society creates a number of challenging policy questions for government, including:

- How do we balance the benefits of mass data collection and continuous environmental monitoring without infringing on individual privacy?
- How can we ensure the bandwidth exists to support billions of new devices?
- How do we ensure data is protected from unauthorized hackers?
- How do we ensure businesses have the right talent able to analyze and create value out of data?
- How will government regulations, standards and protections keep pace with rapid developments in technology without impeding the development of industry?

While these policy challenges are broad, they are not entirely different from those created by emerging technologies in the past. As our recommendations outline, it is important that governments work with industry to support creative innovation and avoid taking policy actions that could impede growth.

IoT in Canada

IoT is still in its infancy and much of the work around the world today is focused on laying the foundation for future success. While there has been significant dialogue in Canada about the potential impacts, opportunities and challenges of IoT, at present there is no national strategy on how to make Canada a leading IoT jurisdiction.

There are many reasons why Canada could be a leader in IoT, including:

- High Digital Adoption and Acceptance: Canadians are among the top users of the internet in the world.[5] We have been among the earliest adopters (and inventors) of smart phones and digital payment technologies.
- Inherent respect for Canadian Innovations: Canadian technologies are highly regarded as innovative and reliable in many markets around the world. Canada is also seen as a secure place for data routing and storage with high regards to privacy.
- Workforce: Canada has a diverse and highly skilled workforce with post-secondary institutions ranked among the highest quality in the world.[6]
- Natural Test Market Position: While Canada's small population may limit growth potential, the openness and diversity of Canadians and geographic/cultural proximity to the U.S. makes Canada an ideal test site for a range of technologies.
- Integrated Vertical Markets: Many sectors that could derive the most value from IoT in Canada (e.g. healthcare) are publically operated and highly integrated.
- Established IoT Firms: Canada is already home world leading companies and fast growing start-ups in key IoT fields including sensors, machine-to-machine (m2m) communication, artificial intelligence and cyber security.
- Leading Universities and Strong R&D Network: Established and highly regarded R&D Centres (e.g. Communitech in Waterloo, MaRS in Toronto and Wavefront in Vancouver) support promising start-ups and help commercialize research from post-secondary institutions.

Comparing Canada with Other Jurisdictions – What is Canada Missing?

- ***National Leadership****:* Both the UK and the European Commission have undertaken large-scale public/private/ academic studies to develop cross-government strategies to support the growth of IoT.[7] The U.S. Senate is currently considering the *Digit Act*, a bi-partisan bill to create a national strategy and encourage interagency coordination to support IoT.[8]
- ***Talent Development and Retention Strategies:*** Other jurisdictions have taken a strong lead in ensuring the right tech talent is available for fast growing IoT and other technology firms. For example, in 2015 President Obama launched a TechHire initiative which allocated $100M to help fill the technology talent gap.[9] As well, Canada is also

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[5] World Economic Forum, *Global Competitiveness Rankings 2016.* http://reports.weforum.org/global-competitiveness-report-2015-2016/competitiveness-rankings/ Canada is ranked 14th globally for the number of internet users and 12th for number of broadband internet subscriptions.

[6] World Economic Forum, *Global Competitiveness Rankings 2016.* Canada is ranked 7th for the quality of its post- secondary education system.

[7] See U.K. Chief Scientific Adviser, *The Internet of Things: making the most of the Second Digital Revolution*. 2014. For more information on the EU's Alliance on Internet of Things Innovation (AIOTI) see: https://ec.europa.eu/digital-single-market/en/alliance-internet-things-innovation-aioti

[8] For more information on the *Digit Act* see: https://www.congress.gov/bill/114th-congress/senate-bill/2607/text

[9] For more details on the TechHire initiative see: https://www.whitehouse.gov/the-press-office/2015/03/09/fact-sheet-president-obama-launches-new-techhire-initiative

often seen by many ICT workers as overly taxing (given their inherently higher income brackets).

- **Smart Cities Strategy:** Several countries (e.g. U.S., U.K.) have launched national strategies to hasten the creation of "smart cities," including funding demonstration projects or creating living labs for emerging IoT technologies. While many Canadian cities are taking taken steps in this direction at present there is no national smart cities strategy or federally funded network of IoT demonstration municipalities.
- **5th Generation (5G) Demonstration Corridor:** 5G connectivity will form the backbone of IoT and Canada is currently the only G7 country without an experimental 5G corridor. As they are developed and deployed, 5G wireless technologies will use spectrum in faster and more dynamic ways than previous generation standards. Premarket demonstration sites are essential to help companies, especially small and medium sized enterprises (SMEs), develop and prototype new technologies so they are ready to launch when 5G goes mainstream in the early 2020s.

HOW CANADA CAN SEIZE THE IOT OPPORTUNITY - ITAC RECOMMENDATIONS

To help Canada seize the IoT opportunity, ITAC has brought together a working group of industry experts representing firms of various sizes and a range of IoT subsectors. Through this group, ITAC has developed 15 recommendations under six themes to guide federal and provincial approaches to IoT. Key themes include:

1. Overall Government Vision and Strategic Approach
2. Government Adoption
3. Encouraging Business Adoption
4. Building, Attracting and Retaining Talent
5. Predictable and Harmonized Standards, Security and Privacy

1. Overall Government Vision and Approach:

1.1 - The federal government should hold a national dialogue to create a clear aspirational vision and strategy for how Canada can become a world leader in IoT.

ITAC's 2015 White Paper and 2016 Federal Budget Submission suggest the best approach for increasing awareness and developing a national consensus on IoT will emerge from a broad federal government-led dialogue with Canadians. This was the approach taken in the 1990's when the federal government launched the *Information Highway* consultation process, which guided the national approach to the then emerging World Wide Web. As we move from the web to a world of devices, big data and ubiquitous connectivity, it is important that Canadians and Canadian businesses are given the opportunity to participate in a similar holistic dialogue.

The ultimate outcome of a national dialogue should be a clear, aspirational vision and strategy for how Canada can become a leader in IoT. This vision needs to include a strategy for increased government adoption of connected technologies to improve service delivery and efficiency. It should consider potential legislative and regulatory tools and forums to ensure the law is nimble and adaptive to keep pace with technological change. It needs to create a framework so that Canadians can trust that their personal data is protected while businesses are given space to innovate. It should also contain the seeds of a new industrial strategy, as part of the federal Innovation Agenda, that works with experts to identify areas where Canada can win (e.g. smart cities, autonomous vehicles), and help fast runners in those areas become world beating companies. The plan should also help Canadian businesses, including SMEs, realize the productivity benefits of adopting connected technologies.

1.2 - Create a public/private IoT Leadership Forum to:
- **- Coordinate public/private funding**
- **- Advise policy makers on the need for legislation**
- **- Maintain oversight/awareness of potential risks and vulnerabilities**
- **- Promote public dialogue**

As connected devices and the complex horizontal ecosystem of the IoT are evolving and changing at a rapid rate, the effective implementation of a national vision and strategy will require close oversight, support and coordination from experts inside and outside government. An IoT Advisory Board of industry representatives, government officials, security and privacy professionals, R&D organizations and academics should be convened to provide ongoing guidance and strategic advice to the government, including on new ways to provide timely funding to fast-growing IoT firms.

1.3 - Canadian governments need to develop a <u>nimble, flexible and pro-innovation regulatory environment.</u> This can be done by dedicating policy resources to removing unnecessary barriers to the adoption of new technologies, keeping pace with change, and creating space for experimentation.

Governments have a fundamental duty to protect the health, safety and privacy of Canadians and guard the public interest. However, as Canada's economy evolves, it is important that regulators keep pace with technological change and avoid unnecessarily inhibiting Canadian innovation.

In recent years, technology-driven businesses in the "sharing economy" (e.g. Uber, Airbnb) have demonstrated the challenges of regulators planning for future disruption. However, in other areas, Canadian jurisdictions have boldly taken a leadership role in allowing for experimentation and testing of new technologies. For example, Ontario is the first jurisdiction in Canada to allow the full on-road testing of autonomous vehicles.[10] Canada's flexible aerospace regime has made

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[10] https://news.ontario.ca/mto/en/2015/10/ontario-first-to-test-automated-vehicles-on-roads-in-canada.html

British Columbia a major demonstration site for testing drone delivery systems[11], and New Brunswick is working with Siemens to develop a world leading demonstration smart grid.

This pro-innovation regulatory focus must continue. As new IoT-based business models emerge, Canadian governments need to take a flexible and risk-based approach to regulation and find ways to work with innovators rather than fight new business models. To this end, Canadian governments—federal, provincial and municipal—should introduce a component on innovation in their training for regulatory and policy staff. This training should stress the value and inevitability of technological change and highlight the government's important role in working with innovators to facilitate economic growth while still protecting the public interest.

1.4 - Invest in cross cutting infrastructure and technologies (e.g. network infrastructure, cyber security, innovation and demonstration centres, and data analytics).
Just as roads and canals are essential infrastructure for the physical economy, if Canada wants to lead in an economy based on data and ubiquitous connectivity, governments need to invest in foundational infrastructure that will support, secure and accelerate the growth of IoT.

Key investments the government should pursue include:

Network Infrastructure: Invest in creating a wired and wireless network capable of supporting billions of new connected devices. Besides the need to release spectrum in a timely manner, this must also include crafting a predictable and adaptive spectrum policy that aims to maximize harmonization with larger ecosystems, maximize the continuity of connectivity and recognizes new emerging technologies that are competing to serve the IoT. Governments should increase support for firms making investments to service remote areas which could benefit significantly from technologies like remote environmental monitoring.[12] Federal and provincial governments should consider ICT network infrastructure as part of its broader infrastructure spending to stimulate the economy and pursue shovel-ready projects such as creating an experimental, pre-commercial 5G corridor. This will allow Canadian companies to test technologies so they are ready to take advantage of next generation telecommunication standards as they go mainstream.

Cyber Security: Cyber security is now foundational infrastructure for any connected device and virtually every economic activity. Government needs to support the development and adoption of world-leading cyber security technologies and infrastructure to ensure that Canadians can trust that their data will be protected. This should include the creation of a National Centre for

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[11] http://www.cbc.ca/news/technology/amazon-tests-delivery-drones-at-a-secret-site-in-canada-here-s-why-1.3015425
[12] Great strides were made in connecting remote communities through the federal *Connecting Canadians* program. The 2016 federal budget committed $500M over five years to a new rural high-speed broadband initiative currently under development. ITAC looks forward to working with the federal government to develop this initiative.

Cyber Security to provide national leadership, guidance and support to Canada's cyber security industry.

Innovation and Testing Facilities: Create Infrastructure to allow Canadian entrepreneurs to experiment, prototype and bring their innovations to market including living labs, incubators and accelerators. As previously mentioned, Canada already has a network of successful innovation centres. Considering the broad applicability of IoT to a range of economic sectors, new and targeted centres should be created to allow IoT innovators to test new sector-specific IoT use cases in realistic settings, ranging from food processing, to advanced manufacturing and agriculture.

Data Analytics: As discussed earlier, the greatest economic benefits from IoT will come from vast swaths of new sensor generated data that will help businesses operate more efficiently and effectively. However, to realize these benefits, businesses will need the capacity to analyze the data they collect. This is presently a significant challenge. For example, McKinsey reports only 1 percent of data from an oil rig with 30,000 sensors gets examined.[13] Most data collected today by businesses is used for anomaly detection and control, not optimization and prediction, which could provide the greatest value. To realize the true value of IoT for Canadian industry, governments need to invest to improve Canada's data analytics capacity. This should include both investments to create the human talent through education and investments in new analytical technologies, like artificial intelligence.

2. - Government Adoption
Governments across Canada recognize the need to modernize how they operate and become more efficient in how they deliver services to Canadians. Pressed between an aging population, declining tax base and increasing demand for services, modernization, fueled by technology, is a key component in ensuring continued positive outcomes for Canadians. Connected technologies and IoT will play a key part in meeting these demands.

2.1 - The Canadian public sector should become early and model adopters of IoT to enable more innovative, effective and efficient public services.
It is crucial that governments across Canada consider the opportunities for IoT to improve the delivery of public services. Canada's public sector dominates a number of key sectors that could derive significant benefits from IoT. For this reason, if Canada is going to lead in IoT, government must proactively seek to include connected technologies in infrastructure and program procurements. There are many examples of Canadian governments already using connected technologies, ranging from bridge sensors to warn of ice build up to drug dispensing robots in hospitals. To ensure that the public sector is making the most of IoT, governments need to work with industry to learn about new technologies and consider how they could improve their business practices. Procurement processes should likewise be modernized to

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[13] McKinsey Global Institute, *The Internet of Things –Mapping the Value Beyond the Hype*. June 2015

allow for early industry input and spaces where businesses can provide governments with out-of-the-box solutions to pressing problems.

Beyond being early, it is key that governments are seen as model users of IoT, demonstrating for the rest of the economy how connected technologies can improve operational efficiency and serve the public interest. For example, government drivers or police officers could leverage body cameras or other wearable technologies to identify when staff are tired, overworked or in distress. To support government adoption, ITAC will continue to work with government to raise the profile of innovative public sector uses of technology through our annual Ingenious Awards program and other venues.

2.2 - The Government of Canada should create an internal demonstration fund to support public sector experimentation and pilots with connected technologies.
While public servants are increasingly encouraged to innovate and deliver more effective services, ministries and other public agencies seldom have the resources or "safe spaces" to invest in experimentation. If the government wants to drive internal innovation and explore novel uses of connected technologies, it must create more opportunities for experimentation. A dedicated IoT Experimental Fund, which ministries would compete to gain access to, could help deploy the creativity of Canada's public servants and technology professionals for the benefit of Canadians. A demonstration fund would also support key federal priorities including the Innovation Agenda and Pan-Canadian Innovation Agenda for Healthcare.

Beyond improving public services, an IoT demonstration program will give Canadian technology innovators a chance to demonstrate their products with a verified government customer, providing companies with invaluable credibility as they work to develop a customer base at home and abroad. Ontario's 2016 budget included a technology demonstration fund for this expressed purpose which a federal plan could be modeled on, along with existing federal tech demo programs in aerospace and defence.[14]

2.3 - Open programming interfaces should be adopted by government entities and federally regulated industries to maximize public value of data (e.g. open data).
Governments across Canada have committed themselves to the principle that government collected data should be made open and machine readable so Canadians are free to create additional value from this public resource. As governments adopt IoT technologies, this approach should be maintained. Canadian governments should also, where practical and

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[14] The Build in Canada Innovation (BCIP) program goes part of the way in providing this early stage validation to companies, but the funding for BICP is far lower than similar programs in other jurisdictions. For example, the U.S. Small Business Innovation Program allocates between $2-3 billion annually for procurements from SMEs. See Section 7 of: Independent Panel on Federal Support to Research and Development. 2011. *Innovation Canada: a call to action.* http://rd-review.ca/eic/site/033.nsf/eng/h_00287.html

appropriate, support and promote open programming interfaces that will allow businesses and entrepreneurs to connect and create value from public IoT investments.

3. - Business Adoption
While much of the early excitement around IoT has focused on consumer products like fitness trackers and connected appliances, in the long term the real opportunities for economic growth will be in the business application of connected technologies.[15]

Canada has long suffered a productivity gap compared to peer countries. A substantial reason for this gap is under investment by Canadian businesses, especially SMEs, in tools and technologies that can improve their operational efficiency. For example, Canadian businesses ICT investment per worker sits well below several peer nations and is only 51 percent when compared to firms in the U.S. [16] Considering the profound impacts connected technologies and IoT will have across the economy, if Canadian businesses aim to compete in the data-driven world, their adoption of technology will need to improve.

3.1 - The Government should develop a strategy and more creative approaches to encourage Canadian businesses to adopt technology.
There have been many reasons given for the lack IT investments by Canadian firms. Some have blamed this on a "culture of complacency" among business leaders.[17] A 2014 study by the Conference Board of Canada found a broad range of factors are preventing SMEs from adopting new technologies including time and money constraints, fear and confusion around new technologies and the potential opportunity costs of investing in large IT overhauls. [18]

In recent years, the federal government has sought to increase business productivity primarily through tax incentives, like the federal Capital Cost Allowance. While tax incentives must be a component of technology adoption strategies, they should not be viewed as a panacea. Governments need to be more creative in finding opportunities, venues and support structures to help Canadian businesses—including SMEs—learn about new technologies and how they could improve their business. For example, the German government is currently working with industry and academics to launch up to 20 competency centres aimed at helping small and medium sized companies go digital and embrace technologies like cloud and IoT.[19] The U.K.

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[15] McKinsey Global Institute estimates more than 2/3 of potential IoT value is associated with B2B applications. McKinsey Global Institute *The Internet of Things: Mapping the Value Beyond the Hype*. 2015. Pg. 30.
[16] StatsCan, *State of the Digital Nation*, 2014.
[17] Canadian Council of Chief Executives, *From Common Sense to Bold Ambition.* 2008.
[18] Conference Board of Canada. *Adopting Digital Technologies: The Path for SMEs.* February 2014. Accessed March 2016. http://www.nrc-cnrc.gc.ca/obj/doc/irap-pari/dtapp-ppatn/resources-ressources/REPORT_6029_adoptingdigitaltechnologies_en.pdf
[19] *markets Germany*, "Germany's Mittelstand 4.0 initiative," Jan. 2016. http://www.gtai.de/GTAI/Navigation/EN/Meta/Press/Markets/Markets-germany/Issues-2016/markets-germany-2016-01,t=welcome-to-the-future,did=1384204.html

has adopted a similar strategy for helping SMEs with cyber security.[20] Canadian governments should follow these model and find more direct ways to connect businesses with the technologies that could improve their operations.

3.2 - Partner with industry to create world leading demonstration factories, facilities and Centres of Excellence for Industrial IoT and Industry 4.0 to test technology and inspire new approaches.

The most dramatic demonstrations of IoT will be seen in fully integrated factories where systems of connected technologies, including robotics and 3D printing, combine to transform how work gets done. To educate businesses on how connected technologies can transform production, governments should partner with industry to create demonstration factories and Centres of Excellence for Industrial IoT and Industry 4.0. Demonstration initiatives should be varied and recognize the diverse sectors in Canada's economy that could benefit from IoT and solutions appropriate for different business sizes. IoT demonstration sites can also serve as venues for Canadian businesses prototype and test new connected technologies in realistic industrial environments. While Germany is leading the world in creating industry 4.0 test facilities, Canadian companies are already moving in this direction through new centres like Catalyst 137 in Waterloo.[21]

4- Talent:
One challenge facing every ICT Company in Canada is attracting and retaining talented staff. This is especially true in high demand, niche fields like cyber security and big data analytics.

4.1 - The Government of Canada and provincial governments should work with industry to ensure the education system trains IT-professionals with the skills needed for the connected future.
According to IDC, Canada currently has an IT talent gap of approximately 71,000 positions. [22] Canadian firms are spending close to $1 billion to try and fill that gap every year. This is not a new issue. In fact, it is so long-standing that for many firms it has become "business as usual."

 If Canada wants to be a leader in IoT and the connected economy, it is vital that Canada's education system produce the talent required to make it happen. Not only will computer programmers and sensor designers be needed, but to take advantage of the data created from connected devices, Canada will need an army of data analysts and tech savvy business professionals to capitalize on insights. To ensure billions of devices are safe and secure, we will need more cyber security experts and privacy-literate engineers.

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[20] See the UK's *Cyber Essentials* scheme: https://www.gov.uk/government/publications/cyber-essentials-scheme-overview
[21] See: http://catalyst137.com/
[22] Findings from IDC report to ITAC's National Board of Directors (November 2015). For more information, see: *IDC Canadian ICT 2015-2019 Forecast* (IDC #CA7ICT15, July 2015).

Canada's ICT industry, through ITAC, has taken the lead in some of these areas by creating the CareerMash program which encourages high school students to pursue tech careers.[23] ITAC has also led the creation the Business Technology Management (BTM) curriculum, which is now in place at 19 Canadian universities, graduating over 1000 students annually with hybrid skills in technology and business management.[24] The BTM program will expand over the next several years to 50 post-secondary institutions and will include six specialty streams including cyber security and data analytics. Another valuable program is the Canadian Cyber Defense Challenge, which encourages high school students (primarily in Winnipeg) to pursue cyber security careers through competitive hacking challenges.[25] While these programs are primarily industry or volunteer led, they rely on government funding to operate. Canadian governments and educational institutions need to continue their support of these and other technology skills development programs to create the right foundation for Canada to compete in the 21st century economy.

4.2 - Governments must create the right social and economic conditions to make Canada an attractive destination for IT professionals.
Attracting and retaining the best and the brightest is just as important for Canadian ICT firms as developing talent at home. If Canadian companies want to compete globally, they need to scale quickly and they need access to talent to fuel this growth. For this reason, Canada needs to revisit its Temporary Foreign Worker program and make it easier to import skilled ICT workers to fill Canada's ICT talent gap. Canada also needs to consider how its income tax and incentive system impacts companies' ability to retain skilled technology workers, many of whom can easily find employment in more attractive jurisdictions.

5. - Predictable and Harmonized Standards, Privacy and Security
The ICT industry is one of the most integrated and competitive segments of the global economy. It is important that governments view ICT technologies within this global context when considering how they approach technical, security and privacy requirements. With the predicted dramatic increase in connected devices, policymakers should work to ensure regulatory approval systems are as globally-harmonized, predictable, transparent, and reliable as possible. This will promote a "build once, sell anywhere" principle, which drastically reduces regulatory costs, time-to market, and cost to end users.

5.1 - Policy makers should encourage and leverage voluntary, open and consensus-based standards, while maintaining a technology-neutral approach to regulation.
A major driver of IoT will be the development of open, voluntary and consensus-based standards. For industry, international standards reduce costs and expand markets because manufacturers can benefit from economies of scale. For consumers, standards make it easier to know the capabilities and functionality of the products they buy. Standardization is also an

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[23] For more information on CareerMash visit http://careermash.ca/
[24] For more information on Business Technology Management visit http://itactalent.ca/talent-initiatives/btm/
[25] For more information on the Canadian Cyber Defence Challenge visit http://www.cyberdefencechallenge.ca/

important form of self-regulation that can relieve the government of the responsibility for developing detailed technical specifications. Currently, there are a several organizations across different industry variables working to develop technical and best practice standards for IoT.[26] While some of these organizations collaborate, others compete – which can be a good thing. Ultimately, for IoT to thrive, consensus standards will emerge or be developed at the international level. To help Canada be a leader in IoT, ITAC recommends Canadian governments work closely with industry to support the development of consensus standards for IoT. This can be done by supporting existing standards development committees through the Standards Council of Canada and by funding academic research into areas where evolving standards will be required such as cyber security and Machine-to-Machine (M2M) interoperability.

While supporting standardization efforts, governments should also recognize the value of competition in fueling new innovations. Policy makers should avoid taking any action that restricts the market to a limited set of solutions when new innovations—some of which cannot be predicted—are constantly being rolled out. Where practical Canadian governments should adopt a competition and technology neutral approaches to regulating connected technologies, and ensure that adequate space is always given for businesses to invent new, creative solutions.

5.2 - The government should adopt a flexible, outcomes-based approach to data security and personal data protection based on international standards and consultations with industry and stakeholders.

Canada's ICT industry recognizes that IoT growth will depend heavily on Canadians trusting that connected devices protect their personal privacy. In this context, government has a clear role in working with all parties to create broad consensus on issues like consent for data collection, opportunities to 'opt out,' data ownership and retention.

As Canada's Privacy Commissioner noted in a recent report, as sensor technology and IoT becomes more ubiquitous, new privacy questions will arise.[27] This will be especially true in situations where it is challenging for individuals to provide informed consent, such as the passive collection of data by sensors, machine-to-machine transfers and the use of big data analytics. For example, in the retail environment, passive Wi-Fi or Bluetooth technologies are able to track how many times a customer visits a shop and the areas or departments in which they spend the most time. This data can be tracked and combined across multiple stores to provide deeper insights on individual consumer behaviour.

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[26] Examples of organizations developing standards for IoT include: the IEEE Standards Association, the Industrial Internet Consortium, the Open Interconnect Consortium Standards, the AllSeen Alliance, the IPSO Alliance, Third Generation Partnership Project (3GPP) and others.

[27] Office of the Privacy Commissioner of Canada, *The Internet of Things: An introduction to the privacy issues with a focus on the retail and home and environments.* February 2016.

In relation to emerging privacy areas with IoT, we urge regulators to avoid adopting privacy regulations that will make it impossible for IoT systems to flourish. Regulators should work with industry to develop best practices and standards that can be responsive to new data driven business models while allowing individuals to manage their level of data sharing. Canada's *Personal Information Privacy and Electronic Documents Act* (PIPEDA) provides many clear guidelines for industry. However, as new regulations are developed under PIPEDA and other privacy legislation, ITAC believes the government should work to build consensus and facilitate both innovative and ethical uses of data. Regulators should also focus on areas that present the most significant privacy concerns, recognizing that de-identified or aggregated data do not necessarily present the same privacy concerns as other types of data.

Canada should also work with other jurisdictions to create interoperable privacy regimes that avoid unnecessary duplication or barriers to cross-border information flows. Collaboration should also support international privacy certification initiatives, such as privacy by design certification, and the creation of a privacy engineering discipline.

Conclusion

The Internet of Things represents a transformational opportunity for Canada's economy. But for Canada's brightest innovators and entrepreneurs to seize this opportunity, governments have a key role to play. We need a pan-Canadian dialogue to set a national strategy on where and how we can win. We need to create a regulatory environment that supports innovation and experimentation while respecting individual privacy. We need government investments to build the infrastructure that will sustain the connected economy, and to create or attract the talented individuals who will make it thrive.

ITAC looks forward to working with governments across Canada to help advance these recommendations.

SEIZING THE IOT OPPORTUNITY: SUMMARY OF ITAC RECOMMENDATIONS TO GOVERNMENT

Theme	ITAC Recommendation
1. Overall Government Approach	1.1: The federal government should hold a **national dialogue** to **create a clear aspirational vision and strategy** for how Canada can become a world leader in IoT.

	1.2: **Create a public/private IoT Leadership Forum to:**
	  - Coordinate public/private funding
	  - Advise policy makers on the need for legislation
	  - Maintain oversight/awareness of potential risks and vulnerabilities
	  - Promote public dialogue.

	1.3: Canadian governments need to develop a **nimble, flexible and pro-innovation regulatory environment.** This can be done by dedicating policy resources to removing unnecessary barriers to the adoption of new technologies, keeping pace with change, and creating space for experimentation.
	1.4: **Invest in cross cutting infrastructure and technologies** (e.g. network infrastructure, cyber security, innovation and demonstration centres, data analytics).
2. Government Adoption	2.1: **The Canadian public sector** should become **early** and **model adopters of IoT** to enable more innovative, effective and efficient public services.
	2.2.: The Government of Canada should **create an internal demonstration fund** to support **public sector experimentation** and pilots with connected technologies.
	2.3: **Open programming interfaces** should be adopted by government entities and federally regulated industries to maximize public value of data (e.g. open data).
3. Business Adoption	3.1: The Government should develop a strategy and **more creative approaches** to encourage Canadian businesses to adopt technology.
	3.2: Partner with industry to create **world leading demonstration** factories, facilities and Centres of Excellence for Industrial IoT and Industry 4.0 to test technology and inspire new approaches.
4. Talent	4.1: The Government of Canada and provincial governments should work with industry to ensure **the education system** trains IT-professionals with the **skills needed for the connected future**.
	4.2: Governments must create the **right social and economic conditions** to make Canada an attractive destination for IT professionals.
5. Predictable and Harmonized Standards, Privacy and Security	5.1: Policy makers should encourage and leverage **voluntary, open and consensus-based standards**, while maintaining a technology-neutral approach to regulation.
	5.2: The government should adopt a **flexible, outcomes-based approach to data security and personal data protection** based on international standards and consultations with industry and stakeholders.