DIGITAL TALENT

ROAD TO 2020 AND BEYOND

A NATIONAL STRATEGY TO DEVELOP CANADA'S TALENT IN A GLOBAL DIGITAL ECONOMY

INFORMATION AND COMMUNICATIONS TECHNOLOGY COUNCIL (ICTC) | www.ictc-ctic.ca

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Preface

Digital Talent: Road to 2020 and Beyond is Canada's first national digital talent strategy. It highlights the opportunities and challenges facing Canada's digital economy and underscores the importance of digital talent as one of the most critical advantages for Canada in a global economy. The strategy is aimed at ensuring that Canadians are well prepared to succeed as skilled workers and entrepreneurs in this fast pace economy, as well paving the way for greater participation as consumers and citizens in an increasingly digital world.

To develop the strategy, the Information and Communications Technology Council (ICTC) consulted with industry, education, government, and professionals in information and communications technology (ICT) sector from across Canada to ensure a broad representation of stakeholders and supplemented those insights with an extensive review of published research as well as data from Innovation, Science and Economic Development and Statistics Canada. In total, the strategy reflects the inputs of more than 500 individuals and organizations who contributed their ideas over a three-month period. The strategy is a living document that will continue to evolve through ongoing stakeholder engagement with a view to implementing the recommendations. As the strategy sets a path to move forward, three national taskforces, comprised of industry, education and government leaders, have been formed: 1) Education and Skills; 2) Industry Growth; and 3) Diversity and Inclusion. The taskforces will set the course for 2020 and beyond and will engage a wide array of stakeholders to support the move from strategy into action.

ICTC has made all reasonable efforts to ensure the accuracy of the information contained herein and the fair reflection of the diverse perspectives gathered during the consultations leading up to the creation of this document.

Acknowledgements

This strategy was made possible with the support of Microsoft Canada Inc. We are grateful to Microsoft for their curiosity, thoughtful contributions and support for the independent process ICTC undertook to develop a strategy that is truly national in scope and reflective of the diverse range of perspectives on this important issue.

Microsoft

We would also like to acknowledge the following organizations for their insights and input into the strategy:

Adputer Inc.
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Canadian Chamber of Commerce
Canadian Information Processing Society
Canadian Women in Communications and Technology
Canadore College
CATAAlliance
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Cyanic Automation
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High Level Analytics
Holland College
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Isolation Network
ITI International Integration Inc.
:ITO Employment Services
Justice Institute of British Columbia
La Cité Collégiale
Lakehead University
Latitude Geographics
New Brunswick Community College
Newzulu
Nmédia Solutions
OCAD University
Ontario JOIN
Ottawa Catholic School Board
Ottawa Community Immigrant Services Organization
Peter Mielzynski Agencies Ltd.
P&M Technologies
Randstad Technologies
SaskTel
Seek Thought Consulting
Seneca College

Digital Nova Scotia
EPIC Information Solutions
Fanshawe College
FDM4 International Inc.
First Mobile
FOX GROUP Technology Consulting
Fundamental Software Solutions Inc.
Georgian College
Get Workers
Gevity Consulting Inc.
Global Knowledge
Google Canada
GroupHEALTH Benefit Solutions
Signifi Solutions Inc.
Solutions In Progress
TECHNOCompétences
Tessellate Inc.
ThinkCards Inc.
True North Systems Consulting
University of New Brunswick
United Way of Calgary & Area
V2 Games
Vancouver Economic Commission
ViaTec
Vital Insights
Vendor Search Group
Weever Apps
Wicked EH Inc.
Willis College
Workday

We would also like to extend a special thanks to the Entertainment Software Association of Canada (ESAC) for their collaboration. We look forward to moving our complementary strategies into action.

Last, but certainly not least, we are also extremely thankful to all the individuals, government ministries, educational institutions, industry associations and companies that generously shared their time and insights through the consultation process. This strategy would not have been possible without their collective wisdom.

Executive Summary

Over the past several decades, the world economy has witnessed unprecedented growth as young economies emerged, trade expanded, and education continued to bridge the social and economic divide. This growth has largely been the result of technological advances — a critical enabler behind any modern economy.

The economic landscape today and moving forward, however, is somewhat different. Increasingly, the global economic outlook remains uncertain and Canada is facing its own challenges owing to low commodity prices and a precipitous devaluation of the Canadian Dollar against other major currencies. Compounding this situation are emerging labour trends — such as the availability of global online labour, spurred by the sharing economy, crowd sourced employment, and the automation of jobs — that have the potential to reshape labour demand and supply, immigration, as well as talent strategies that are no longer defined by the physical workplace. And while international trade agreements like the Trans-Pacific Partnership (TPP) will create new opportunities for Canadian businesses, they may also expose weaknesses in our own industrial sectors.

The recipe for success in this dynamic and evolving economic environment is dependent on our ability as a nation to increase investments in innovation, equip our workforce with relevant skills, produce higher-value goods and services, and expand trade. While Canada's ICT sector is a $74[1] billion per year industry on its own, it's the value-added contribution it provides to other industries that make it a strong driving force behind our nation's economic growth and prosperity. With a favourable political and business environment, and a flourishing digital ecosystem, Canada has strong potential to become a leader in the global economy.

Canada's leadership in the global economy will depend on its ability to capture the benefits of emerging digital trends. In the next 3-5 years, the adoption of smart and connected technologies, such as the Internet of Things (IoT), will continuously reshape all industrial sectors, including manufacturing, financial services, health, transportation, essential services and cities, as well as media and creative industries. Research by Cisco, among others, estimates the size of the global IoT economy to exceed $19 trillion by 2020.[2]

Despite the importance of technology adoption to business sector innovation and competitiveness, Canada's adoption rate remains low compared to our international counterparts. One of the principal reasons for this is the lack of skilled workers who can assess and implement technological innovations.[3] This is particularly vital for small and medium-sized enterprises (SMEs) that acutely need skilled digital talent, but have limited means to train or find a job-ready workforce to respond to the fast changing reality of the global economic landscape. It is, therefore, critical that skilled digital talent is available so that companies can effectively adopt and leverage digital technologies.

Canada's digital economy[4] currently employs 877,470 ICT professionals spread throughout all sectors the economy. The growth in digital jobs has outpaced the overall economy in the last two years by over 4 to 1, leading to a strong demand of *182,000* skilled ICT workers by 2019. Unfortunately, the domestic supply of ICT graduates and workers will be insufficient to meet this demand. Engaging all available talent, including women, youth, immigrants, Indigenous persons and persons with disabilities, will be critical in mitigating the talent shortage. We also need to ensure that new graduates have the practical knowledge and skills they need to enter the workforce quickly and add value to Canadian businesses.

The purpose of *Digital Talent: Road to 2020 and Beyond* is to provide practical recommendations that will position Canada's talent as a comparative advantage in the increasingly global and rapidly evolving digital landscape. This strategy is unique in that it targets both the "vertical" ICT industry and the "horizontal" adopters of ICT and digital technologies, both of which depend on a strong, vibrant digitally-savvy workforce. This strategy is not intended to supplant digital strategies developed by provincial governments (such as British Columbia's technology strategy) or other associations representing sub-sectors of the ICT vertical (such as the Entertainment Software Association of Canada's talent strategy). Rather, it supports and reinforces the elements of those other strategies that we believe should be prioritized at a national level.

This strategy contains practical recommendations aimed at building Canada's digital talent base for today and the future. Those recommendations are organized according to the following categories:

Implementing this strategy will contribute meaningfully to the promise of real change for Canadians. It will ensure that SMEs, the engine of our economy, and all Canadian businesses are well equipped to respond to a rapidly evolving global economy. Moreover, it will ensure that Canadians, particularly youth, will be well prepared to succeed as skilled workers and entrepreneurs in our increasingly digital and global economy. Making the right investments and policy choices has never been more critical for Canada.

Introduction

The global market for information and communications technology (ICT) is estimated to have reached $3.8 trillion in 2015, with nearly all new investment focused on “third platform” technologies that require interdependencies between social, mobile, applications, analytics and the cloud (SMAAC).[5] The Internet of Things (IoT) — the extension of the Internet into the physical world through embedded technology that can communicate in real time[6] — has become the most important innovation for accelerating digital adoption and ICT expansion worldwide. Innovations in IoT alone are expected to lead to thousands of new ICT solutions and services that permeate all industries of the global digital economy.

Although telecommunications services still represent the bulk of global ICT spending, this category is growing at a fraction of the rate of devices, enterprise software and data centre systems. According to the research firm Gartner, worldwide spending on devices surged 5.1% to $732 billion in 2015. Annual spending on enterprise software climbed 5.5% to $335 billion, and the market for data centre systems also expanded 1.8% to $143 billion. Growing demand for cloud solutions, connected devices and enterprise business solutions are creating a more digitally savvy workplace throughout the world.[7]

Canada is home to a strong and vibrant ICT workforce that is being increasingly relied upon to drive productivity, Innovation and growth in key sectors of the economy. As of 2015, there were more than 877,470 ICT workers employed in Canada, the majority in sectors outside of traditional ICT. This vibrant ecosystem has spawned new innovations in SMAAC technologies, resulting in more than 450,000 people being employed directly and indirectly across the country.

Domestically, Canada enjoys a stable political environment, favourable business incentives and a diversified economy that is showing resilience in the face of plummeting oil prices. Canada boasts a highly advanced economy with strong ICT user industries in finance, manufacturing, retail, natural resources, government and professional services. Canada is also one of the most highly educated countries in the world, with more than half of the population having a post-secondary degree or diploma.[8] According to the Organisation for Economic Co-operation and Development (OECD), Canada is a world leader in professionally guided reform of its education system. In addition, Canadian students perform well at all levels of education regardless of socioeconomic status or first language.[9]

Canada has the potential to become a leader in the global digital economy. Talent and skills shortages, international trade agreements and an uncertain global economic environment will influence Canada’s digital ecosystem and workforce landscape. These factors present opportunities for Canada’s digital economy and barriers that could impact our nation’s rise to the top.

A growing demand for skilled digital talent

Advances in SMAAC technologies — and their application in sectors such as health, manufacturing, natural resources, financial services and government services — have created strong demand for highly skilled workers capable of applying business and analytical skills to ICT. This demand has culminated in a direct hiring requirement of more than *182,000* ICT workers in Canada by 2019, with an additional 36,000 workers by 2020.

This does not include emerging occupations — jobs that have evolved from existing occupations or that have been created in response to technological advances — in areas such as artificial intelligence, neural networks, virtual and augmented reality, additive manufacturing or the rapidly expanding IoT ecosystem. However, Canada faces challenges in meeting the expanding demand for skilled digital talent.

The labour gap is not unique to Canada. The European Commission, for example, anticipates a shortfall of around 825,000 ICT positions by 2020.[10] A report from the United States Department of Labour forecasts there will be 1.4 million computer specialist job openings by 2020 — but, universities are unlikely to produce enough qualified graduates to fill even a third of these positions.[11] In this context, companies and recruiters have had to evolve human resources practices — such as introducing new employment models like crowd sourced labour and global virtual workers — to obtain skilled top talent. Although Canada has a significant home grown talent pool, it is insufficient to meet the growing demand for ICT workers and other digitally skilled professionals, and this will intensify through to 2020. The growing competition for global talent will further intensify with increased labour mobility resulting from international trade agreements like the Trans-Pacific Partnership (TPP).

Additionally, Canada is experiencing a shortage of skilled talent, especially as the application of new technologies to traditional industries creates specialized roles that merge technical and business domains. Attracting and retaining experienced professionals is highly competitive, and the transition between education and industry is not always seamless for post-secondary graduates. While larger businesses have the resources to hire and train young graduates, small and medium-sized enterprises (SMEs) experience the most difficulty securing job-ready ICT talent.

Furthermore, the basic technology skills needed to function in today's hyper-connected workplace have expanded. The digitisation of the workplace via technologies like automation and artificial intelligence will make work more complex, creating higher demand for more digitally skilled workers in knowledge-intensive occupations in non-ICT domains.

If Canada does not address the talent and skills gap, it could cost the economy billions of dollars in lost productivity, tax revenues, and Gross Domestic Product (GDP). It is imperative that this challenge is tackled, especially if Canada wants to secure its place as a competitive leader in the global economy.

The importance of international trade agreements

Canada is involved in several free trade agreements, including the North American Free Trade Agreement (NAFTA), which comprises the largest free trade region in the world. In 2014, Canada concluded negotiations with the European Union on the Comprehensive Economic and Trade Agreement (CETA), the country's largest bilateral trade initiative since NAFTA. Part of this agreement includes eliminating existing tariffs on ICT exports to the European Union, which currently run as high as 14% on some goods. The proposed agreement will remove tariffs on optical fibres, semiconductors, microtomes and electrical sound or visual signalling equipment.[12]

A strong presence of entrepreneurs and professionals capable of applying innovative technologies is crucial at a time when Canada seeks to obtain competitive advantage on a global scale. The TPP is expected to encourage foreign direct investment in knowledge-intensive industries; signing this agreement would provide Canada with an outstanding opportunity to maximize its competitive advantage in highly skilled knowledge

sectors that intersect with ICT and other digital domains. The TPP framework has the potential to open up Canada's ICT sector, including digital entrepreneurs, to advanced industrialized nations and emerging economies in South America and the Asia-Pacific region. The agreement is expected to boost international trade among signatories by $305 billion per year by 2025.

Realizing the opportunity associated with the TPP is not without its challenges. By joining the TPP, Canada will open itself up to 11 other Pacific Rim countries, such as Australia and Japan — two countries well ahead of Canada in terms of labour productivity growth.[13] The TPP agreement is expected to strain traditional industries like the manufacturing sector, resulting in the need to upskill and reskill existing pools of labour.

In addition, the increased labour mobility resulting from the agreement will likely affect virtually every sector of Canada's job market. Increased labour mobility has the potential to enhance Canada's access to skilled talent. This is especially true given the high demand for science, technology, engineering and math (STEM) skills in Canada's digital economy, which is not being met by domestic labour supply.

An additional layer of complexity stems from the uncertainty regarding the permanence of economic migrants' stay in Canada. Will they eventually become full citizens or return home? This is an important question in the current context of Canadian immigration, where temporary migration programs such as the Temporary Foreign Worker Program (TFWP) and International Mobility Program (IMP) still outpace growth in other economic migration classes.[14]

Uncertain global economic outlook

The ratification of the TPP agreement is anticipated to occur over the next two years, a period that will be defined by heightened economic and financial challenges. In January 2016, the International Monetary Fund (IMF) downgraded its global growth forecast for the next two years following news that China's economy was growing at its slowest pace in 25 years. Global growth is expected to average 3.4% in 2016 and 3.6% in 2017, 0.2 percentage points below previous estimates.[15]

The IMF downgrade came amidst a tumultuous start to 2016 for the financial markets, with Chinese and European equities plunging into bear market territory. With oil prices hovering below $30 a barrel — and expected to bottom out near $20,[16] — producer countries such as Russia, Norway, Venezuela and Canada have been hit especially hard.

A slower pace of growth in the Chinese economy, peak oil production by the Organisation of the Petroleum Exporting Countries (OPEC) and a shale boom in the U.S. will keep the global crude market well supplied for the foreseeable future. The resulting low oil prices will continue to put economic pressure on major producers such as Canada. Canada's economic growth slowed to around 1.2% in 2015, around half that of the previous year.[17] As the world's fifth-largest energy producer, Canada is unlikely to escape the ill effects of low oil prices, which are down a staggering 75% since mid-2014. As of 2013, more than 13% of Canada's economy was directly and indirectly tied to the energy industry.[18]

Canada's stable political environment, entrepreneur and business friendly climate, and well renowned education system provide a strong foundation to become an ICT and digital leader. However, domestic talent scarcity, skills gaps, an uncertain global economic climate and a lack of clarity as to the full impact of international trade partnerships, have the potential to influence and forever reshape Canada's overall economy and digital ecosystem. The next section of this document will provide an in-depth outline of Canada's digital economy to provide more context in terms of the current landscape and future directions.

A Snapshot of Canada's Digital Economy

Canada's digital economy encompasses more than just the ICT sector. The term "digital economy" broadly refers to markets based on digital technologies. Increasingly, the digital economy is becoming more integrated with other sectors, reflecting the broad reach and impact of technology adoption on all aspects of the economy. From a human capital perspective, talent in the digital economy includes two components of the labour market: ICT workers employed in every sector of the economy and non-ICT workers employed in the ICT sector. This definition captures two important concepts: widespread employment of (and demand for) ICT workers across all sectors and the total labour output of the ICT sector.

As of December 2015, Canada's digital economy employed more than 877,470 ICT professionals.

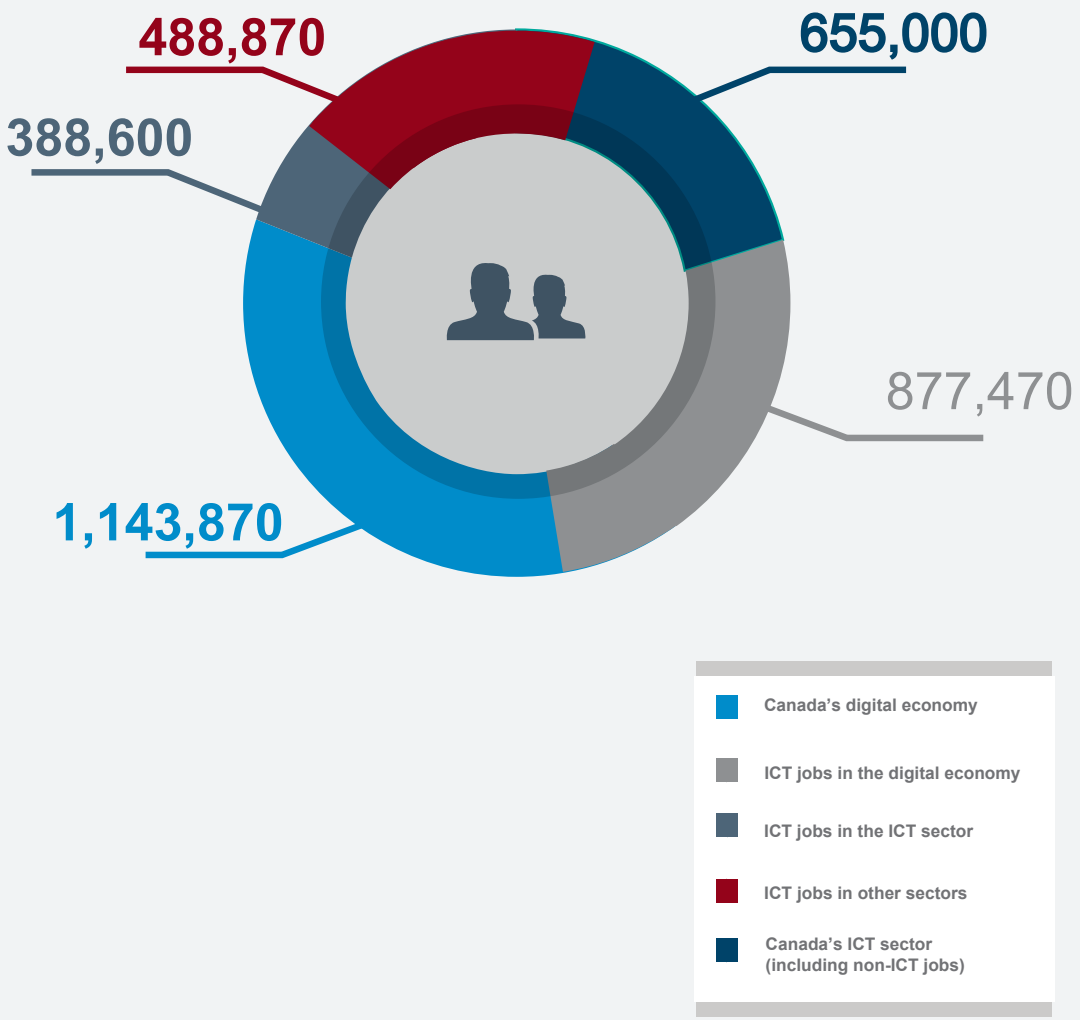
The economic impact of Canada's ICT sector

ICT is a key enabler of Canada's digital economy, providing organizations with the means to increase productivity, reduce operational expenses and boost overall efficiencies. Although Canada's ICT sector is a $74[19] billion per year industry on its own, it's the value-added contribution it makes to other industries that is helping Canada become a global digital economy leader. Given that more than half of Canadian ICT workers are employed in sectors outside of ICT, the value-added by ICT workers across all sectors of the economy is expected to intensify over the next five years as businesses adopt new technologies.

What is the digital talent?

Digital talent refers specifically to two components of the labour market: ICT workers employed in every sector of the economy and non-ICT workers employed in the ICT sector. This definition captures two important concepts: widespread employment of, and demand for, ICT workers across all sectors and the total labour output of the ICT sector.

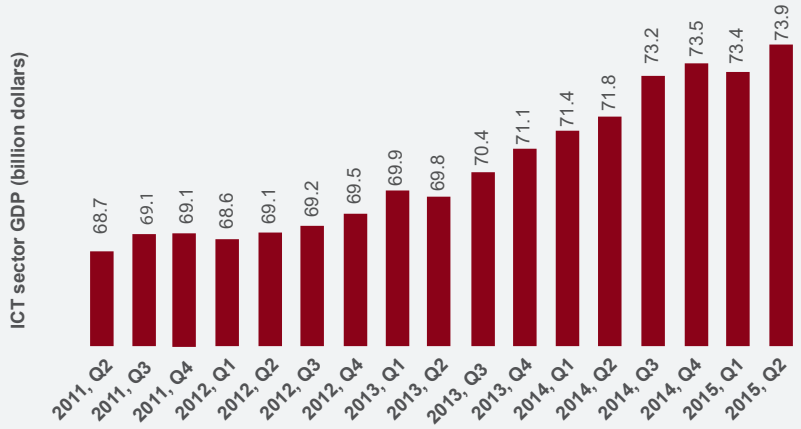
Figure 1. Canada's digital economy employment



Source: ICTC; Statistics Canada (2015).

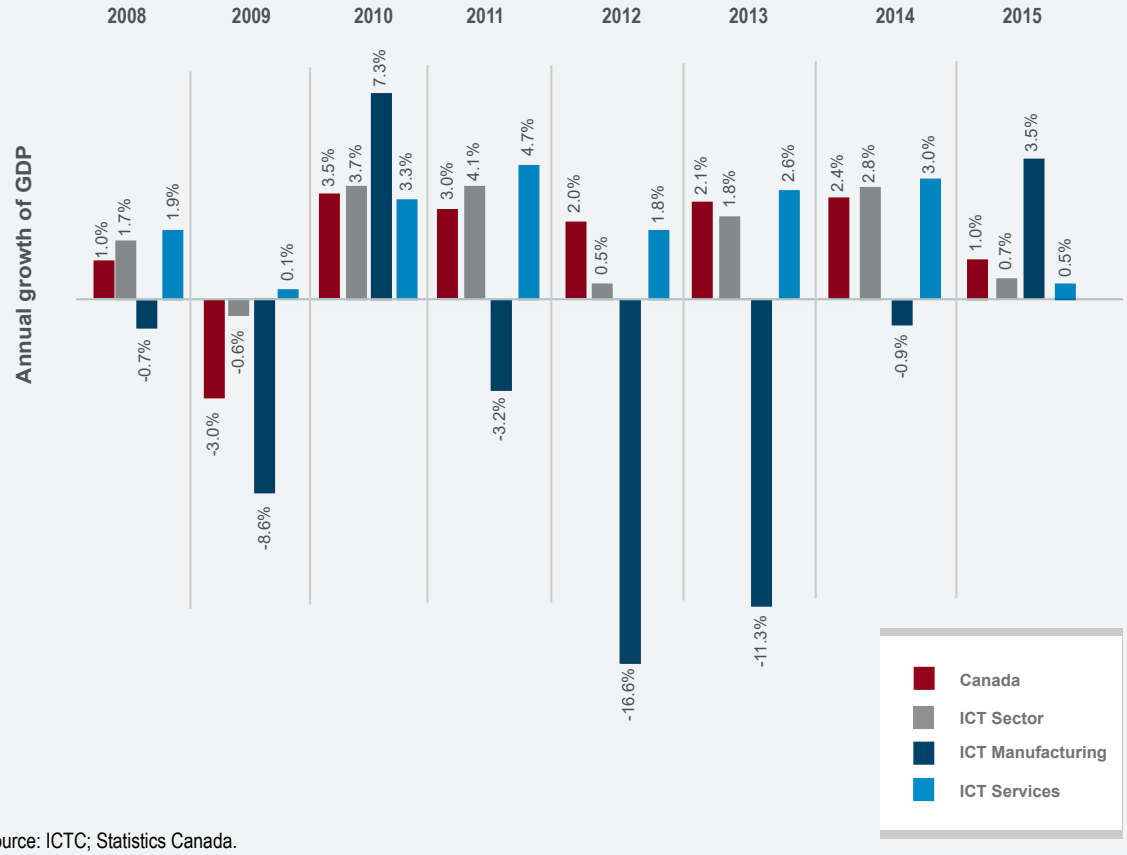
As an industry, the ICT sector has outperformed the overall economy since the global financial crisis in 2008. Average annual growth in Canada's ICT sector has been 2% over the past five years, driven by a growing ICT services industry and a rapidly expanding digital manufacturing industry. ICT sector growth has accelerated in the past two years, averaging 6.4% annually over that period and doubling the growth and pace of other sectors of the economy.

Figure 2. ICT sector GDP contribution, quarter over quarter



Source: ICTC; Statistics Canada (2015).

Figure 3. Annual growth of ICT sector GDP



Source: ICTC; Statistics Canada.

From a geographical perspective, Ontario is Canada's ICT leader, contributing $31.6 billion to the total Canadian ICT output in 2015. Other notable ICT output contributors are Quebec ($14.6 billion), Alberta ($9.6 billion), British Columbia ($8.7 billion), Manitoba ($1.8 billion), Saskatchewan ($1.5 billion) and Nova Scotia ($1.4 billion).

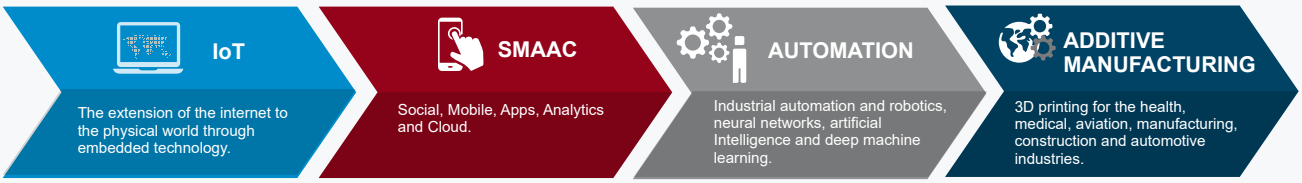
Strong contributors — small and medium-sized enterprises

Canada's ICT sector is heavily comprised of small and medium-sized enterprises (SMEs). In 2013, the ICT sector contained approximately 80 companies with more than 500 employees in the ICT sector. In comparison, there were approximately 32,000 companies with fewer than 10 employees — meaning SMEs account for 86% of all the companies in the ICT sector.[20] In terms of sub-sectors, ICT manufacturing companies tend to be larger, with approximately 14% of manufacturers having more than 50 employees compared to 3% for the ICT sector as a whole.[21] Based on ICTC's calculations, approximately 53% of the ICT sector's GDP contribution is made by micro, small, and medium-sized enterprises employing fewer than 50 employees.

Technology growth drivers in ICT

Substantial growth in consumer and business adoption of ICT products and services has helped drive the ICT sector's rapid expansion over the past several years. ICTC's research, conducted in close partnership with industry and other stakeholders, suggests that a variety of technological subsectors will lead the hyper-connected expansion over the next five years, including the Internet of Things (IoT); social, mobile, applications, analytics and cloud (SMAAC) technologies; automation; and additive manufacturing.

Figure 4. Technology growth drivers for the next 5 years



Advances in SMAAC, automation and additive manufacturing technologies all fall under the larger IoT umbrella, an economy that is projected to reach as high as $19 trillion annually by 2020. In Canada, SMAAC sub-sector employs more than 450,000 workers both directly and indirectly. Industrial automation alone is a $2 billion market in Canada, with growing employment opportunities resulting from increased efficiency and cost savings.[22]

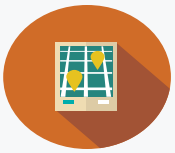
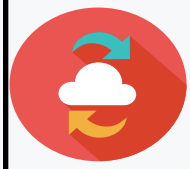
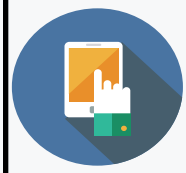
Advances in these and other domains are placing a premium on cross-disciplinary skill sets that intersect traditional ICT, mathematics, business analysis and interpersonal skills — skill sets that have proven difficult to recruit for according to the more than 2,000 employers interviewed by ICTC. These shortages are further compounded by relatively few post-secondary programs specializing in new and emerging ICT sectors.[23]

The growth and widespread adoption of these technologies will continue to reshape the digital economy, creating even more demand for highly skilled professionals who can solve complex challenges and drive business growth. In an increasingly competitive environment, Canadian businesses will rely on all key stakeholder groups to meet the demand for ICT workers.

High demand sectors in the digital economy

Demand for real-time intelligence, predictive analytics, risk management and machine-to-machine connectivity is leading the global drive toward digital adoption. Over the next five years (2016–2020), these and other technologies will reshape the Canadian and global economies by engineering new economies of scale.

The ICT sector and its associated subsectors and technologies will continue to experience exponential growth and a high demand for talent. This includes SMAAC and areas like the entertainment and video game industry.

	**Apps and services:** Canadian app enterprises generate nearly $2 billion annually in revenues. Approximately 65,000 Canadians are employed directly and indirectly because of app adoption. This figure is expected to exceed 110,000 by 2020 as app enterprises generate in excess of $5.2 billion in revenue annually.[24]
	**Cloud:** Extrapolating from ICTC's 2013 cloud study, well over 50,000 Canadians are employed as a result of cloud computing. Half of Canadian enterprises already adopt identifiable cloud services (a figure as high as three-quarters for ICT firms), with nearly two-thirds reporting a reduction in expenses as a result of cloud adoption.[25]
	**Mobile:** ICTC has shown that Canada's GDP grows 0.08% for every 1% increase in mobile technology adoption due to increased productivity. GDP grows an additional 0.069% for every 1% increase in wireless subscriptions due to higher subscription revenues of telecommunication service providers. Since these are incremental to each other, every 1% increase in mobile adoption yields 0.149% to the economy. Assuming a national GDP figure of $1.649 trillion in November 2015,[26] Canada's GDP grows by $2.46 billion for every 1% increase in mobile adoption ($1.649 trillion x 0.00149%).[27]
	**Data analytics:** Canada's data analytics market generates approximately $1.1 billion annually in revenues, excluding many of the large multinational firms operating within the country. This figure is expected to exceed $1.8 billion in 2020. Direct employment in Canada's big data market reached 33,600 in 2016 and is expected to exceed 43,000 by 2020.[28]

Emerging high demand areas

Advances in advanced manufacturing, robotics, cyber security, intelligent retail, connected transportation, smart cities, financial technology, clean technology, biotechnology and eHealth are expected to lead to profound shifts in the ways businesses operate, as well as in the skills profiles of Canadians.

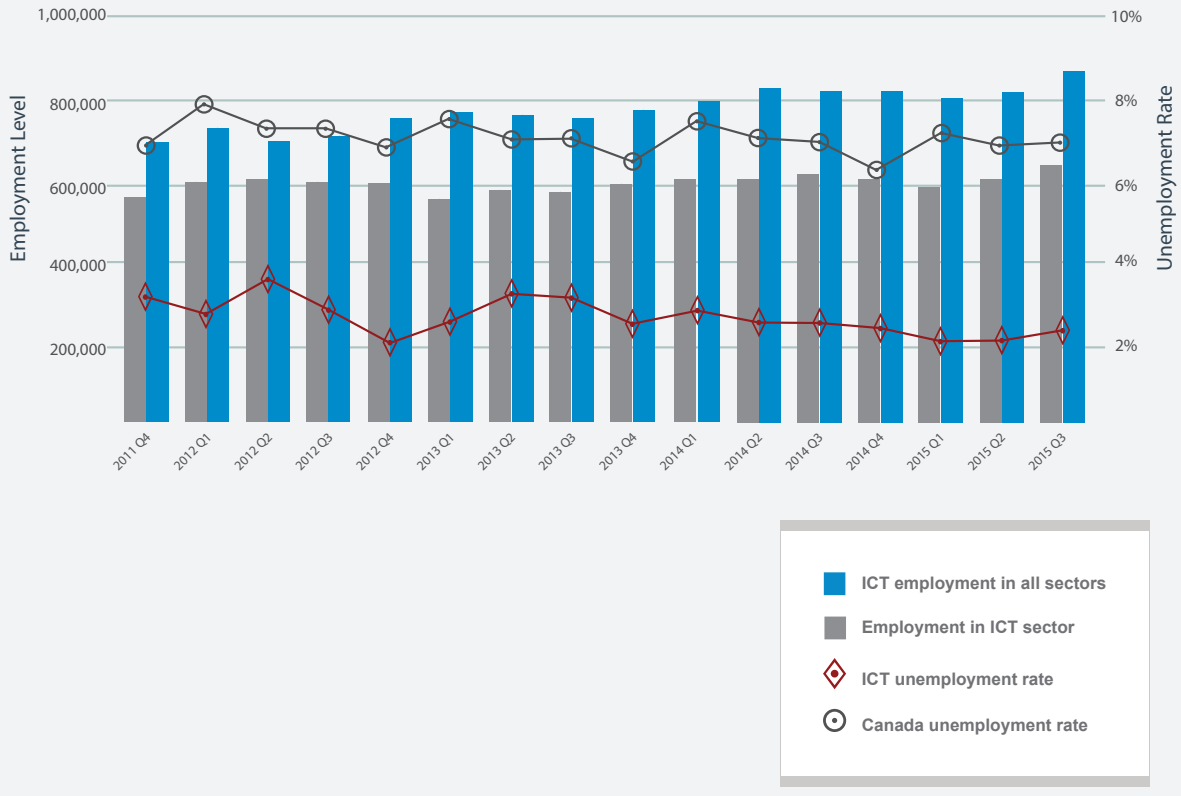
	**Advanced manufacturing & robotics**: The growth of IoT is creating a world where billions of devices are connected to the Internet. In the context of advanced manufacturing systems, IoT will help streamline production capacity and improve yields. The global end-market value of industrial automation already exceeds $150 billion in annual revenue.[29]
	**Cyber security:** Cybercrime costs the global economy $445 billion annually, according to a 2014 report from the Center for Strategic and International Studies. The evolving threat posed to critical infrastructures, SMEs, corporations and individuals is creating high demand for new cyber security strategies and protocols that can protect Canada's commercial integrity.
	**Intelligent retail:** By using big data analytics to learn more about consumer behaviour, retailers can deliver more targeted promotions, discounts, and other value-added services that boost sales and profitability. Global e-Commerce is already a multi-trillion dollar industry that will eclipse $3.5 trillion within the next five years.[30]
	**Entertainment and video gaming:** The Canadian entertainment and video gaming industry continues to show rapid growth and a high demand for specialized talent. From 2013 to 2015, the workforce grew by 24% to 20,400 employees. By 2017, another 1,400 workers in specialized and well-paying creative and technical positions will be required. Globally, the video game industry is the fastest growing sector of the entertainment industry, with a market valuation of nearly US$100 Billion.[31]
	**Connected transportation & smart cities:** Advances in technology are transforming not just the automobile industry, but also public transportation systems, enabling the creation of smarter cities that improve safety, create greater efficiencies and provide end-to-end connectivity to commuters and city dwellers. When segments such as energy, transportation, infrastructure, and governance are taken into account, smart cities and the connected transport systems within them represent a $1.5 trillion global market opportunity.[32]
	**Financial technology (FinTech):** Mobile payments, advanced risk management and counterparty risk exposure, crowd funding and alternative finance are all transforming the ways traditional banking and finance sectors operate. Global investment in FinTech ventures tripled in 2014 reaching $12.21 billion.[33]
	**CleanTech:** Clean technology is an umbrella term used to describe business sectors that use technology to produce clean energy, environmental, and sustainable products and services. The sector involves a wide array of products and services designed to reduce waste, control pollution and promote sustainable business and consumption. In the current period, clean technology is generally associated with solar and wind power, biofuel research and sustainable infrastructure development. According to a 2014 study by the World Bank, the global market for cleantech is valued at approximately $1.6 trillion.[34] Canada is considered a small player in the global cleantech ecosystem and is home to more than 800 cleantech firms directly employing 50,000 people.[35]
	**Biotechnology**: The biotechnology industry represents a diverse range of firms at the forefront of medical research, new treatments for disease mitigation and drug developments for the pharmaceutical industry. The global market for biotechnology could exceed $400 billion by 2017,[36] leading to new breakthroughs in biopharmaceutical, bio-services and bio-industrial applications.
	**eHealth:** The digitization of the healthcare industry is one of the most defining trends in the global economy, intersecting everything from client care and medical informatics to public health and business. The global eHealth market is forecast to exceed $300 billion by 2022.[37] Canada's eHealth sector already generates $3.4 billion annually in revenues and employs nearly 50,000 workers directly and indirectly — a figure that is expected to grow by 32,000 by 2020.[38]

Employment in the ICT sector

More than half (55%) of Canada's 877,470 ICT workers are employed in sectors outside ICT. With every sector employing ICT professionals, skilled Canadians are the foundation of economic growth in today's hyper-connected landscape. As a result of widespread demand for ICT professionals, the ICT unemployment rate is a fraction of the national average at just 2.6%.

As an industry, the ICT sector employs 655,000 workers, including both ICT and non-ICT professionals.

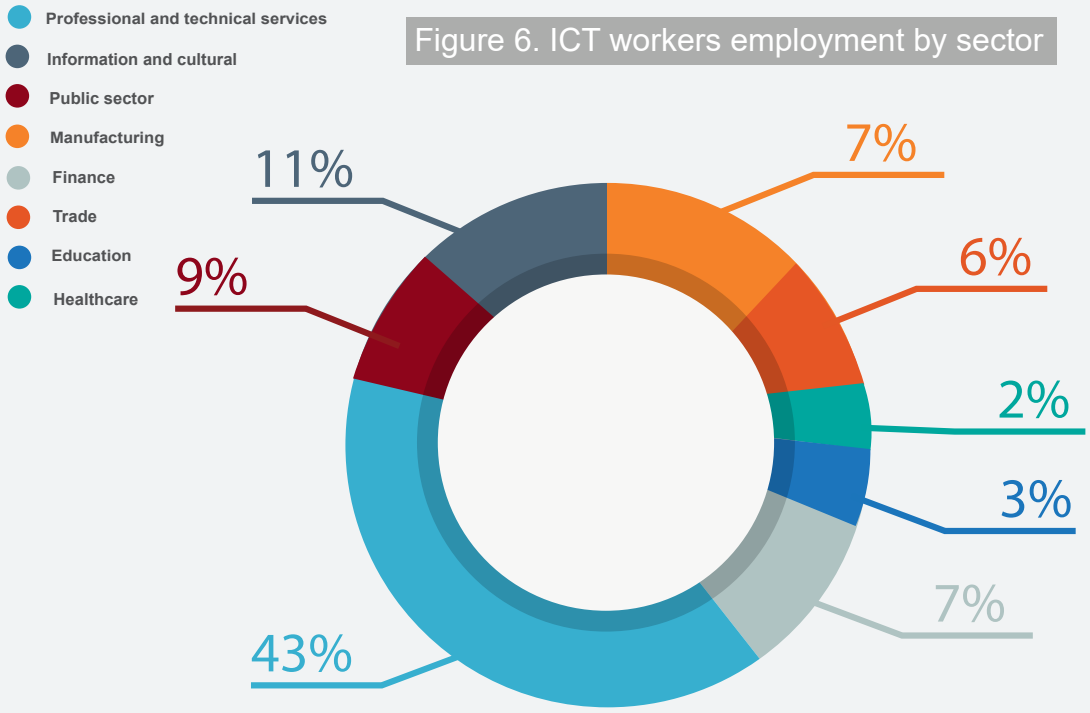
Figure 5. ICT and ICT sector employment across Canada, 2015.



Source: ICTC; Statistics Canada (2015).

More than two-fifths (43%) of Canada's ICT professionals are employed by companies in the professional and technical services industry. By comparison, ICT employment is 11% in the information and cultural industry, 9% in the public sector, 7% in manufacturing and finance industries, 6% in the trade sector, 3% in the education sector and 2% in the healthcare sector. Employees in the ICT sector are well compensated and their salaries are on average 48% higher than jobs in other sectors of the economy.[39]

Figure 6. ICT workers employment by sector



Source: ICTC; Statistics Canada (2015).

Overall, Canada has a strong digital ecosystem that is pivotal to our prosperity and growth. Low unemployment rates and high demand in almost all sectors of the digital economy creates a strong foundation for success in the competitive global economy. However, trends, challenges and opportunities related to digital adoption, innovation, skills, and talent shortages remain in the foreground. These themes — digital adoption, skills and talent scarcity — will be further exacerbated by fierce global competition and uncertainty as to how global trade partnerships will influence domestic employment and labour mobility. How Canada addresses these themes may define our ultimate success in becoming a global digital leader.

Themes, Trends, Challenges and Opportunities Economy

The rise of IoT is causing a transformative shift in the global digital economy: one that is not only transforming the ICT sector but also the industries that rely on digital technology to conduct business. Canada is expected to play an important role in the $3.8 trillion global ICT sector, in the traditional areas of software services, telecommunications and in emerging areas such as advanced manufacturing and intelligent retail. Canada's favourable investment climate, world-class economy and highly skilled workforce provide a strong base for leading the global shift toward IoT and other digital innovations.

To get there, however, Canada needs to develop a steady pipeline of entrepreneurs, ICT workers and digitally savvy non-ICT workers with the skills to succeed in the evolving 21st century digital economy. Education at the pre- and post-secondary level plays an important role in this endeavour. Adopting digital technologies will continue to be critical in staying 'ahead of the curve' in a hyper-connected, competitive global economy. These themes — digital adoption, education and skills, and talent supply and demand — the opportunities and challenges they hold are explored in detail below.

Digital adoption

In an increasingly connected global environment, digital technologies have become significant drivers of productivity, innovation and competitiveness in every sector of the economy. Greater digital technology adoption can yield tremendous economic gains for Canada: a 1% increase in labour productivity resulting from the adoption of digital technology yields an additional $8 billion in value to the Canadian economy. Furthermore, research from the Boston Consulting Group found that tech-savvy SMEs create twice as many new jobs and grow their revenues 15% faster than those that use less technology.[40] Unfortunately, Canada has not been in a position to reap these benefits due to sluggish business innovation cycles, which have hampered its productivity performance compared to other nations, most notably the United States.[41]

On average, Canadian companies invest less in digital technologies than their counterparts in the United States and other advanced economies. According to latest available figures, Canada's ICT investment as a percentage of non-residential gross fixed capital formation was 17% compared to more than 30% in the United States and more than 20% in countries like Sweden, Denmark and the United Kingdom.[42]

As of 2011, Canada's business investment in ICT per worker was slightly more than half of the U.S. level.[43] Additionally, ICT investment in Canada in recent years has grown at less than half of the U.S. rate, which suggests a growing gap between the two countries.[44] Part of the challenge is that digital technology adoption requires more than just investment in technology — it also requires upgrades in business processes, digital skills and technology management expertise.

In this environment, non-ICT workers must also be digitally savvy in order to ensure successful adoption of new technologies and related processes at the enterprise level. Aspects related to cultural risk aversion, a lack of digital expertise and economies of scale are partly responsible for the adoption shortfall in Canada.[45] This comes at a time when advances in digital technologies are leading to cost savings and business gains that are generating additional jobs in non-ICT roles. ICTC has documented this "multiplier effect" in various studies ranging from mobile technologies to cloud computing and Big Data analytics. Therefore, the link between digital adoption and job growth extends far beyond ICT occupations.

Given that SMEs are the lifeblood of the Canadian economy — accounting for almost 90% of employment[46] and more than half of the national GDP — raising their digital adoption rates is paramount to Canada's capacity to compete in the digital economy. This includes not only embedding digital technologies into business processes but also providing more opportunities for SMEs to expand their talent pool and promote digital adoption in the workplace. A critical part of this process is ensuring that procurement policies and procedures promote technology adoption and talent acquisition in both public and private organizations. Governments in other countries like the United States and European Union have successfully leveraged procurement policies as an economic development tool.[47] Public sector procurement fosters innovation, economic opportunity, and growth leading to long-term job creation.[48]

Increased digital adoption is essential for Canadian industries to reach digital maturity, which is a combination of greater investment in technology-enabled processes and an increase in digital leadership within organizations.[49] Digital maturity allows organizations to become more competitive by allowing them to do more for less. Decades of research have shown that greater digital adoption in the workplace increases staff productivity.[50]

> *According to a recent study, a 20% increase in ICT investment could yield a 1% growth in a country's GDP.*[51] *For Canada, a 20% increase in ICT investment would yield more than $16.5 billion to the national GDP.*

Given that ICT adoption is a prerequisite for innovation, the widening gap in ICT capability between Canada and the U.S. is cause for concern. A lack of innovation is partly responsible for Canada's relatively weak standing in the World Economic Forum's 2015 Global Competitiveness Report, in which Canada places 13th of 140 countries. Canada ranked 18th in terms of technological readiness and 22nd in terms of innovation.[52] Investment in digital entrepreneurs can play an important role in improving innovation. Furthermore, public and private investment mechanisms that promote the commercialization can help ensure the latest technological advances are actually brought to market.

Technological innovation and digital adoption are critical components of Canada's digital ecosystem, driving economic growth and social development. Therefore, improvement in both these areas is strongly needed for Canada to realize its goal of being a global leader in the digital economy.

Education and skills

Global economic growth and technological advancements have intensified the need for a highly-skilled workforce, with countries and companies competing for top talent. The ICT industry seeks both entry-level graduates and experienced professionals who are capable of information processing as well as high-level cognitive and computational skills. By 2019, Canada will need an additional 182,000 skilled ICT workers at various levels to innovate and adopt ICTs in the workplace. Closing the gap between the demand for and supply of ICT talent will help drive the $19 trillion IoT-enabled economy. If the relevant skills are not easily accessible, companies will consider it to be high risk to invest in new production technologies. To mitigate the skills and competency gap, educational institutions and companies have a key role to play, and a more effective continuum of cooperation between educators and employers needs to be systematically developed.

Building skills for the intelligence economy

The enhanced connectivity between billions of devices made possible by IoT is driving the transformation of the digital economy into an intelligence economy. By 2020, there will be more than 50 billion devices connected online worldwide.[53] As this rapid connectivity shapes up, the demand has intensified for a skilled workforce that offers a fusion of technology, business, computational thinking, entrepreneurial, creative and interpersonal skills.

Building a workforce with these skills requires extremely strong and up-to-date educational programs that offer a blended curriculum. At the same time, programs need to integrate a component of interpersonal skills that graduates will require to build client relationships, understand organizational needs and package technical information in a way that can be communicated to a non-technical audience. This is a growing phenomenon across all sectors of the economy, where traditional jobs are morphing into new roles influenced by technology.

> *"Finding qualified and experienced workers in programming, game design, data analysis and artistic animation continues to be a challenge as our growth outpaces the domestic supply of talent," said Jayson Hilchie, President and CEO of the Entertainment Software Association of Canada. "There is an opportunity for both industry and for government to find long-term solutions for developing digital skills in our workforce and shorter-term solutions to bring-in qualified workers from abroad to impart innovative techniques and skills."*[54]

The table below illustrates some of the types of skills Canadian technology industries are searching for when looking for talent.

Table 1. Skills desired by Canadian technology industries.

Technical Skills	Business and Management Skills	Soft and Interpersonal Skills
• Data management and analytics • Network security • Cloud computing content, design, and service management • Java • Python • Mobile and software development	• General Business Acumen • Business Analysis • Sales and marketing • Product management • Creativity and innovation • Leadership	• Communication (public speaking and writing) • Collaboration (virtual and in-person) • Adaptability • Cross-cultural competence and sensitivity

To develop this talent, Canada's post-secondary education system needs to design and deliver programs in closer consultation with the employers who are leading innovation and research in new technologies. Embedding digital intelligence and skills across all post-secondary programs will help position Canada as a global leader in cutting-edge technologies like big data, cloud computing, and cyber security. Growth of digitally skilled talent will also support SMEs by providing easier access to the talent required for understanding and adopting new technology.

Work placements and wage subsidy programs have also shown to be effective. Students benefit immensely from internships or co-op positions with industry, which allow them to not only work on the research side of their studies but also apply their knowledge to projects that will have tangible outputs and outcomes. The opportunity to work in an industry setting also helps students build the cultural skills that are so critical in a diverse and global economy. While a number of Canadian universities and colleges have integrated the internship and co-op program model into their programs, even more workplace-integrated learning is needed to strengthen the talent pipeline.

Canadian graduates in a shifting economy

The successive waves of technological change have made it increasingly difficult for Canadian graduates to understand and identify the skills needed by industry. This does not mean Canada's existing ICT programs are undesirable; if blended with the innovative needs of the new technologies, they can help Canadian graduates add more value to the bourgeoning economy. Already, Canada has one of the most educated and skilled workforces among members of the OECD, supporting the innovation and adoption of new technologies like Big Data and cloud computing.

ICTC's research indicates that there are 33,600 data analytics specialists directly employed in Canada who come from many different educational backgrounds, including mathematics, statistics, computer science and engineering. This highlights the hybrid, interdisciplinary nature of ICT professions that require high-level cognitive skills. Post-secondary institutions like the University of Waterloo and the University of Toronto have taken the lead in developing core skills and advanced degrees in data analytics.

However, employers have noted persistent challenges in finding ICT professionals who can also understand new technologies and platforms like cloud computing at a macro level. As businesses increasingly rely on cloud infrastructure to host their big data solutions, or other technologies such as high-performance computing or mobile solutions, there is a need to close the gap between the demand for and the supply of ICT talent from the post-secondary institutions.

Canada needs more active engagement from and collaboration between industry, education, government and ICT professionals to help boost investment in the post-secondary STEM programs that are powering the technologies that drive innovation across the global economy. The support for STEM degrees becomes even more critical as the number of STEM jobs continues to rise. At the same time, education providers and graduate students should be informed of the job opportunities in new and emerging technological sectors, and must have greater access to quality career-guidance services and work-integrated learning opportunities. Growth of talent through the STEM education pipeline will help Canadian technology companies expand here in Canada versus moving elsewhere.

To further shape the intelligence economy, students must be engaged in industry-driven research projects starting in their first year of studies. Doing so will offer students from all disciplines the opportunity to learn and apply their knowledge in a real-world setting. If rightly guided, these students can more effectively develop the skills needed to fuel Canada's digital economy.

ICT enrolment and graduation rates

Canada's digital economy relies heavily on students enrolled in STEM programs, who graduate with the scientific skills necessary to support the advancement of the country's innovation agenda. Annual enrolment of ICT students in Canada increased by 24% between 2010 and 2015.

ICTC's research indicates that of the 2.21 million students enrolled in post-secondary education in Canada in 2015, nearly 126,000 (6%) students were enrolled in ICT (with 72,000 attending university and 54,000 in college). More than 527,000 students graduated in 2015, including more than 29,000 (6%) from ICT programs (with 12,800 graduating from university and 16,300 from college).

Although there is a flow of enrolments and graduations from ICT programs, industry has identified gaps in the nature of skills graduates bring to the workforce. Industry needs a blend of technical, entrepreneurial, creative, business, management and interpersonal skills to help power an economy driven by science and technology. The two strategies — industry research projects and internships/co-op placements with industry — are just two means of acquiring the employability skills that are so crucial for moving Canada's innovation agenda forward.

Engaging youth in STEM and ICT learning

Youth are tomorrow's innovators, entrepreneurs and solution providers. The ICT sector can be an excellent entry point for today's graduates — yet Canada simply does not have enough young people selecting STEM disciplines in school nor ICT as a career choice to meet its current and future needs. Learning STEM based topics, such as computer science, math, and physics, in elementary and secondary school serve as an important gateway to future education and careers in ICT.

On average, Canadian youth perform well in subject areas related to STEM and ICT. In both the Programme for International Student Assessment (PISA) and the Pan-Canadian Assessment Program (PCAP), Canadian students perform above the OECD average in science and math.[55] The participation rates of Canadian schools in activities that promote STEM learning (such as science fairs and extracurricular projects) also exceed the OECD average.[56] Clearly, the gap in choosing STEM disciplines is not solely related to ability.

Despite this, students continue to opt out of STEM based learning. A 2012 Let's Talk Science study found that, Canada-wide, students take fewer STEM courses as they get older. In Alberta, for example, approximately 50% of Grade 11 students took biology, 49% chemistry and 33% physics. In Grade 12, the enrolment level for each of these courses dropped to 44%, 38% and 21% respectively.[57] A 2010 Canada Foundation for Innovation and Ipsos Reid study also found that interest in science decreases with age. Although many students say science is fun and important, few express an interest in taking STEM at the secondary and post-secondary levels.[58] Even when told that most jobs are STEM-related, students are still no more likely to select STEM as a career.[59]

Two obstacles preventing students from studying STEM are insufficient grades and the difficulty of the subject.[60] Because interest in STEM tends to decrease with age, teaching computational learning and digital literacy to students at an early age can help build the foundational skills needed to successfully engage with STEM topics.[61]

Parents, teachers and counsellors also have an important role to play in fostering interest in technology. Many teenagers say parents have the greatest influence on their educational and career decisions.[62] While most parents agree that it's important to be involved in their children's education, a 2011 survey found that few (23%) carve out time to discuss future goals with their children.[63] That same survey also found that Canadian students feel that Internet searches and websites are more useful in providing information about post-secondary education and career paths than teachers or counsellors.[64]

These trends reinforce the importance of engaging youth early and throughout their formative education in ways that will enable them to experience STEM and ICT in a more enriched manner and better prepare them for studies and careers in these fields.

Talent supply

The competitive pressure on employers seeking ICT talent is extremely high and employers are feeling the pinch. In a survey done by ICTC, more than 53% of organizations cited attracting and retaining skilled employees as one of their top human capital challenges. The demand for top ICT talent continues to grow and has resulted in expanding career options for ICT professionals, placing competitive pressure on employers seeking ICT talent. Having a steady supply of skilled talent is critical to alleviating this pressure — and to helping Canada realize the goal of being a leader in the global digital economy.

A tightening ICT labour market demand

As a result of the accelerated pace of technological change, the demand for skilled digital talent in Canada has never been greater. Based on ICTC's projections, more than 84,000 new ICT jobs — not including replacement demand due to retirements and other exits — will be created in Canada by 2019. When combined with replacement demand, more than 182,000 ICT positions will need to be filled by 2019. As digital adoption across all sectors increases and the emerging subsectors continue to grow, the ICT labour market will tighten even further. Based on our calculations and consultations from industry, ICTC predicts that finance and health care will have the highest demand for ICT labour in the next four years. By 2019, the in-demand roles[65] in the digital economy will include:

- information systems analysts and consultants,
- computer network operators and web technicians
- computer programmers and interactive media developers,
- software engineers,
- graphic designers and illustrators,
- computer and information systems managers, and
- database analysts and data administrators.

Challenges related to supply and demand

The insatiable demand for highly qualified labour is compounded by talent shortages and pipeline challenges, including an aging population, low fertility rates and an increase in the number of retiring baby boomers. Since the mid-1990s, Canada's population growth has remained stagnant at 1% per year and the contribution of natural increase (i.e., the difference between births and deaths) is predicted to further decrease over the next 20 years.[66] Even today, almost 90,900 ICT workers are nearing retirement and this number will continue to grow over the next several years. While annual ICT enrolment rates have increased by 24% since 2010,[67] the number of ICT graduates will not satisfy labour market demand.

In addition, as a result of employment growth and replacement demand due to skills mismatch, retirements and other exits, demand–supply imbalances will affect some occupations (e.g., information systems analysts, computer and network operators, computer programmers, software engineers, database analysts and administrators) more than others.

The need to engage all available talent

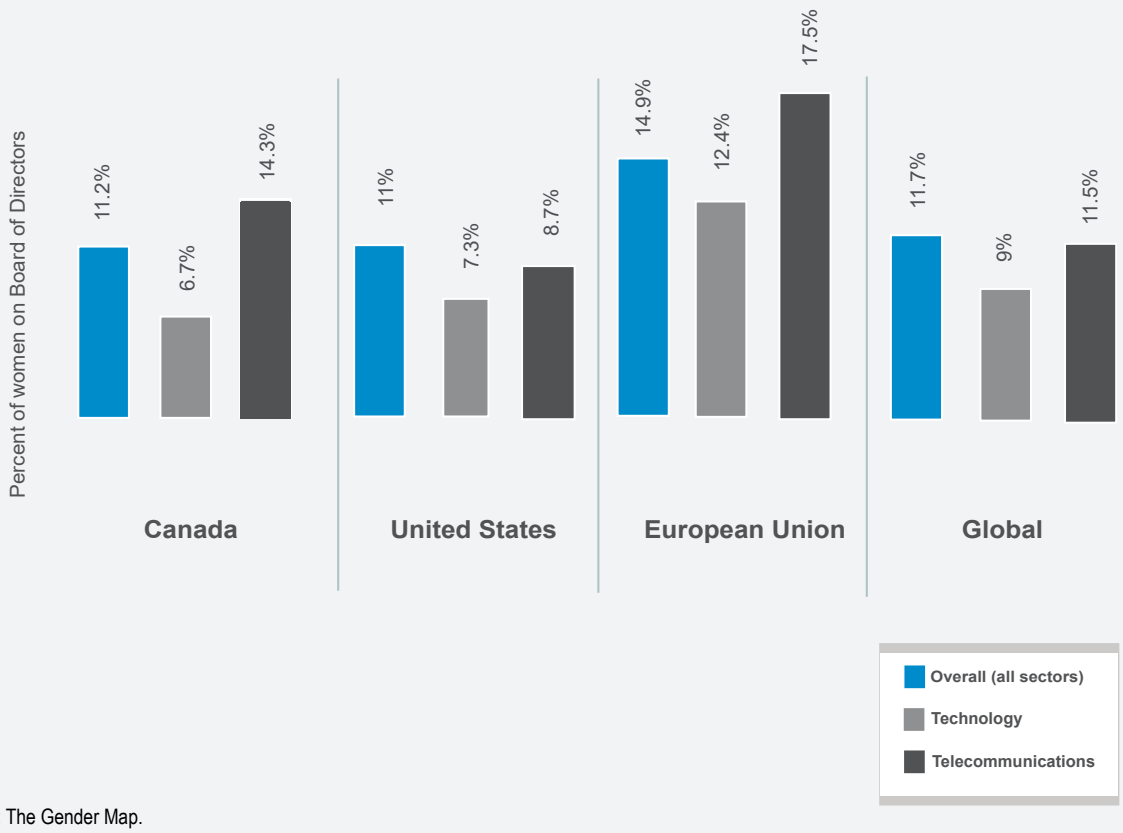
The ICT labour situation highlights the importance of engaging all available talent within and beyond our borders, including women, youth, immigrants, Indigenous persons and persons with disabilities. Doing so will help mitigate the impact of the talent shortage and increase business' innovation and competitiveness.

Women

Representing almost half of working age Canadians, women are an important and high potential talent pool. Women's participation in ICT professions has remained consistent between 23% and 25% for more than 10 years; with a three-to-one ratio of men to women employed in ICT positions, there is clearly room for improvement. There are approximately 209,550 women currently employed in ICT jobs, compared to 667,920 men. Challenges also persist in terms of wage gaps where women in ICT professions earn 88 cents for each dollar earned by men. This gender imbalance is also evident early in the talent pipeline. In 2015, only 21% of all ICT graduates across Canada were women.[68] Furthermore, a survey of Canadian teens found that almost one in five felt that careers in engineering and/or technology are best suited for men.[69]

According to ICTC's data, the distribution of women in management positions is as follows: 34% are in entry level ICT positions, 23% are in mid-level positions, and 24% are in senior level positions. At the C-suite level, approximately 18% of positions are held by women. According to Gender Map, at the board of directors level, 6.7% of board positions in publically traded[70] Canadian technology companies and 14.3% in publically traded Canadian telecommunications companies are held by women.[71] Globally, Canada's female board representation rate is relatively comparable or exceeds international levels. However, compared to counterparts such as the European Union, Canada's female representation rate in the technology sector lags behind.

Figure 7. Representation of women on board of directors



Source: The Gender Map.

While Canadian data is limited, women tend to leave STEM at a higher rate than men.[72] In a global study of MBA graduates in the tech industry, women were more likely than men to take a position in another industry.[73] In an American study of more than 1,000 women who worked in engineering, the top reasons cited among those who left the field for a non-STEM career included working conditions (30%), work-life integration (27%), dissatisfaction with the work (22%) and organizational climate (17%).[74] Due to the limited data available, we must be cautious about extrapolating these findings to the Canadian context.

To fully leverage this high-potential talent pool, Canada must continue to vigilantly tackle the barriers (both visible and invisible) that contribute to women's lower participation rate in ICT at all stages in the pipeline.

Youth

As tomorrow's leaders and innovators, youth (people between the ages of 15 and 25 years) are a rich and vital talent pool for the digital economy. There are more 45,130 youth currently employed in ICT positions in Canada, comprising 5% of the total ICT workforce. The oldest cohort of millennials (i.e., those born between 1980 and 2000) turned 35 in 2015 and make up an increasingly larger share of the Canadian workforce. From 2005 to June 2015, ICT employment among those younger than 35 grew from 254,400 to 264,600 — but with the number of ICT positions increasing at a greater rate over that same period, the proportion of ICT workers under 35 actually fell from 41% to 33%.

Almost 70% of the ICT jobs held by those aged below 35 are in high-demand positions such as software programmers, Graphical User Interface (GUI) developers, business systems analysts, informatics specialists, multimedia designers, graphic illustrators, technical support analysts, web administrators and network support technicians. These are all key roles in the technological subsectors that are primed to grow the fastest and make the largest economic contributions to the Canadian economy over the next few years.

As of mid-2015, there were approximately 9,200 newly employed youth ICT professionals in the sector. The growth rate in ICT employment among those aged below 35 (4%) has not kept up with the growth rate among that age group in the overall labour market (10%). In stark contrast, the growth rate in ICT employment among those aged 35 and older (76%) was nearly four times the growth rate among that age group in the overall labour market (20%). While the increase in the number of youth employed in ICT is promising, the transition of younger workers into the ICT workforce is not happening at the desired rate.

Immigrants

Immigrants play a critical role in the health and growth of Canada's ICT workforce. Of the total number of workers presently employed in ICT occupations, 352,800 (40%) are immigrants.[75] The proportion of immigrants has remained consistent in recent years at just above one-third of the ICT workforce. This is in sharp contrast with the overall economy, where immigrants hold one-quarter of all jobs. Unemployment amongst ICT immigrant professionals is consistently lower and is currently at 2.7%, remaining steady for the past four years. In contrast, the unemployment rate among immigrants in the overall Canadian labour market is 7.7%.

Ontario employs the highest number of immigrants in ICT roles, with 199,650 at present. By comparison, ICT employment for immigrants is 63,500 in Quebec, 45,810 in British Columbia, 28,800 in Alberta, 5,110 in Manitoba, 2,650 in New Brunswick, 2,360 in Saskatchewan, 3,540 in Nova Scotia, 1,280 in Newfoundland and Labrador, and 100 in Prince Edward Island.

Jobs that have a strong emphasis on technical skills — for instance, software programming or web development — are in high demand and these skills are relatively easy to transfer across jurisdictions. Of all the immigrants that arrived in Canada in the previous 12 months and secured employment, 9.7% are employed in ICT professions. Approximately 14% of immigrants employed in ICT immigrated to Canada in the past five years. The transferability of these skills is a major reason why employing internationally educated professionals (IEPs) is so attractive. Highly skilled temporary foreign workers also represent a source of talent for ICT organizations. Historically, temporary migration programs such as the Temporary Foreign Worker Program (TFWP) and International Mobility Program (IMP) have outpaced growth in other economic migration classes. However, the Canadian Chamber of Commerce notes that the number of temporary foreign workers entering Canada has been declining in recent years with potentially negative implications for the inflow of high-skilled talent.

However, there are still recruitment challenges as well as skills mismatches, especially with respect to communication, which creates barriers to effectively leveraging this vital talent pool. Canada is not alone in the quest for global talent, placing added pressure on employers to quickly secure top international talent.

Indigenous peoples

Indigenous peoples remain an underutilized talent pool in the Canadian economy and ICT sector. In 2011, 1,409,100 people in Canada identified as an Indigenous person.[77] Nearly half (46%) are under the age of 25, compared to just under one-third of the non-Indigenous population.[78] With a significantly higher fertility rate than the non-Indigenous population, Indigenous peoples represent one of the fastest growing domestic population segments.[79]

In 2011, 48% of Indigenous people aged 25 to 64 had some form of post-secondary education (i.e., a certificate, diploma or degree from a trade school, college or university).[80] According to ICTC's research, both enrolment and graduation rates for Indigenous peoples in ICT is approximately 3%. Among those that pursue post-secondary education, approximately 3% go into ICT and 3.7% go into STEM. While the education level of Indigenous peoples is increasing, challenges remain surrounding the on- and off-reserve transition for education and employment.[81]

Persons with disabilities

Persons with disabilities are a consistently overlooked talent pool. In 2012, approximately 2.1 million Canadians between the ages of 25 and 64 (11% of the population) were limited in their daily activities because of a disability.[82] Because the prevalence of disability increases with age, the number of people with disabilities is expected to increase due to Canada's aging population.[83] The severity of disability can limit educational outcomes: people with severe disabilities are less likely to obtain a high school, college or university degree/diploma than those with mild or moderate disabilities.[84] As of 2012, more than 50% of people with a disability had some form of post-secondary education.[85]

Yet persons with disabilities have not fared well in the labour market and experience difficulty finding meaningful employment. In 2011, the employment rate for persons with disabilities aged 25 to 64 was 49%, significantly lower than the 79% for Canadians without a disability.[86] Employment and labour force participation rates across all sectors of the economy are significantly lower for persons with disabilities and has remained unchanged for more than a decade.[87] In 2012, there were 411,600 working-aged persons with disabilities who had had the potential to work.[88]

ICTC and Statistics Canada's 2002 National Survey of IT Occupations found that only 1.5% of all people working across 24 IT occupations in Canada identified themselves as a person with a disability. Although there are no additional recent reference points available and data is extremely limited, it is likely this proportion has remained relatively unchanged, with the possible exception of employment within the public sector.

Displaced and mature workers

The decline of the workforce in traditional sectors like manufacturing offers the digital economy an additional talent pool to utilise: displaced and mature workers.

The OECD defines job displacement as involuntary job loss due to economic reasons such as company closure or downsizing. Approximately 2% of Canadian workers with at least one year of experience are displaced each year.[89] Less than half are re-employed within one year and two-thirds are re-employed within two years.[90] Compared to countries like Australia, Sweden and the United States, re-employment rates for displaced workers in Canada are lower.[91]

A number of displaced workers are also mature workers. To secure re-employment, many have to undertake training to upgrade their skills or take part-time or temporary jobs. This can have real and significant effects on their income earnings. Almost 20% of displaced workers face hourly wage cuts of 25% [92] or more. This loss of earnings is much higher for mature workers.

Displaced workers experience several challenges with obtaining re-employment, including limited support prior to job loss, limited or no support for workers who were not part of a mass layoff, and inter-provincial mobility barriers such as recognition of training or certifications, all of which limit their ability to move from declining economic areas to booming ones like ICT.[93]

Additional human capital challenges

In addition to attraction and recruitment challenges, organizations are facing a number of other human capital challenges. In an ICTC survey, compensation, training, and the capacity to innovative and grow were also mentioned among the top human capital challenges.

Table 2. Top 3 human capital challenges

The top 3 human capital challenges orginizations are encountering (n=73)	
Challenge	**Response Percent (%)**
Attracting and recruiting employees	53.4
Capacity to innovate and grow	49.3
Compensation and benefits costs	35.6
Ability to train and develop your workforce	34.2
Productivity improvement	32.9
Leadership capacity	28.8
Ageing workforce	28.8
Retaining employees	15.1
Managing a diverse workforce	9.6
Other	8.2

These challenges are being felt by individual ICT professionals as well. An ICTC survey found that the top three workplace challenges faced by ICT professionals were unrealistic demands and expectations (43.9%), the availability of skilled staff to complete work (43.9%), and training and development (33.3%).

Providing meaningful training and development opportunities is not a challenge unique to ICT organizations. Previous research has shown that Canadian organizations offer fewer training opportunities compared to their OECD counterparts.[94] While many Canadian organizations understand the importance of training and development, organizational realities (such as financial constraints) mean that training budgets are often limited.[95]

The opportunities available to Canada

Given the trends, challenges and opportunities Canada is experiencing in digital adoption, education and skills, and talent supply, paired with an uncertain global economic outlook, it is important to find pathways for strengthening Canada's potential around digital technology and talent — two essential ingredients for innovation and global competitiveness.

Improvement in the area of digital adoption is strongly needed for Canada to realize its goal of being a global leader in the digital economy. Canadian companies tend to lag compared to our international counterparts in terms of investing in and adopting digital technologies. Also, employees must have the skills to leverage and use digital technologies for Canadian companies to effectively make the digital switchover. This creates an opportunity for industry, educators, and government to re-visit strategies for persuading companies to adopt digital technologies. There is also an opportunity to further promote the importance of lifelong learning and

digital skills to individual citizens and workers. Increasing digital adoption amongst businesses will enhance productivity and drive growth, which are critical for Canada to aggressively compete in the global digital economy.

There is an opportunity to bolster the pipeline of skilled talent by providing meaningful work experiences for youth. Educational institutions and companies have the chance to develop a more effective continuum of cooperation in establishing a curriculum that creates job-market ready graduates, and a climate that fosters entrepreneurship. Similarly, there is an opportunity to further engage elementary and secondary youth in ways that will enable them to experience STEM in a more enriched manner and better prepare them for studies and careers in ICT.

With representation rates among women, youth, persons with disabilities and Indigenous persons, lower in ICT, there is an opportunity to further engage these groups in ICT careers. In addition, internationally educated professionals are a rich and highly skilled talent pool as technical skills are the easiest to transfer across geography/borders. While attraction and recruitment are important, we cannot forget about the talent already in the workplace and ensuring they stay engaged and remain in the organization. In such a tight labour market, organizations can ill afford to lose the talent they already have. Fully leveraging and engaging all available and current talent, not only mitigates the effects of the talent shortage, but also makes good business sense for companies and the digital economy.

While Canada has a lot in its favour, how it uses these opportunities to its advantage will be an important component of Canada's future success in the new economy. There are benefits in developing a plan to overcome these challenges and leverage the comparative advantages our country and talent has to offer.

The Case for a National Digital Talent Strategy

With declines in the traditional manufacturing sector, the increasing prevalence of online services, and the digitisation of our personal and professional lives, investments in technology will be critical to ensuring Canada can compete in a dynamic global environment. Additionally, the rise of smart and hyper-connected technologies will reshape all sectors of Canada's economy. This means that the ability to efficiently and effectively leverage the potential of digital technologies will be critical to competing in the emerging intelligence economy. Yet even today Canada's digital economy is experiencing a talent and skill shortage, interfering with our ability to become a global economic powerhouse.

A formal strategy on how to mitigate the skill and talent shortage is essential to ensuring the right investments are made so that Canada can effectively leverage its competitive advantages. There are many economic and societal gains to be reaped by investing in what is possibly our nation's most valuable asset: talent.

Benefits to the economy

The digital economy is pivotal to Canada's growth and prosperity. Canada's ICT sector is a **$74**[96] **billion** per year industry. In early 2015 alone, the ICT sector accounted for **5%** of Canada's **total output**. In fact, over the past eight years, there is an **82%** positive correlation between growth in the ICT sector and growth in the overall Canadian economy. In addition, direct investments in ICT technologies and adopting digital technology have a direct impact on economic growth: a **20%** increase in ICT investment could yield a 1% growth in a country's GDP.[97] For Canada, a 20% increase in ICT investment would yield more than **$16.5 billion** to the national GDP.

Secondly, there are real and significant economic benefits from the participation of ICT workers in the labour market. On average, each ICT professional's annual contribution to GDP is **$150,000**, compared to **$95,000** by a non-ICT professional. This difference is largely due to enhanced productivity resulting from greater adoption of technology and opportunities for business expansion through technological innovations. Over the course of their lifetime, the average ICT professional will contribute **$2.2 million more** to Canada's GDP than others in the labour market.

The inclusion and full participation of women, immigrants, Indigenous people and persons with disabilities in the labour market also has a significant economic impact. For example, Royal Bank of Canada estimates that if the labour force gender gap (with respect to participation rates) were to be closed by 2032, Canada's **annual GDP** would increase by **4%**.[98]

The largest benefit in closing the digital talent gap is that it ensures industry has a full pipeline of the skilled talent it needs to grow and compete in the hyper-connected and competitive global economy. The consequence of not closing the gap between the demand and supply of ICT talent and skills will result in a **$27.3 billion** direct loss in GDP. In addition, the associated losses from multiplier effects, lost tax revenues, lower productivity and human resources costs by Canadian businesses trying to fill these positions will be billions of dollars.

Benefits to society

The simple truth is that investing in the digital economy enhances the lives of all Canadians, not just those in ICT. Improved digital literacy could help all citizens and consumers continue to confidently navigate an increasingly digital world. From banking to health care, strong digital literacy means that everyone has the ability to confidently, safely, securely and easily access the information, services and support they need. Furthermore, investing in developing digital skills today means the next generation will be equipped with the skills, competencies and tools to be successful in their personal and professional lives.

A National Digital Talent Strategy

Drawing on the data and analyses conducted, ICTC has formulated seven recommendations for addressing the challenges and opportunities facing Canada in relation to digital adoption, education, skills and labour supply:

Collectively, these recommendations form the basis of a national talent strategy focused on strengthening Canada's competitiveness, creating jobs and growing the digital economy — with the first three in particular having the greatest potential impact on Canada's digital economy, the overall economy and society.

While some recommendations are more targeted to one stakeholder group than another, in the end, all stakeholders — companies, industry associations/councils, all levels of government, educators, and individual citizens — have a role to play in effectively implementing this strategy.

1. Nurturing a strong youth talent pipeline

Global economic growth and technological advancements have intensified the need for a highly skilled, innovative and adaptable workforce. It is increasingly important that the workers of tomorrow have the skills needed to be global leaders in the digital economy. To ensure future success in the dynamic and evolving digital ecosystem, Canada needs to nurture a strong talent pipeline for science, technology, engineering and math (STEM) and information communications technology — starting with elementary and secondary education through to post-secondary education to employment transition.

STEM — which is intricately linked to ICT — provides greater access to post-secondary education programs, which in turn will open career doors. While many youth understand the importance of STEM, few end up choosing it as a field of study. There are real and significant financial benefits to pursuing a career in STEM and ICT. For example, over the course of their career, the average ICT professional will earn a million dollars more than an average non-ICT professional. ICT professionals' salaries are 48% higher than those working in other areas of the economy.[99] Additionally, on average, each ICT professional's annual contribution to GDP is $150,000 — compared to $95,000 by an average non-ICT professional — due to enhanced productivity through greater adoption of technology and opportunities for business expansion through technological innovations.

Enhancing youth engagement in STEM and ICT during their formative education years is critical to ensuring more youth stick with these fields. Tools and programs that support STEM teaching and integrate new ways of teaching and experiencing STEM and ICT will better prepare youth for studies and careers in these fields.

Problem solving, analytical skills and creativity are the building blocks for innovation. These skills can be integrated into the curriculum in ways that inspire STEM learning while still promoting a balanced education.[100] Furthermore, creating "21st century learning environments" — schools that promote critical thinking, analytics and abstractions — will help teach foundational STEM skills without necessarily having a heavy emphasis on technology.

What are 21st century learning environments?

21st century learning environments help students become comfortable with ideas and abstractions, skilled at analyzing and synthesizing new information, learn quickly and flexibly, creative and innovative, and work well as part of a team. Students that learn 21st century skills will spend significant time on basic skills, including reading, writing, and math. They will debate ideas, be capable of creating meaning from multiple texts, and have the ability to generate new ideas. Teachers will become facilitators and coaches, helping students find information they need while helping them make informed judgments about its accuracy and relevance. A 21st century learning environment emphasizes how to learn, along with what to learn. Students acquire this through:

- Applied, project-based and interdisciplinary learning;
- Collaborative and personalized learning;
- Inquiry and investigation;
- Technology for learning; and
- Information access, analysis, synthesis and the generation of new ideas.

The United Kingdom has successfully introduced a national computing curriculum to advance the computational skills of youth. In Canada, there are several successful programs that promote STEM learning in secondary schools, such as the Focus on IT Education (FIT) program. An evaluation of FIT shows that for an average cost of $500 per student, these skills and subject matters can be integrated into the high school curriculum.

Promising practices — Teaching 21st century digital skills in K–12

The United Kingdom's national computing curriculum: In September 2014, the UK altered its national curriculum to incorporate a more concrete, up-to-date computing syllabus to advance the digital literacy of children starting at five years of age. The aim of this new curriculum is to equip children with the fundamental skills and understanding of computer science to create a future generation of confident and highly skilled ICT users. In a study of 400 primary, secondary and tertiary teachers, 85% said their students have been responding "positively" or "very positively" to learning coding within the classroom. As technology continues to become more embedded in our daily lives, digital literacy becomes increasingly critical — and as the study indicates, students are showing a willingness to nurture their ICT skills.

Source: Government of the United Kingdom (September 2013). *National Curriculum in England: Computing Programmes of Study.* ; Farnell element14. *Engineering in Education Survey.*

Canada's Focus on IT (FIT) program: The FIT program is a part of ICTC's youth education initiatives. FIT was designed to help Canadian secondary students recognize the importance of ICT while developing their skills in business, communications and technology. Students and schools have the opportunity to choose between four different concentrations: interactive media, software design, business and information analysis, and network systems and operations. FIT is carefully aligned with provincial curricula, allowing students to meet the requirements of their secondary school diploma while pursuing FIT certifications. FIT further challenges students by encouraging them to prepare for industry recognized credentials such as A+, Java, Cisco IT Essentials, Adobe and Microsoft.

This initiative has helped increase high school students' awareness of ICT prospects through access to learning opportunities relevant to the world of work, certification, skills recognition and credential achievement. It has helped increase the participation of girls choosing careers in the information and communications sectors, and has improved the integration of career planning as well as interpersonal, entrepreneurial and technological skills into the curriculum. Most important, it has helped increase the supply of skilled workers entering the workforce.

FIT has been implemented in more than 200 schools across Canada. Since its inception in 2008, FIT has granted more than 3,286 certificates. This program is heavily concentrated in schools within Ontario, Québec, Alberta, British Columbia and New Brunswick.

Source: Information and Communications Technology Council.

This can only be achieved with the support of educators. It is critical that teachers have the knowledge, resources and tools required to provide an enriched STEM learning environment. Support mechanisms, such as training and professional networks, can help ensure educators are equipped to support 21st-century learning environments. For example, in the UK, an initiative called the Digital Schoolhouse London Programme was launched to support primary and secondary educators in delivering the new computing curriculum. This program has been extremely successful with more than 600 educators participating in the London area.

While foundational STEM skills can be taught without the use of technology, identifying ways to incorporate new and emerging technologies into the classroom should be taken into consideration. With so many of today's students digitally native, incorporating creative, fun, and challenging ways to use technology in teaching could further help engage students in STEM.[101]

Promising practice — Digital Schoolhouse London Programme, United Kingdom

The Digital Schoolhouse London Programme aims to develop a new generation of educators who can effectively teach the UK's new national computing curriculum. Funded by the mayor of London, each "digital schoolhouse" is based in a London-area secondary school and works with a growing network of local primary teachers to deliver creative and cross-curricular computing lessons. This initiative shows teachers how to teach the national computing curriculum using a creative, play-based learning model that leaves pupils feeling inspired and engaged. Secondary school teachers are trained by universities on the latest technologies and pedagogical methods, while industry stakeholders are included in the lesson-design stage to ensure the latest innovations and expertise are present. The secondary teachers then share their experiences teaching the new curriculum with primary school teachers. Free and flexible workshops using the digital schoolhouse methodology are also provided to interested primary schools. Within its first term, more than 40 primary schools and 2,200 students took part in a Digital Schoolhouse workshop, with many feeling inspired and engaged to learn.

There were 80 Digital Schoolhouse schools across London as of December 2015, with more than 600 teachers reaching 5,500 students. According to Shahnelia Saeed, Director of the Digital Schoolhouse London Programme, the workshops have received very positive feedback. Teachers have gained self-confidence and have better honed their abilities to teach the new computing curriculum, particularly to KS2–KS5 pupils. Between September 2014 and June 2015, more than 200 teachers took part and completed the professional development opportunities that accompany every workshop.

Source: The Digital Schoolhouse London Corporate Website.

The economic return for investing in STEM and ICT learning in elementary and secondary schools is significant: ICTC asserts that every $70,000 invested in Grade 11 and 12 programs that engage students in ICT careers can potentially increase Canada's talent supply by 100 ICT workers.

Gaining practical, real-world experience is also a crucial component to success. Apprenticeships help youth in high school and post-secondary education gain the critical skills and experience they need to enter the workforce. There is a role to be played by high schools, universities, colleges, industry, and government in providing greater access to opportunities for youth to gain these experiences. Making internships, co-ops and work placements mandatory academic components in high school through to post-secondary can strengthen youths' skills profiles. This will help them acquire necessary work-related skills and connect them with high-demand roles in key sectors.

One of the most critical challenges is that ICT graduates often struggle entering the workplace after post-secondary studies. The benefits to the Canadian economy of having youth seamlessly shift from post-secondary education to employment are clear. However, integrating technical and vocational training at the necessary scale is challenging when the large majority of Canadian enterprises are small- and medium-sized enterprises (SMEs) that employ fewer than 50 employees. Without support, these companies do not have the time or money to participate in and support on-the-job training. Although employers directly benefit from any developments that increase the available talent supply, practical constraints mean that a successful focus on on-the-job training requires multi-stakeholder participation.

Fostering on-the-job training for new ICT graduates through wage subsidy incentives is a proven approach for bridging newly graduated youth into employment. The CareerConnect program, for example, helps employers hire eligible unemployed or underemployed graduates looking for work experience in ICT and the broader digital economy. Between 2013 and 2015, CareerConnect had 184 companies granting 237 contracts, totalling an average of $10,926 in wages. Following their employment term, 80% of workers were retained by their employers. ICTC asserts that $10,000 invested as a wage subsidy to assist an SME to hire a graduate can potentially yield $6 million in lifetime GDP contribution if the graduate is gainfully employed in the job market.

Promising practice — CareerConnect

The CareerConnect program helps employers hire eligible unemployed or underemployed graduates who are looking for work experience in a position that matches one of the digital economy labour force National Occupational Classification (NOC) codes. For a private sector employer looking to hire a full-time ICT worker (for a minimum three-month term), CareerConnect will subsidize half the eligible participant's salary (up to a certain limit).

Between 2013 and 2015, CareerConnect had 184 participating companies and granted 237 contracts. Most of the placements (78%) took place in Ontario, followed by 16% in British Columbia, 3% in Quebec, 2% in Alberta and 1% in New Brunswick. In terms of gender breakdown, 163 of the participants were males and 75 were female. In total, 222 participants (94%) successfully completed their minimum three-month placement with their employer. Following this employment term, 80% of workers were retained full-time by their employer. Only 5% of participants were not continued and 15% chose to resign. On average, the total length of placement for employees was 6.16 months, totalling $10,926 in subsidized wages. This program has proven to be successful. The high retention rates demonstrate that employees are adding value to the labour force, which eliminates the burden placed on employers to hire new workers.

Source: Information and Communications Technology Council.

Recommendations:

- The provinces should make computer science mandatory in the education curriculum from Kindergarten to Grade 12, consistent with recent announcements by Nova Scotia and British Columbia. Specifically, policy makers should consider including the following components in the curriculum:
  - Computational thinking (with or without devices) for students in early grades;
  - Coding for students in intermediate grades;
  - Application development, networking, and cyber security for students in advanced grades;
  - Experiential learning opportunities such as co-ops or apprenticeships; and
  - Information about career paths and occupational roles that require computer science.
- The federal government should facilitate efforts by provincial governments to incorporate computer science into the K-12 curriculum by developing, in consultation with the provinces and industry, a standard national curriculum with lesson plan materials. The Digital Schoolhouse example from the United Kingdom provides an approach that could be emulated.
- Industry (associations and/or corporations) should support the implementation of the computer science curriculum by contributing knowledge, programs or assets, each according to their core competencies.
- Federal and provincial governments should increase the availability of wage subsidies provided to industry, particularly to SMEs, to enable them to provide on-the-job training to youth entering the ICT industry. This can be achieved by scaling existing wage subsidy programs to reach a greater number of SMEs.
- Education, industry and government should strategically enhance their work together to build education programs that better align with industry needs and improve student employment outcomes.

2. Leveraging Canada's diverse talent

Canada has a proud tradition of welcoming and celebrating diversity. A significant proportion of our population is made up of women, immigrants, Indigenous peoples and persons with disabilities, and this is only expected to grow in the coming years. The diversity of our nation and talent is a source of strength. Diverse and inclusive businesses are more productive and innovative, translating into real and significant financial gains for businesses and the economy at large. As talent scarcity increases, leveraging Canada's diverse talent pool will help ensure businesses have the skilled people they need to compete in the global digital economy.

pool will help ensure businesses have the skilled people they need to compete in the global economy. There are numerous benefits to our economy and society when we employ people of all backgrounds and abilities. For example, increases in female labour force participation over the past 30 years have added $130 billion to annual Canadian economic activity.[102] Gender-diverse companies are 15% more likely to outperform their peers; for ethnically diverse companies, that number rises to 35%.[103] In addition, companies who take disability and accessibility into consideration in their customer service, product development and talent management practices are more likely to outperform other companies on the stock market.[104]

Recent research by Deloitte showed that inclusive companies that built diversity and inclusion into their talent management practices had 2.3 times higher cash flow per employee, were 1.8 times more likely to be change-ready, and were 1.7 times more likely to be innovation leaders in their market.[105] In terms of talent management benefits, these companies were 3.8 times more likely to be able to coach people for improved performance, 3.6 times more able to deal with personnel performance issues, and 2.9 times more likely to identify and build leaders.[106] These results also applied to SMEs, which experienced 13 times higher mean cash flow as a result of embedding inclusion into their organizational practices.[107]

Women represent a strong source of potential talent and the case for their advancement and inclusion is extremely strong. A report by Credit Suisse found that there are significant benefits to increasing the representation of women on boards of directors. Based on an analysis of 2,360 companies worldwide, it was found that the share price of companies with some female board representation outperformed those with no women on the board. The average return on equity for companies with at least one woman on the board[108] over a six-year period was 16%, four percentage points higher than companies with no women on their boards.[109] Given this data, a number of jurisdictions (including several provinces in Canada, the United Kingdom, Australia, Norway and France) have undertaken several strategies, from targets to disclosure standards, in order to promote the advancement of women in board and executive positions.

Promising practice — Increasing the representation of women on boards of directors

Voluntary targets: In 2010, the United Kingdom commissioned an independent review on how to improve gender diversity on corporate boards. The resulting report called for businesses to meet voluntary targets in lieu of imposing quotas. Annual reports have been issued ever since, benchmarking businesses' progress against the voluntary target created in 2011: to have 25% of the directors of FTSE 100 boards be women by 2015. From 2010 to 2014, the percentage of women on FTSE 100 boards increased from 10.5% to 20.7%. This initiative and its respective recommendations gained considerable momentum in the UK because it inspired businesses to increase board diversity without imposing quotas.

Government-led initiatives: The Australian government decided to lead by example in promoting more women on boards. In 2010, it committed to a target of 40% of women on government boards by 2015 — and based on the progress noted, it is expected to exceed this goal. Furthermore, prominent public servants, such as Sex Discrimination Commissioner Elizabeth Broderick, have initiated programs to accelerate private sector efforts to recruit and promote women.

Promising practice — Increasing the representation of women on boards of directors (Cont'd)

Quotas: While controversial, quotas have a successful track record in promoting more women on boards. Countries like Norway and France have been particularly successful in introducing quota legislation. In Norway, the proportion of women on boards increased from 9% in 2003 to more than 40% in 2012 after enacting quotas. In France, women held 7.2% of board seats on publicly listed companies in 2004; this rate has increased to more than 29% after quota legislation was introduced in 2010.

Disclosure standards: Several countries, such as the UK and Australia, have disclosure standards for publicly-listed companies to report on board gender diversity. In Canada, the Ontario Securities Commission has recently introduced gender-reporting requirements for all publicly-listed companies. Using a "comply and explain" approach, publicly-listed companies will have to disclose the number of women on their board and outline what policies and interventions they will introduce to increase women's board representation. This approach has also been adopted in several provinces and territories, including Saskatchewan, Quebec, Manitoba, Newfoundland and Labrador, New Brunswick, Nova Scotia, Northwest Territories and Nunavut. How successful this approach will be in increasing gender diversity on boards remains to be seen.

Source: EY (July 2014). *Women on Boards: Global Approaches to Advancing Diversity.*

Canada's digital economy currently comprises about 25% women, 3% Indigenous people, 7% youth and 40% immigrants — signalling room for improvement in terms of the participation of diverse talent. Over the years, numerous successful programs aimed to diversify the ICT talent supply have been implemented, including mentorships, promotional campaigns, sponsorships and targeted professional development and training initiatives. Rapid and targeted technical training, for example, has helped to engage more women in ICT careers — and this approach could also be beneficial for youth, Indigenous peoples and persons with disabilities seeking employment who don't yet have the skills to work in ICT. Additionally, training and development initiatives, focused on leadership and soft skills, have successful track records in developing women and immigrants for entry and advancement in ICT. Specialisterne, originally from Denmark, helps organizations successfully attract and retain ICT workers with autism, a group of individuals previously thought to be unemployable. Despite these successes, based on the low representation numbers for these groups, it is clear that more work has to be done.

Promising practice — Ladies Learning Code

The Ladies Learning Code (LLC) program started in 2011 to provide rapid coding training for women interested in advancing their digital skills. The program now operates in more than 22 cities across every province in Canada, with more than 15,000 adult learners and 5,000 youth learners. In 2014, an extensive research report revealed that 96% of learners would recommend LLC to their peers. In addition, 36% of learners who identified as "complete beginners" felt more confident having completed the LLC program and were already applying the knowledge they learned on their own.

Promising practice — Ladies Learning Code (Cont'd)

In early 2012, LLC launched Girls Learning Code, which offers workshops, after-school programs, camps and other events for 8- to 13-year-old girls. Hundreds of girls in Toronto have already participated in the programs, which is now expanding to new cities in Canada. As a result of its tremendous success and demand, LLC created the Kids Learning Code for girls as well boys aged 8 to 13.

Source: Ladies Learning Code (2014). *Our Shared Vision, Our Shared Success: 2014 Report.*

In an ICTC survey, companies cited increasing their organizational capacity and capabilities, increasing their innovation and capacity to grow, and enhancing their ability to source new talent as the top three reasons for investing in diversity and inclusion. Another ICTC survey also found that few ICT employers have formal diversity and inclusion strategies or policies in place for doing so. This suggests that while companies understand the benefits of diversity and inclusion, few have the resources (e.g., time, finances, people) to invest in and implement these initiatives. Given the time-constraints and financial realities faced by many SMEs, more support is likely needed to help them promote and build more inclusive workplaces.

Lastly, there is limited Canadian data on the advancement of and impact of systemic barriers on diverse groups in the ICT sector. While there is richer data on these elements for other sectors like finance and law, even obtaining current data on the proportion and employment outcomes of persons with disabilities in ICT is challenging. Better data on diverse groups' employment outcomes and experiences in ICT and the digital economy will help identify more targeted interventions to complement current practices and strategies. This will further define the path toward systemic change so that we can more effectively leverage the rich diverse talent our nation has to offer.

Recommendations:

- Federal and provincial policy-makers, post-secondary academic institutions and industry should collaborate on a strategy for improving diversity and inclusion in the ICT profession. This group should focus on:
  - Understanding the barriers to full participation (such as wage gaps) in the ICT field by women, immigrants, persons with disabilities, Indigenous peoples, and visible minorities;
  - Sharing best practices in the area of diversity and inclusion; and
  - Establishing targets and an action plan to attract and retain underrepresented persons in the ICT field.

Recommendations (Cont'd):

- Industry, educational institutions and governments should tailor existing ICT learning opportunities (e.g., coding lessons, leadership courses) to encourage participation from underrepresented groups.

- Industry and governments should make available to SMEs existing resources that can help SMEs identify and address unconscious bias in their organizations so that they can make the most effective use of all talent available to them.

- Industry, education and government should develop and promote targeted learning opportunities to attract underrepresented groups. This may include targeted industry-driven awareness and community programs to attract a diverse talent into high-demand ICT careers and targeted scholarships to attract underrepresented groups.

3. Supporting workforce upskilling to enhance digital adoption

Advanced digital technologies such as SMAAC, under the larger banner of IoT, are the drivers of innovation in the digital economy. They have the potential to create a distinct competitive advantage for Canada — but only if the capabilities of those technologies are effectively adopted by Canadian business and entrepreneurs.

An innovative economy able to capitalize on emerging technologies is better prepared to compete in the global digital economy. ICTC has conducted a series of studies on emerging technologies to define their impact on the Canadian economy at large. Not only are they ushering in a new ICT paradigm, they are redefining organizational capacity and creating new opportunities for productivity gains across all sectors. For example, ICTC found that just a 1% increase in labour productivity as the result of adopting mobile technology would yield $2.5 billion to the Canadian economy — and $8 billion if multiple emerging technologies were adopted. An ICTC study found that 48% of companies that have adopted digital platforms have seen an increase in revenue of 10% or more attributable to marketing on digital platforms. For example, the National Bank of Canada boosted sales of their proprietary mutual funds by providing social media training to internal employees and external mutual fund wholesalers.[110] Yet only half of Canadian enterprises have enabled mobile solutions across their entire workforce. Challenges related to capital and financing, the workforce, organizational culture, and pricing and affordability are the key hurdles to technology adoption, according to ICTC research.

Continually upskilling the workforce to be in-tune with the latest technology advances is a must for businesses to remain competitive. ICTC asserts that every $100,000 of investment or tax incentive to train 10 mid-career ICT professionals on emerging technologies has the potential to contribute $2.1 million in output to Canada's GDP. For continued workforce participation, employers must invest in and offer learning opportunities to their employees.

While large organizations have the capacity to upskill their workforce and fully embrace technology as a competitive advantage, the reality is that more than 75% of Canada's industry is represented by organizations of fewer than 10 employees. These organizations have limited resources and find it the hardest to invest in talent training and digital adoption. They are often dependent on immediate business opportunities in the marketplace to finance talent upskilling and digital adoption. Additionally, it can be difficult for SMEs to assume the compounded cost of training plus the potential loss of earning while the employee is absent from the workplace.

Recommendations:

- Governments at all levels should create mechanisms that reduce the financial burden on SMEs to upskill an employee in ICT. This could include a subsidy or tax credit for SMEs to assist with covering the cost of short duration training.
- Federal and provincial governments should make it easier for SMEs to adopt new digital technologies to improve their competitiveness through support programs such as the Digital Technology Adoption Pilot Program by the National Research Council which ended in 2014.
- Governments at all levels (municipal, provincial, and federal) should allocate a percentage of their ICT procurement spend to Canadian SMEs.

4. Attracting and retaining global digital talent

As population growth continues to decline, domestic skilled talent will become increasingly scarce. Canada is not alone in this trend, with nations like Denmark, Germany and the United Kingdom also experiencing talent shortages. The global talent scarcity will boost the importance of securing highly skilled international workers. Furthermore, open global economies, enabled by free-trade agreements like the Trans-Pacific Partnership (TPP), increase talent mobility as companies expand into new markets and labour markets become further globalized. This new reality means that Canada must continue to recognize and welcome international talent to remain competitive and address the skills shortage in our digital economy.

Canada has a strong tradition of welcoming global talent and is a popular destination for immigrants. However, as more countries look to internationally educated professionals (IEPs) to fill impending talent gaps, this will increase the competition Canadian employers will encounter in securing top talent from abroad. With the digital economy already experiencing acute talent shortages, more and more interest is being paid to the power of IEPs, who will make important contributions to Canada's innovation competitiveness and economic growth.[111]

However, there are a number of challenges in efficiently and effectively matching immigrants to jobs commensurate with their experience and skills while also meeting employers' labour demands. Canadian ICT organizations are so strapped for labour that, in addition to domestic talent, highly skilled temporary foreign workers represent an important source of digital talent.

Yet, the transition process for highly skilled temporary foreign workers to stay in Canada can be complicated, making companies vulnerable to losing this productive and innovative skilled talent.[112] Already, there is evidence suggesting that the number of temporary foreign workers has decreased and this reduction may not be limited to low-skilled workers.[113]

Additionally, employers in high-demand sectors like ICT experience difficulties and delays in getting visas for high-skilled (permanent and temporary) digital talent to come to Canada.[114] Furthermore, companies in new and emerging technology sectors are experiencing difficulties in securing talent because there are few or no National Occupational Classification (NOC) codes to match these jobs to. As a result, these jobs and the potential candidates get overlooked while demand keeps exponentially growing. Overall, these challenges reduce a company's competitiveness in attracting highly educated global digital talent.

Countries like Australia and New Zealand have developed immigration systems that effectively attract and retain global talent. For example, Australia's immigration system quickly processes migrants with a strong focus on ensuring they obtain work commensurate with their experience and skills while meeting the country's regional economic and social needs. In 2015, the UK launched an expedited visa process for highly skilled digital talent.[115]

Promising practice — Expediting the migration process for in-demand occupations in Australia

In 2012, the Australian government launched a new electronic application system to manage its skilled migration program, which is the main pathway to permanent residency. Prospective immigrants complete an expression of interest (EOI) and are ranked according to the information provided. Those who rank high in points are then invited to apply for a visa. This new system benefits Australia because it works toward meeting its economic needs and labour market shortages while taking into account and addressing regional skill needs. The EOI allows employers to quickly identify potential skilled workers that can meet their demands.

Over the years, the composition of Australia's migration program has changed to focus more heavily on skilled migrants. In 2014–2015, 68% of people migrating under this program were skilled workers, with 38% being employer-sponsored and 22% nominated by a state, territory or region. According to the Australia's Migration Trends report published by the Department of Immigration and Border Protection, employment outcomes in 2013–2014 for skilled migrants were even better than the Australian population: the labour force participation rate for primary skilled migrants was 95.6% compared with the national average 64.8%. This suggests that when migrants are matched correctly according to their skills and the recognized labour shortages, they are finding work and helping advance the economy.

Source: The Government of Australia. *Australia's Migration Trends at a Glance. ;* The Government of Australia. *About Us — Fact Sheet: Australia's Migration Programme.*

To make the migration process for ICT and other high skilled workers more efficient, last year, Canada adopted a similar model to Australia and New Zealand. The Government of Canada launched the Express Entry program to improve the efficiency and effectiveness of economic migration to Canada. The new system is designed to process permanent resident applications within six months and is more demand driven to meet labour market needs. Despite the positive enhancements, anecdotal evidence suggests there is room for improvement. A full and concrete evaluation of the effectiveness of the new system will help shed light

on what refinements could be made. If Canada wants to become a leader in the global digital economy, it is imperative that we have an immigration system that is efficient at attracting and retaining the best global digital talent.

It is also crucial that we continue to build and promote Canada's brand as a talent-friendly nation. While already a popular destination, we must continue to highlight the excellent blend of advanced technological research and corporate infrastructure that offers unique opportunities to individuals and entrepreneurs. Similarly, provincial regions and municipal communities experiencing high growth in the digital economy will also have to brand themselves as talent- and business-friendly to promote talent attraction, investment, and economic growth. An example of a successful campaign that could be emulated internationally is the Vancouver Economic Commission's (VEC) marketing campaign to attract digital talent to the Vancouver region.

Recommendations:

- Federal and provincial policy-makers should work with industry to update the labour market information used by immigration and workforce development staff for assessing the supply of and demand for emerging occupations.
- Federal policy-makers should reinstate the expedited visa stream previously referred to as the Facilitated Processing for IT Workers in order to allow skilled global digital talent to enter Canada quickly to fill immediate talent shortages in high-demand occupations.
- Federal policy-makers should promptly re-evaluate the Express Entry program to ensure it achieves its objective of facilitating the path to permanent residence for individuals possessing skills in demand.
- Governments at all levels, industry associations, and companies should create more marketing campaigns to brand Canada and its respective regions, as talent- and business-friendly.

5. Strengthening digital literacy and digital skills for Canadians

Strong digital literacy for all citizens will enable people of all ages, backgrounds and abilities to effectively and confidently navigate the increasingly digital world. It will also boost technology consumption, promoting growth and increasing demand for ICT goods. In turn, this has the potential to attract more digital entrepreneurs and companies to Canada, creating more jobs and overall prosperity for Canadians. Government, industry, and educators all have a role to play in enhancing Canadians' digital literacy. Digital literacy for all citizens is a critical component to creating a competitive advantage for Canada in the global digital economy.

In the coming years digital will be the business and the business will be digital. The growing markets for SMAAC technologies and the IoT are fuelling the intelligence economy, which will affect all jobs — not just those in ICT. Across all sectors, digital skills are becoming increasingly important in supporting effective participation, inclusion and innovation in this new economy.[116] Furthermore, new technologies such as automation and artificial intelligence will make work more complex.[117]

As the level of collaboration and convergence between ICT and other business areas continues to increase, the ability to work effectively with each other to solve business problems will be critical to ensuring success.

These trends are making it increasingly important for everyone to engage in lifelong learning to stay competitive and ahead of the curve in the job market. Kirk Bone, data scientist and professor of astrophysics and computational science at George Mason University, summed up the new reality for workers: "Digital must become part of what you do and who you are."[118]

A survey by the Economist Intelligence Unit found that nearly a quarter of professionals cited mastering new technology as one of their top three ways to achieve career aspirations.[119] However, some professionals in Canada still do not have the skills needed to succeed in an increasingly connected, digital and competitive global economy. In 2010, the Government of Canada found that a substantial proportion — almost 40% — of Canadian workers lack the necessary skills to support digital adoption.[120]

The ability of Canadian businesses to innovate and compete in the global economy depends not only on adopting technology but also on ensuring the workers using that technology have the skills to effectively leverage its benefits. The right digital skills can help boost digital adoption, in turn increasing productivity, innovation and economic growth. By being digitally literate, professionals from all backgrounds can better apply digital technologies to their context to solve business problems. Already, more and more non-IT functions expect their workers to use digital technology as part of their daily job. This trend is evident in the marketing and finance professions, and is increasing in human resources.

Promoting the value and benefits of technology adoption — such as improved job satisfaction and more time to focus on strategic tasks — is one way of encouraging professionals to update their digital skills.[121] Employers also play a key role in ensuring their organizational cultures promote continuous learning and are open to implementing new technologies. However, even when people and organizations are open to upgrading their digital skills, time and financial constraints often make it difficult to maintain and apply their digital skills in the workplace.[122]

Recommendations:

- Governments at all levels with industry and education should develop and expand the availability of free online technology guidance and resources (such as cyber-security advice) for SMEs and individual citizens. This will enable citizens to engage with confidence in the digital economy and improve the foundational digital skills for employment.

- Governments at all levels should move promptly towards serving their constituents through digital portals and online services as this will encourage greater digital adoption and literacy among Canadians.

6. Fostering digital entrepreneurship

The primary aim of nurturing Canada's future entrepreneurial capacity is to create new industries, and spur growth in all sectors of the economy. Technological innovation has always been at the heart of this

ecosystem, driving economic growth and social development. While Canada has a strong R&D capacity and entrepreneurial culture, we lag behind other advanced economies when it comes to translating these innovations into commercialized products and services. According to the World Economic Forum's 2015 Global Competitiveness Report, Canada is ranked 22nd in terms of innovation,[123] despite large per-capita investments into R&D programs by the federal government.[124] Part of the challenge is that the government funds more R&D than industry in Canada. This can create a gap between the research undertaken in public universities and the direct needs of industry, which is at the heart of the commercialization shortfall.[125] Effective and successful innovation is a union of invention and commercialization.[126] To achieve this government, academia and industry must collaborate and invest in the commercialization of technological innovations, which in turn will better prepare students for entrepreneurship or the workforce and will drive job creation and economic growth.

Venture capital and other forms of private investment are also ways to assist firms in increasing their R&D and overall innovation. Financing plays an extremely important role in the innovation cycle. Venture capital has become an increasingly important source of funding for technology-based ventures, especially in the latter stage of expansion.[127] Large technology companies have also entered the venture-fund field by setting aside funds for external investment in underperforming companies.[128] The rise of corporate venture capital (CVC) — where a large organization makes a direct equity investment into a smaller company — has been shown to increase the larger company's access to innovative technology and creative output essential for R&D and innovation.[129] CVC is also seen as a way for avoiding some of the challenges with traditional forms of venture capital, such as a narrow focus on specific industries and volatile funding cycles.[130]

Additionally, Foreign Direct Investment (FDI) serves an important role for open and successful economic growth in a global environment,[131] especially in encouraging technology transfers that accelerate overall growth and development in recipient countries. Nations with the most successful FDI regimes provide special tax incentives and subsidies to attract foreign businesses.[132] While FDI is usually considered within the context of developing nations, it can help foster economic growth in advanced technology sectors and economies. Increased FDI can also increase R&D diffusion, domestic capital formation, and even trade.[133]

Although, increasing the amount investment is crucial, tax incentives linked to commercialization can incentivize the development of patents while also protecting and retaining high-value intellectual property in Canada. For example, the United Kingdom increased its capacity for intellectual property through its Patent Box program. This program was designed to retain and commercialize patents from the development of new products. The Patent Box concept is a way to incentivize innovation, as companies are entitled to receive significant tax breaks on qualifying profits. By the third quarter in 2015, the UK Patent Box regime had distributed £335 million in funding to 639 companies. According to the UK Government, large investments into the UK have already been attributed to the existence of this program.[135]

While creating a financial environment that promotes innovation is important, we must also allow for the seamless continuity between research conducted in universities and colleges, the skills that students acquire in the process and the journey of the product to the marketplace. Applied and advanced research laboratories that foster the creation of innovations in collaboration with private industry can help bridge the divide between invention and commercialization. For example, a number of the advanced laboratories attached to British Columbia's universities (such as at Simon Fraser University and the University of British Columbia) conduct world-class research and actively collaborate with private industry to find commercialization avenues for these technological advancements. These scientific institutes can provide undergraduate and graduate students with the experiences they need to become entrepreneurs and commercialize their technological advancements.[136]

Furthermore, post-secondary projects where students identify and creatively solve real-world problems and market opportunities using their technical knowledge, help build the skills required for successful entrepreneurship. Additionally, encouraging risk-taking, creativity, self-initiative, and teamwork in post-secondary education can foster and develop entrepreneurs.[137] However, it is important that a direct link with industry be maintained to ensure that innovations align with industry needs.

As the IoT and SMAAC industries rapidly expand, ICT graduates must have the skills to innovatively use these technologies to create new markets and opportunities. Successful entrepreneurs have a unique mix of technical, business, interpersonal and creativity skills. Increasingly, companies are requiring all employees to have this mix of skills so they can better leverage emerging global markets and business opportunities. While programs that promote a mix of business, interpersonal and technical skills do exist (such as Infosys' Campus Connect program, SAP University Alliances or the University of Waterloo's WAT PD program), very few make learning business or soft skills a mandatory requirement. Furthermore, industry needs to provide hands-on, in-person, instructional support to academia on how to integrate industry-centric skills into the curriculum.

Promising practice — Infosys Campus Connect

Infosys Ltd. runs Campus Connect, an industry–academia partnership that focuses on creating industry-ready IT professionals by aligning engineering students' competencies and skills with industry needs. As of September 2013, Infosys had partnered with more than 350 colleges and trained more than 275,500 students, with about three-quarters registered in a technical skills program and the remainder learning soft skills. While primarily run in India, the program has been extended to Malaysia and Mexico.

The technical programs are based on "learn and apply" models that allow students to learn the latest industry trends and understand future demands. They also help faculty create learning channels with industry. Elective courses cover topics such as IT systems, business intelligence and enterprise applications.

The purpose of the soft skills program is to ensure students have the skills and competencies to be collaborative and productive in the workplace. It focuses on building English skills, business communication, teamwork, problem solving, group discussion and interview skills. Elective courses are conducted either as seminars or webinars by the Campus Connect team.

The program has supported more than 9,800 faculty members in integrating industry-specific technical and soft skills training into their teaching. Faculty are provided case studies, prototype projects and teaching aids. Faculty can also apply for research sponsorship and sabbaticals at Infosys.

Source: Infosys Campus Connect Report.

While Canada already has a thriving entrepreneurial culture, making sure entrepreneurs have access to capital and the workforce has the skills to develop innovative, digital solutions will assist in further creating an ecosystem that fosters digital entrepreneurship, a key component of success in the global digital economy.

Recommendations:

- Governments at all levels, industry and educational institutions should encourage investments in research and development that result in the commercialization of new products and services. A potential path forward is modifying the scientific research and experimental development (SR&ED) program to focus benefits on early-stage companies and link payment of the tax credits to commercialization (as is the case with the U.K. “patent box” approach).
- Governments at all levels should develop a comprehensive strategy to attract Foreign Direct Investment (FDI) for early stage technology R&D. The strategy should include consideration of intellectual property protection afforded to new innovation, corporate taxation rates and the availability of tax efficient financial and fiscal instruments for investment.
- Governments at all levels and industry should further incentivize the commercialization of research and educational institutions’ applied research. This will nurture entrepreneurial talent’s capacity to innovate, experiment and bring solutions to market.
- Post-secondary academics should focus students’ research assignments on projects that have the potential for commercialization.

7. Building labour mobility pathways to fill high demand occupations

Smart and hyper-connected technologies are rapidly expanding while traditional economic powerhouses, like manufacturing and oil and gas, are declining. Significant numbers of workers from these declining areas are laid-off or displaced because of this economic situation. These displaced workers represent an untapped talent pool that could fill talent shortages in other sectors like ICT. While some displaced workers may have transferable skills from their previous roles that could be applicable in a new role, they do not have the technical skills required to enter the ICT industry. This does not mean we should reject them as a source of talent; instead, we need to build alternative career pathways, competency standards, and training supports to leverage this talent pool. Effectively and efficiently shifting displaced and transitioning workers into the digital economy will facilitate the rebalance of ICT labour supply and demand discrepancies and drive more growth in the Canadian economy.

Labour mobility is more than international postings and transfers. It also includes the movement of talent within a country or across occupations, sectors, and skill sets.[138] In order for labour mobility to achieve its full potential, career pathways, standard skills and competency frameworks, and training interventions must established. Information gaps with respect to career paths and inconsistencies in skills needs make it difficult to move displaced workers into new jobs.[139] These mobility barriers and others, like a lack of recognition of training or certifications, make it difficult for displaced workers to transition from declining sectors and jobs into high-demand sectors like ICT.

Some displaced and transitioning workers may have transferrable technical, business or soft skills that could be utilised in ICT roles. However, without standardised skills and competency frameworks, it is difficult to map transferrable skills to the competencies required for specific ICT occupations. In addition, a lack of a common ICT competencies make it challenging to create alternative career pathways as well as accurately determine the type of education and training transitioning workers require to enter the ICT workforce. Other countries have already started developing ICT competency frameworks. For example, the European Union is developing a common framework for IT skills and India's National Association of Software and Service Companies has created the Assessment of Competence, a national standard skills assessment for ICT workers.[140] Collaboration amongst government, industry, and educators is required to establish a sustainable and long-term ICT skills and competency framework in Canada, which in turn could also support international mobility pathways.

Education and training also play an important role in re-tooling transitioning workers who have transferable skills. Rapid and targeted technical training can be a particularly useful intervention to bridge workers' skills. However, educators must collaborate with industry to ensure the training provides the skills transitioning workers need to be gainfully employed in ICT. In addition, adequate support for displaced workers during their entire transition period should be considered. The required investments in education and training compounded with the loss of income can have negative financial impacts on these individuals.

Harnessing the power of labour mobility pathways to move displaced and transitioning workers into the ICT sector will assist in filling critical talent and skills gaps. Leveraging this untapped talent pool will provide industry with additional skilled talent to innovate and grow Canada's digital economy.

Recommendations:

- Governments at all levels, industry and associations should collaborate on developing a comprehensive strategy that supports the transition of displaced workers into high demand jobs in the digital economy. This would focus on:
  - Prioritising which declining sectors require the most assistance with transitioning displaced workers;
  - Creating guidelines and tools for mapping transferrable skills;
  - Leveraging new and existing occupational standards to establish new ICT career pathways;
  - Creating targeted and short duration training programs; and
  - Developing supports to facilitate the transition of displaced workers into ICT by continuing their Employment Insurance benefits for a period that enables training to occur at no (or a reduced) cost to the worker and employer.

Conclusion…The Route to 2020 and Beyond

The Canadian economy is rapidly becoming increasingly global and digital in nature. With its favourable political and business environment, in addition to a vibrant digital ecosystem, Canada is poised to become a leader in the global digital economy. However, talent shortages, skills gaps, and the slow pace of digital adoption must be overcome in order for Canada to achieve this vision.

This strategy puts forward a series of recommendations distilled from the many ideas and insights generously shared with the ICTC by members of industry, government and academia. It will require further iteration and work to implement, and above all, the cooperation and effort of the many stakeholders who contributed so generously to this work.

Adopting the recommendations outlined in the seven areas of the strategy will help Canada become a leader in the global digital economy. Charting a path forward, with milestones and timelines, will help ensure we implement the strategy and its associated recommendations. Three taskforces have been established to guide the strategy, each with the responsibility of developing an action plan with critical milestones. To achieve the strategy, the seven areas highlighted in the strategy will be segmented into three areas that also form the taskforces: industry growth, education and skills, and diversity and inclusion. However, as with the strategy and its recommendations, in the end, all stakeholders — companies, industry associations/councils, all levels of government, educators, and individual citizens — have a role to play in ensuring the milestones and actions are achieved by 2020 and beyond.

We must harness the passion and commitment of our Canadian community in order to take the concrete actions necessary to secure Canada's place in the global, digital economy.

Summary of Recommendations

Nurturing a strong youth talent pipeline

- The provinces should make computer science mandatory in the education curriculum from Kindergarten to Grade 12, consistent with recent announcements by Nova Scotia and British Columbia. Specifically, policy makers should consider including the following:
  - Computational thinking (with or without devices) for students in early grades;
  - Coding for students in intermediate grades;
  - Application development, networking, and cyber security for students in advanced grades;
  - Experiential learning opportunities such as co-ops or apprenticeships; and
  - Information about career paths and occupational roles that require computer science.
- The federal government should facilitate efforts by provincial governments to incorporate computer science into the K-12 curriculum by developing, in consultation with the provinces and industry, a standard national curriculum with lesson plan materials. The Digital Schoolhouse example from the United Kingdom provides an approach that could be emulated.
- Industry (associations and/or corporations) should support the implementation of the computer science curriculum by contributing knowledge, programs or assets, each according to their core competencies.
- Federal and provincial governments should increase the availability of wage subsidies provided to industry, particularly to SMEs, to enable them to provide on-the-job training to youth entering the ICT industry. This can be achieved by scaling existing wage subsidy programs to reach a greater number of SMEs.
- Education, industry and government should strategically enhance their work together to build education programs that better align with industry needs and improve student employment outcomes.

Leverging Canada's diverse talent

- Federal and provincial policy-makers, post-secondary academic institutions and industry should collaborate on a strategy for improving diversity and inclusion in the ICT profession. This group should focus on:
  - Understanding the barriers to full participation (such as wage gaps) in the ICT field by women, immigrants, persons with disabilities, Indigenous peoples, and visible minorities;
  - Sharing best practices in the area of diversity and inclusion; and
  - Establishing targets and an action plan to attract and retain underrepresented persons in the ICT field.
- Industry, educational institutions and governments should tailor existing ICT learning opportunities (e.g., coding lessons, leadership courses) to encourage participation from underrepresented groups.
- Industry and governments should make available to SMEs existing resources that can help SMEs identify and address unconscious bias in their organizations so that they can make the most effective use of all talent available to them.
- Industry, education and government should develop and promote targeted learning opportunities to attract underrepresented groups. This may include targeted industry-driven awareness and community programs to attract a diverse talent into high-demand ICT careers and targeted scholarships to attract underrepresented groups.

Supporting workforce upskilling to enhance digital adoption

- Governments at all levels should create mechanisms that reduce the financial burden on SMEs to upskill an employee in ICT. This could include a subsidy or tax credit for SMEs to assist with covering the cost of short duration training.
- Federal and provincial governments should make it easier for SMEs to adopt new digital technologies to improve their competitiveness through support programs such as the Digital Technology Adoption Pilot Program by the National Research Council which ended in 2014.
- Governments at all levels (municipal, provincial, and federal) should allocate a percentage of their ICT procurement spend to Canadian SMEs.

Attracting and retaining global digital talent

- Federal and provincial policy-makers should work with industry to update the labour market information used by immigration and workforce development staff for assessing the supply of and demand for emerging occupations.
- Federal policy-makers should reinstate the expedited visa stream previously referred to as the Facilitated Processing for IT Workers in order to allow skilled global digital talent to enter Canada quickly to fill immediate talent shortages in high-demand occupations.
- Federal policy-makers should promptly re-evaluate the Express Entry program to ensure it achieves its objective of facilitating the path to permanent residence for individuals possessing skills in demand.
- Governments at all levels, industry associations, and companies should create more marketing campaigns to brand Canada and its respective regions, as talent- and business-friendly.

Strengthening digital literacy and digital skills for Canadians

- Governments at all levels with industry and education should develop and expand the availability of free online technology guidance and resources (such as cyber-security advice) for SMEs and individual citizens. This will enable citizens to engage with confidence in the digital economy and improve the foundational digital skills for employment.
- Governments at all levels should move promptly towards serving their constituents through digital portals and online services as this will encourage greater digital adoption and literacy among Canadians.

Fostering digital entrepreneurship

- Governments at all levels, industry and educational institutions should encourage investments in research and development that result in the commercialization of new products and services. A potential path forward is modifying the scientific research and experimental development (SR&ED) program to focus benefits on early-stage companies and link payment of the tax credits to commercialization (as is the case with the U.K. “patent box” approach).
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- Governments at all levels and industry should further incentivize the commercialization of research and educational institutions' applied research. This will nurture entrepreneurial talent's capacity to innovate, experiment, and bring solutions to market.

- Post-secondary academics should focus students' research assignments on projects that have the potential for commercialization.

Building labour mobility pathways to fill high demand occupations

- Governments at all levels, industry and associations should collaborate on developing a comprehensive strategy that supports the transition of displaced workers into high demand jobs in the digital economy. This would focus on:
  - Prioritising which declining sectors require the most assistance with transitioning displaced workers;
  - Creating guidelines and tools for mapping transferrable skills;
  - Leveraging new and existing occupational standards to establish new ICT career pathways;
  - Creating targeted and short duration training programs; and
  - Developing supports to facilitate the transition of displaced workers into ICT by continuing their Employment Insurance benefits for a period that enables training to occur at no (or a reduced) cost to the worker and employer.

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