RESEARCH

SKILLS IN THE DIGITAL ECONOMY
WHERE CANADA STANDS AND THE WAY FORWARD

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INFORMATION AND COMMUNICATIONS TECHNOLOGY COUNCIL (ICTC)

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PREFACE

ICTC’s trusted labour market research provides critical economic and labour market insights to inform innovative workforce and skills solutions, as well as practical policy advice, to drive the development of a more prosperous Canadian workforce and industry in a global digital economy.

This report was made possible with the generous support of Innovation, Science and Economic Development Canada. We are grateful for their insights and contributions to this important piece of research.

The authors made all reasonable efforts to ensure accuracy and fair reflection of the diverse perspectives gathered during consultations in compiling the document. The opinions and interpretations in this publication are those of the authors and do not necessarily reflect those of the Government of Canada.

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Thank you!
# TABLE OF CONTENTS

**EXECUTIVE SUMMARY** .......................................................................................................................... VII

1. **INTRODUCTION AND PURPOSE** ...................................................................................................... 10

2. **RESEARCH METHODOLOGY AND ANALYTICAL FRAMEWORK** ................................................... 11

3. **THE DIGITAL ECONOMY AND NEW TECHNOLOGIES** ..................................................................... 12
   - The digital economy ............................................................................................................................ 12
   - Technologies transcending sectors ..................................................................................................... 12
   - ICT investments and digital adoption ................................................................................................. 12
   - Benefits of digital adoption ............................................................................................................... 13
   - Challenges of digital adoption .......................................................................................................... 14
   - Skills the new currency ..................................................................................................................... 14

4. **THE EMPLOYEES OF THE DIGITAL AGE** ......................................................................................... 15
   - Increasing need for digital and complementary skills ........................................................................ 15
   - General trends on skills demand ......................................................................................................... 15
   - What are the digital skills frameworks? ............................................................................................... 16
   - OECD: New skills for the digital economy ........................................................................................ 18
   - An industry-stakeholder group perspective ....................................................................................... 19
   - Recent categorization in Canada ....................................................................................................... 19
   - ICTC’s framework ............................................................................................................................. 20

   - Canada’s global standing and national studies on skills gap .............................................................. 25
   - OECD findings .................................................................................................................................... 29
   - The costly gap ...................................................................................................................................... 29
   - Causes of digital skills gap .................................................................................................................. 30
   - Technological innovations ................................................................................................................... 30
   - Rapid adoption of new technologies ................................................................................................. 31
   - Industry-education alignment issues ................................................................................................... 31
   - Lack of interpersonal and business skills ........................................................................................... 32
   - Intergenerational differences ............................................................................................................ 32

6. **ADDRESSING THE GAP: TRENDS AND CHALLENGES** ............................................................... 34
   - Training, development, and workforce upskilling .............................................................................. 35
   - Training courses ................................................................................................................................. 35
   - Mentoring and on-the-job training ...................................................................................................... 36
   - Sharing knowledge and social learning .............................................................................................. 36
   - Skills gap analysis and development plans ....................................................................................... 36
   - Human resources practices ............................................................................................................... 37
   - Education ............................................................................................................................................ 37
   - Post-secondary .................................................................................................................................... 37
   - K-12 curriculum amendments ........................................................................................................... 38

7. **CONCLUSIONS AND POLICY RECOMMENDATIONS** .................................................................... 39
   - Investing in training to improve digital adoption ............................................................................... 39
   - Strengthening digital skills for professionals and youth ................................................................. 40
     - Professionals .................................................................................................................................... 40
     - Youth ............................................................................................................................................... 40
   - Fostering digital entrepreneurial talent ............................................................................................. 41

8. **APPENDIX A1: INTERVIEW GUIDE FOR CASE STUDIES** ............................................................... 43

9. **APPENDIX A2: CASE STUDIES** ....................................................................................................... 44
   - Case Study 1 – PSI Engineering ........................................................................................................ 45
   - Case Study 2 – Imperial Manufacturing Group ................................................................................ 47

10. **REFERENCES** ..................................................................................................................................... 48
# TABLE OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>Types of Technology Platforms Utilized by Canadian Digital Adopters</td>
<td>13</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Technology adoption benefits among canadian digital adopters</td>
<td>14</td>
</tr>
<tr>
<td>Figure 3</td>
<td>“Must have” Skills Ranking among canadian employers I</td>
<td>17</td>
</tr>
<tr>
<td>Figure 4</td>
<td>“Must have” Skills Ranking among canadian employers II</td>
<td>18</td>
</tr>
<tr>
<td>Figure 5</td>
<td>The Skills Spectrum in The Digital Economy</td>
<td>21</td>
</tr>
<tr>
<td>Figure 6</td>
<td>Reasons for dissatisfaction with the quality of new hires among global firms</td>
<td>25</td>
</tr>
<tr>
<td>Figure 7</td>
<td>Comparison of countries on Difficulty in Filling Jobs Due to Skills and Talent mismatch</td>
<td>26</td>
</tr>
<tr>
<td>Figure 8</td>
<td>Difficulty in hiring for ICT positions in Canada due to skills mismatch</td>
<td>26</td>
</tr>
<tr>
<td>Figure 9</td>
<td>Hays Global Skills Index, 2015 - Canada’s scores on labour market pressure dimensions</td>
<td>28</td>
</tr>
<tr>
<td>Figure 10</td>
<td>Hays Global Skills Index 2015 - Comparison of average scores: Canada with Australia, Germany, UK and the US</td>
<td>28</td>
</tr>
<tr>
<td>Figure 11</td>
<td>Hays Global Skills index 2015 - Comparison of talent mismatch: Canada with Australia, Germany, UK and the US</td>
<td>29</td>
</tr>
<tr>
<td>Figure 12</td>
<td>Difficulty in finding required skills due to technology adoption among Canadian employers</td>
<td>30</td>
</tr>
<tr>
<td>Figure 13</td>
<td>Key skills-related challenges facing Canada’s employers</td>
<td>34</td>
</tr>
<tr>
<td>Figure 14</td>
<td>Would addressing skills-related challenges improve employee productivity and business growth?</td>
<td>34</td>
</tr>
<tr>
<td>Figure 15</td>
<td>Top Challenges organizations are encourtering</td>
<td>35</td>
</tr>
<tr>
<td>Figure 16</td>
<td>Ranking of K-12 Education Components</td>
<td>38</td>
</tr>
</tbody>
</table>
## ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERP</td>
<td>Enterprise Resource Planning</td>
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<tr>
<td>HR</td>
<td>Human resource</td>
</tr>
<tr>
<td>HRM</td>
<td>Human resource management</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communications Technology</td>
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<tr>
<td>ICTC</td>
<td>Information and Communications Technology Council</td>
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<tr>
<td>IoT</td>
<td>Internet of Things</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>SMAAC</td>
<td>Social media, mobile, analytics, apps, and cloud</td>
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<td>SME</td>
<td>Small and medium enterprises</td>
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EXECUTIVE SUMMARY

In an increasingly connected global environment, digital technologies have become significant drivers of productivity, innovation and competitiveness in every sector of the Canadian economy. In the next 3-5 years, the adoption of smart and connected technologies, such as the Internet of Things (IoT), will continuously reshape all aspects of the economy, including manufacturing, financial services, health, transportation, essential services and cities, as well as media and creative industries. Additionally, Canada’s entrepreneurial capacity is creating new digital innovations and industries, which are in turn driving economic growth and social development.

Technological innovations are modifying business models through virtualization of operating systems and digitalization of key business processes, such as marketing, commerce, production, customer service, communication, and more. These technological innovations transcend all economic sectors and reach almost every organization in Canada. The economic and business benefits of technology adoption are well understood by organizations of all sizes, including small to medium size enterprises (SMEs).

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. As the workplace becomes more digital, the requisite skills for a successful worker are evolving. In this dynamic environment, every professional needs to be comfortable with both digital technologies and business processes. If organizations do not have employees with these critical skills, they put the brakes on making the digital switch and miss out on the productivity, innovation, and new revenue opportunities offered by technological innovations.

Given this evolving backdrop, it is crucial to understand the types of skills needed for success in the digital economy. Based on previous efforts to develop a digital skills framework, ICTC proposes a five category model of skills spectrum in the digital economy. These categories are foundational skills, business-interpersonal skills, digital and technical skills, informational skills and entrepreneurial skills. However, there is evidence that the Canadian workforce lacks the digital skills required to be innovative and competitive in this new environment.

Several global studies indicate that Canada has a moderate skills gap; however, the highest pressure on the labour market stems from talent mismatches. Similarly, ICTC’s primary data in 2014 indicates that 34% of Canadian employers reported some difficulty in filling various ICT positions due to skills mismatch. The skills mismatch is not a minor problem for the economy; in fact it is very costly. It is estimated by IDC that inadequate digital skills reduce an organization’s total productivity by 21.3%. The Conference Board of Canada estimates a $24 billion lost in Ontario due to skills deficits, which implies a $65 billion loss in the overall Canadian economy.

Skills gaps are caused by a number of factors, including rapid innovation and adoption of new technologies, industry-education alignment issues, lack of interpersonal and business skills among young professionals, and intergenerational difference issues in digital literacy and information processing skills. The half-life of skills in today’s economy is thought to be about 2.5 to 5 years, hence the technical skills professionals possess today will only be half marketable two years from now.

ICTC’s research indicates that finding employees with the right blend of business, interpersonal, technical, entrepreneurial and digital skills stands out as the biggest skills-related challenge of employers. Addressing these issues is vital to business success as 85% of employers agree that addressing skills-related challenges would improve their businesses’ productivity and growth. On-the-job training, mentoring and sharing knowledge and social learning, skills gap analysis and talent development plans are effective at minimizing skills mismatches. Educational interventions at all levels are also important factors to bridge the skills gap. More specifically, to create an agile and digitally literate workforce for the future, elementary, secondary and post-secondary programs must align with industry’s needs, include experiential learning opportunities, and develop youth’s problem-solving, analytical and creativity skills — key cognitive building blocks for an innovative mindset.

The recipe for success in this dynamic and evolving economic environment is dependent on our ability to equip our workforce with the requisite digital and complementary skills so that companies can effectively adopt and leverage digital technologies. Based on primary and secondary research, ICTC offers following recommendations:
Investing in training to improve digital adoption:

☐ Industry should increase the priority they place on investing in and offering training and development opportunities. These include:
  - Implementing a mandatory number of hours devoted to upgrading digital skills;
  - Conducting organization wide digital skills gap analyses;
  - Increasing the amount of funding devoted to training and development activities; and
  - Providing more training, mentoring, peer-to-peer and on-the-job learning opportunities.

☐ 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 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 workforce. This can be achieved by scaling existing wage subsidy programs to reach a greater number of SMEs.

☐ Educators should incorporate mandatory for-credit experiential learning in all secondary and post-secondary educational programs. This could include offering co-ops, internships, apprenticeships, or applied in-class industry projects.

Strengthening digital skills of professionals and youth:

☐ 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 and industry should offer incentives (financial or otherwise) to professionals of all backgrounds to partake in training to enhance their digital skills. This will assist in creating an atmosphere of continuous learning and promote digital upskilling in the workforce.

☐ 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.

☐ Educators should provide more information about career paths and occupational roles that require computer science, information technology, and more broadly STEAM learning.

Fostering digital entrepreneurial talent:

☐ Post-secondary academics should focus students' research assignments on projects that have the potential for commercialization. This will help students build the innovation and commercialization skills they need to be successful entrepreneurs.

☐ Post-secondary educators (academics and administration) should incorporate mandatory material or courses that develop students' interpersonal and business skills. Materials could be developed in conjunction with industry.

☐ Education, industry and government should strategically enhance their work together to build education programs that better align with industry needs and improve student entrepreneurial and employment outcomes.
These recommendations will ensure Canada’s talent will be well prepared to succeed as skilled workers and entrepreneurs in our increasingly digital and global economy.
1. INTRODUCTION AND PURPOSE

The widespread use of digital technologies in all spheres — from manufacturing, education, health, financial services, to cultural and creative industries — combined with the emergence of hyper-connected technologies is rapidly changing the business paradigm in Canada. At the root of success in this new paradigm is innovation, a factor that is predominantly defined by skills and technological adaptability. The economy is being reinvented as a digital ecosystem that is highly reliant on skills, warranting individuals to possess a wide variety of new competencies to remain productive in this continually changing environment.

An organization’s ability to innovate, compete, and respond to evolving market and consumer needs is increasingly determined by its technological capabilities. Advanced technologies have been shown to heighten the value chain of any industry, from the way organizations manage their finances, to efficient management of supply chain logistics, to how they deal with their staff and clients. In short, the adoption of digital technologies enables businesses to become more productive and competitive, offer new products and services, and increase their scope and scale. To that end, promoting the adoption and use of digital technologies by Canadian businesses is paramount.

Another important aspect of innovation and productivity is the role entrepreneurship plays. In a growing economy, entrepreneurs play a critical role for innovation and productivity. Entrepreneurs spur technological innovations that drive growth. Ensuring that entrepreneurs, who both use technology as parts of their solution and create new digital innovations, have the right skills is important. As hyper-connected technologies rapidly expand, entrepreneurs must have the skills to innovatively use these technologies and to create new markets and opportunities. Economic access to digital technologies and having an adequate number of entrepreneurs, however, are not enough in and of themselves to fuel productivity and innovation, unless they are complemented by a workforce and leadership with the required skills to leverage these technologies and drive growth.

Given this new reality, the demand for digital skills has never been greater in Canada. The Canadian workforce needs to be continually in-step with technological advancements, be business savvy, and well-honed in workplace skills. To enable that, defining required skills and implementing policies and programs to overcome related challenges are both critical, as a clear understanding of the skills required in the digital economy would help frame a coherent approach for building skills for the new economy. It would also help design the appropriate policy responses to ensure that Canadian businesses are leveraging the full potential of advanced technologies.

Against this background, the purpose of current research is to understand new and emerging skills required in the digital economy, nature and scope of the skills gaps, various causes of skills gaps, the impact on Canadian businesses, and how they respond. Hence, this report:

- Provides a brief overview of the digital economy; how and why technologies are transcending all sectors.
- Defines the new and emerging skills shaping the new economy and outlines the skills necessary to succeed in today’s digital economy.
- Explores the “skills gap” concept in the Canadian context.
- Highlights the strategies to address skill-related trends and challenges.
- Provides case studies to showcase how companies address different aspects of the ever-changing skills landscape of the Canadian labour market.
- Summarizes the policy responses to overcome skill-related challenges that will help Canadians compete and operate in the digital economy.
2. RESEARCH METHODOLOGY AND ANALYTICAL FRAMEWORK

To sufficiently address the key research questions, ICTC’s team used proven quantitative and qualitative research methods, including collection of primary and secondary data, reviewing existing literature and environmental scanning of the skills gap issue globally and nationally. Hence the analytical framework for this study relied on following approaches:

- **Primary survey data:**
  - Digital Talent Strategy 2020 Participant Survey: This survey was particularly developed for Digital Talent Road to 2020 and Beyond: A National Strategy to Develop Canada’s Talent in a Global Digital Economy, which was recently released by ICTC (March 2016). The survey was responded by a total of 263 participants from all sectors of economy, educational bodies, as well as by individual ICT professionals (115 industry members from all sectors, 54 education specialists, and 94 ICT/digital professionals, see Appendix B1).
  - Labour Market Outlook 2014 Survey: This survey was developed for ICTC’s Labour Market Outlook 2015—2019 for the ICT sector (ICTC, 2015a). The survey was responded by 1003 organizations in Canada (n=52 ICT producing and n=951 non-ICT organizations were used, see Appendix B2).
  - Labour Market Outlook 2016 Survey: This survey is currently being conducted for ICTC’s next Labour Market Outlook report for the ICT sector. Current sample size is 81 ICT and non-ICT organizations (See Appendix B3).

- **Key informant interviews and case studies:** ICTC’s research team has conducted four key interviews and developed two case studies based on the interviews. Companies included PSI Engineering employing 30 in Canada; Imperial Manufacturing Group employing more than 900 in North America, CARQUEST employing 75,000 across North America and 1500 in Canada; finally Mevotech LP employing 500 in Canada (see Appendix A1 for interview guide and A2 for two case studies).

- **Review of the existing literature and data:** ICTC research team has focused on the nature of the new economy, emerging skills and skills gap issues. The review involved the searching of literature produced by international organizations, academic researchers, industry organizations, government initiatives, as well as news agencies such as Economist, Computer World and Entrepreneur.

3. **THE DIGITAL ECONOMY AND NEW TECHNOLOGIES**

The digital economy

The new economy is knowledge-based and relies predominantly on intellectual capabilities, reducing reliance on natural resources and physical inputs. In this ecosystem, knowledge, skills, and expertise are as critical as any other economic resources to succeed in an increasingly interconnected, globalized economy. At the root of this transformation is technological innovation — modifying business models across all economic sectors through virtualization of operating systems, servers, storage devices, and network resources — as well as digitalization of key business processes such as marketing, commerce, production, customer service, communication, and more. These technological transformations give the new paradigm yet another name: the digital economy.

Technologies transcending sectors

Technological innovations, especially digital technologies such as social media, mobile, analytics, apps, and cloud (SMAAC) have become drivers of economic productivity and growth in most spheres of public and private life. All economic sectors are rapidly transforming and integrating technologies in an effort to increase productivity and efficiency, reduce costs, generate revenues, and improve collaboration and innovation. At the enterprise level, the impact of technological adoption is not confined to the IT department, but throughout the organization in every aspect of business processes. For example, the enormous advances in digital innovations such as SMAAC under the larger umbrella of the Internet of Things (IoT), have become the key drivers of productivity, competitiveness, and growth, reshaping every facet of the Canadian economy from manufacturing, education, health, financial services, to cultural and creative industries.

Furthermore, entrepreneurs have been leading way in developing digital innovations for all areas of the economy. Canadian entrepreneurship is in general healthy: the birth rate of new firms is higher than death rates and survival rates at both the one-year and the five-year point are above 50% (Innovation, Science and Economic Development Canada, 2010). According to Centre for Innovation Studies in Calgary, Canada is ranked second after the US among G7 countries when it comes to entrepreneurship (GEM Canada National Report, 2014). Although there are concerns about the innovation and productivity impact of entrepreneurship in Canada (due to lower levels of corporate or employee ‘intrapreneurship’), new businesses emerge in every sector of the Canadian economy and they adopt digital technologies to differing extends for productivity and profits.

ICT Investments and digital adoption

Despite these developments, ICT investment and digital adoption amongst Canadian businesses has been varied. Investment in ICT in Canada is lower compared to other countries, such as the U.S: Canada’s ICT investment as a percentage of 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 (The Conference Board of Canada, 2013b). Similarly, it is frequently stated that digital adoption among SMEs in Canada should be improved and barriers should be addressed (e.g., The Conference Board of Canada, 2014c). To this end, Government of Canada started and evaluated a digital technology adoption program (NRC, 2013).

Most sectors in Canada, such as ICT, government, finance, healthcare, manufacturing, professional services and others have already embraced digital technologies. Amongst companies that have (self-reported) adopted digital technologies, application software is the most commonly adopted technology/platform (80%) followed by cloud-based services (74%), mobile technologies and data analytics tools (70%), social media (62%), and Customer Relationship Management (CRM) tools (60%, ICTC, 2016).

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SKILLS IN THE DIGITAL ECONOMY
WHERE CANADA STANDS AND THE WAY FORWARD

see Figure 1). Digital technologies such as e-learning tools, enterprises resource planning (ERP), e-commerce applications, and desktop virtualization are gradually becoming more commonplace amongst these digital adopters.

FIGURE 1. TYPES OF TECHNOLOGY PLATFORMS UTILIZED BY CANADIAN DIGITAL ADOPTERS

<table>
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<tr>
<th>Technology Platform</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Application software</td>
<td>80%</td>
</tr>
<tr>
<td>Cloud computing</td>
<td>74%</td>
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<tr>
<td>Mobile technology</td>
<td>70%</td>
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<tr>
<td>Data analytics tools</td>
<td>70%</td>
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<tr>
<td>Social networking/collaboration tools</td>
<td>62%</td>
</tr>
<tr>
<td>Customer Relationship Management (CRM)</td>
<td>60%</td>
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<tr>
<td>E-learning tools</td>
<td>44%</td>
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<tr>
<td>Automation services</td>
<td>40%</td>
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<tr>
<td>E-commerce applications</td>
<td>40%</td>
</tr>
<tr>
<td>Enterprise Resources Planning (ERP) software</td>
<td>34%</td>
</tr>
<tr>
<td>Desktop virtualization</td>
<td>34%</td>
</tr>
<tr>
<td>Learning management systems</td>
<td>19%</td>
</tr>
<tr>
<td>Other</td>
<td>9%</td>
</tr>
<tr>
<td>Enterprise Risk Management (ERM) system</td>
<td>8%</td>
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Benefits of digital adoption

Digital technologies are changing the way companies do business, resulting in quick and easily accessible data and communications, information consistency, responsive case management and seamless information exchanges. In ICTC’s in-depth consultation with Canadian businesses and adopters of technology, four out of five (81%) of respondents reported that digital technologies improved business productivity, enabled employees to work smarter and utilized time more efficiently; 66% reported decreased production costs; and 40% reported increased market share among other competitors (i.e., increased sales and/or profits, see Figure 2). 48% of participants reported, digital adoption also helps with boosting innovation processes in the organizations. 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 (ICTC, March 2016).

Furthermore, the benefits of digital adoption extend to the Canadian economy and job growth. 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 (The Boston Consulting Group, 2013). Some of the other benefits of adopting digital technologies – as confirmed by businesses that already adopted – include increased innovation, improved employee engagement, increased sales and profits, and increased attractiveness of the company to potential recruits. Additionally, adopting digital technology can generate additional jobs in non-ICT roles through cost savings and business gains. 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.


See studies and publications of ICTC here: http://www.ictc-ctic.ca/studies-publications/
FIGURE 2. TECHNOLOGY ADOPTION BENEFITS AMONG CANADIAN DIGITAL ADOPTERS

Challenges of digital adoption

Even though the case and benefits for adopting and creating new digital innovations are strong, there are several obstacles that prevent this from seamlessly occurring. Financial realities can make investing in digital technologies a challenge for businesses, especially small- and medium-sized enterprises (SMEs). Similarly, insufficient financial capital can hamper entrepreneurs’ ability to create and commercialize digital innovations.

Even when equipped with sufficient financial capital (for both adopters and entrepreneurs), skills play a crucial role in effectively leveraging digital technologies. Research indicates that investing more in technology may be insufficient, unless there are strong “key business enablers” such as access to technology-focused and management-focused talent (INSEAD, 2013). Making significant technology investments without key business enablers poses the risk of stalling performance. There is in fact evidence from UK that companies with ICT skills shortages experience negative performance and thus their ICT adoption or intensive utilization of ICTs are inhibited (Forth & Mason, 2006). As the global economy becomes increasingly competitive and the digital divide (access to digital technologies) shrinks, the digital skills of employees and entrepreneurs alike may become the deciding factor of success in the new intelligence/knowledge economy.

Skills the new currency

To benefit optimally from the adoption of digital technologies and to increase business scope and scale nationally and internationally, organizations need employees with the right blend of skills. As business skills enhance application of technical skills, the right combination of business, soft and technical skills contributes to successful performance in workplace and as an entrepreneur. One of ICTC’s most recent studies shows a sharp increase in the demand for business skills, including critical thinking, interpersonal communication, self-management, and the ability to learn fast (ICTC, 2015a). On the other hand, the prevalence of digital technologies impacts all sectors and stakeholder groups, and having access to digitally skilled talent is critical to leverage these technologies for growth. In that context, it is crucial to understand all type of skills as a first step to building skills for the new economy.

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4. THE EMPLOYEES OF THE DIGITAL AGE

Digital technologies have transformed every aspect of business processes, for instance using e-commerce to reach off-shore clients, analyzing large business data for product diversification, using social media for wider outreach, and using cloud-based programs such as Enterprise Resource Planning (ERP) and Human Resources Management (HRM) for productivity and efficiency. A big challenge in using these technologies is to ensure that employees across the organization understand the technical terminology and work efficiently in digital environments. Similarly, the mirroring challenge is that technical teams are well-aware of the business processes for which digital technologies operate.

Increasing need for digital and complementary skills

Most businesses in digital economy adopt digital technologies for productivity and innovation. In order to leverage these technologies, SMEs need digitally skilled employees for increasing productivity, sales, offering better services and generating revenue. In the case of large organizations such as those in advanced manufacturing, innovation is an important agenda and digital adoption/automation is often an inevitable business solution for the survival of the organizations in a competitive environment. As digital technologies transform the nature of work across organizations and sectors, every individual needs to be comfortable with both digital technologies and business operations (Capgemini Consulting, 2013). This is the only way business goals and strategies can be complemented and facilitated by emerging technologies in an increasingly connected global digital economy. Hence digital skills and other complementary skills are essential in the new economic paradigm, and these skills are increasingly required in most sectors of the economy due to rapid digital transformations.

Why is complementing digital skills with other business skills so important? Or is it possible for organizations in digital economy remain competitive without the business skills? The answer to these questions lies in the nature of productivity and innovation as a result of business perspective. Digital technologies increase productivity and boost innovation, however, none of these are possible without an understanding of the business processes. Let’s take the example of a Data Scientist. He/she can analyze data and code specific programs. If, he/she does not have a deep understanding of the goals and strategy of their employer – he/she lacks business skills, in other words – he/she will not be able to make the data talk to generate better business intelligence. Other examples can be given for professionals who only use generic digital technologies to enable their activities and tasks in customer services, administration, sales, services and others. For example, as explained in our Case Study with PSI Engineering, when engineers design/build a system, the system requirements need to be effectively communicated from the production department to service and support department line including the accounting department. Each of these departments should be able to connect well with other departments in explaining their business requirement; and different skills sets (engineering, software, production, accounting) should be able to talk the same ‘language’ (See Case Study 1: PSI Engineering in Appendix A2). The ideal employee of the digital age is someone with digital skills, who creates business knowledge or successfully operates in the business environment with the right tools and makes it functional for the business purposes.

The pervasive impact of technology in all sectors of the economy is changing the nature of work in all fronts. Labour-intensive production processes are giving way to technology-driven mechanisms and even creating virtual workers, working from home and telecommuting. In this case, both digital skills to navigate in the virtual environment are required; as well as soft skills for the challenges of virtual work (Dorr, & Kelly 2011). Those skills include building trust and effectively communicating with other virtual team members, decision making, relationship building, coping with isolation and others (e.g., Meyer, August 19, 2010).

General trends on skills demand

What do employers say about the skill requirements in their organizations? Data collected by the Conference Board of Canada (2013a) in Ontario indicate that skills gaps are reported by the major sectors of the economy such as manufacturing, health care, professional, scientific and technical services and financial industries. Results also indicate that there are skills gaps among

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the most critical foundational and digital skills such as numeracy, continuous learning, computer use (e.g., using information and communication technologies), working with others, literacy skills (e.g., reading, writing, document use), oral communication skills, critical thinking and problem-solving skills (The Conference Board of Canada, 2013a). For example, close to 30% of organizations report skills gap for computer use and other employers report that new graduates with technical skills lack important employability skills or essential skills, resulting “a lop-sided skill set” (p. 27, see also The Conference Board of Canada, 2014a for similar findings in British Columbia).

Research conducted by global organizations shows that the demand for digitally intensive middle-skill jobs – defined as jobs requiring more than secondary school but less than a bachelor’s degree is increasing, indicating a demand trend towards higher skills among the middle-skills jobs. In general, middle skills jobs still compose close to half of all jobs (48% in the US) in advanced economies. Examples include jobs that require any digital technology skills, high-skill manufacturing jobs, nursing, sales, administrative and other jobs that require postsecondary technical education and training (Kochan, Finegold, & Osterman 2012). Close to 80% of these middle-skill jobs require, for example, spreadsheet and word-processing proficiencies among other digital skills; and these new middle-skill jobs are growing 2.5 times faster than traditional middle-skill jobs (20% that don’t require digital skills) and are paying 18% more (Burning Glass Technologies, 2015). Although acquiring core digital and technical skills should not be too difficult for most college and university graduates, it may be significantly difficult for high school graduates and university graduates from non-STEM departments and for older workers. In the Canadian context, middle skills jobs compose 55% of all occupations and the need for higher skills jobs has been significantly increasing, and most of the traditional medium skilled jobs increasingly require digital skills (TD Economics, February 26, 2013).

Understanding the risks of digital skills gaps in Canada, ICTC has recently published A National Strategy to Develop Canada’s Talent in a Global Digital Economy (ICTC, March 9, 2016). The strategy highlights the importance of digital skills in every aspect of 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 fueling 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 (WDM-Consultants, 2011). Furthermore, new technologies such as automation and artificial intelligence will make work more complex (The Economist Intelligence Unit, 2015). 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” (ICTC, March 2016, p. 45-46).

ICTC’s Digital Talent Strategy 2020 participant survey indicates that essential digital skills are as important as technical/hard skills, creativity/innovation skills and leadership/management skills. The data also indicates that interpersonal/soft/social skills and business/entrepreneurial skills are most valued and they are considered as “must haves” to succeed in today’s workplaces (see Figure 3).

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ICTC’s Digital Talent Strategy 2020 also highlighted importance of digital entrepreneurship skills and applying innovative technologies in competitive economy. Successful entrepreneurs have a unique mix of technical, business, interpersonal and creativity skills. In other words, professionals with strong digital entrepreneurial skills are dual thinkers and they combine their business and technical skills with a strong motivation to access digital business opportunities (e.g., e-commerce, data analytics, mobile, cloud, using digital platforms, adopting other critical digital solutions etc., European School net & DIGITAL EUROPE, 2014).

According to The Conference Board of Canada (2013c) being entrepreneurial is part of general innovation skills. Innovation skills have four pillars and these are generating ideas, taking calculated risks and being entrepreneurial, developing and maintaining interpersonal relationships, turning ideas into products, processes, and services. Although Canada is known by its strong entrepreneurial culture, there are difficulties in translating 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, especially validating the specific skills-related barriers in Canada to turn ideas into products, processes and services (World Economic Forum, 2016).

Slightly different from the data presented in Figure 3, ICTC has recently collected information on ‘must have’ skills including communication and information processing skills (not ranking but selecting if applies). Results indicate that about three quarter of (ICT or non-ICT) organizations need essential digital skills and information processing skills (see Figure 4). Because of the need for a limited number of entrepreneurial employees, business/entrepreneurial skills were selected as ‘must have’ by only 40% of the organizations.
SKILLS IN THE DIGITAL ECONOMY
WHERE CANADA STANDS AND THE WAY FORWARD

What are the digital skills frameworks?

To understand the full range of skills and competencies at all workplaces, it is important to understand the broad branches of the skills spectrum. The skills in the today's economy can be categorized to three functional levels, which are foundational-business-interpersonal, technical and entrepreneurial skills. First, as a basic requirement, all individuals must have the foundational skills such as basic literacy and numeracy to operate in any work environment. In the present environment, however, that is not enough. The foundational skills have to be complemented by strong business and interpersonal skills. Second, contemporary technical skills are critical for any production process or service delivery. Finally, technical skills are complemented with the leadership level skills (C-suite level, entrepreneurial) that are specifically adapted for the digital economy and management of digital technologies.

Following sections will review digital skills frameworks or categories outlined by OECD and a private training organization, as well as a framework produced for Canadian workplace.

OECD: New skills for the digital economy

Recently, OECD published evidence on the impact of increasing ICT usage at work on the demand for new skills (OECD, 2015). According to OECD, the new skills in the digital economy can be grouped in three main categories: First is the ICT specialist skills that produce and manage ICT products and services such as software programs, applications and ICT networks. The second category is generic ICT skills that enable professionals successfully use digital technologies (ICTs) such as accessing information, using software programs, using communication tools and others (i.e., digitally savvy non-ICT workers). The third category of skills is ICT complementary skills including cognitive skills such as numeracy, reading and writing, as well as ability to perform certain tasks at work such as cooperation, interaction with co-workers and clients, problem solving, managing one’s own and others’ activities.
For an agile workforce that enables digital technologies and remains productive, it is particularly important to understand how generic ICT skills and ICT complementary skills help problem solving together. Programme for the International Assessment of Adult Competencies’ (PIAAC) concept of problem solving in technology-rich environments offers an insight. Problem solving is defined as “using digital technology, communication tools and networks to acquire and evaluate information, communicate with others and perform practical tasks” (OECD, 2012). Hence problem solving in technology-rich environments contains a technology dimension such as effectively using a web browser, spreadsheet programs or e-mail processors (generic ICT skills), as well as a cognitive dimension of setting goals, monitoring progress, planning, acquiring, evaluating and using information (ICT complementary skills).

An industry-stakeholder group perspective

In recent times, the concept of Digital Skills has made an inevitable entry into the skills spectrum. As the issue of digital skills gap attracted attention in many countries, online training programs have been developed to prepare a digitally-literate workforce and digitally-confident businesses. For instance, DigitalSkillsGap identifies eight core Digital Skills, with some combining hard and soft skills such as attention management and communication. Born out of digital economy’s skills requirements, these skills validate the importance of the unity of generic ICT skills and ICT complementary skills:

- Working with documents
- Digital etiquette
- Project collaboration and management
- Search and research
- Attention management
- Platform flexibility
- Communication
- Security & privacy

Recent categorization in Canada

Digital skills listed above offer an industry-validated and detailed view of digital skills categories. In another categorization adopted in Canada, the broad umbrella of digital skills encompasses other skills categories, including foundational, transversal skills, as well as digital information processing skills. This framework was submitted to Employment and Social Development Canada (ESDC) by WDM-Consultants in 2011. ESDC’s own Essential Skills Profile contains digital technology skills dimension, which taps onto generic ICT skills category of OECD:

“Digital technology refers to the skills needed to understand and use digital systems, tools and applications, and to process digital information. At work, people use digital technology skills to input, access, analyze, organize, create and communicate information and ideas using computers, software, point-of-sale equipment, email, podcasts, web applications, smart phones and other digital devices” (ESDC, 2015).

The former report (WDM-Consultants, 2011) defines essential digital skills in the Canadian workplace in following categories.

- **Foundational skills**: These fundamental skills include basic literacy, writing, document use and numeracy, without which only low skilled jobs can be successfully done. Professionals require a minimum proficiency level in these skills before engaging with digital technologies. Higher level digital technical skills and digital information processing skills first require these foundational skills.

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30 See www.digitalskillsgap.com
• **Transversal Skills**: These skills include mostly transferable and soft skills such as teamwork, continuous learning, problem solving and relationship development. Without these soft skills, digital technical knowledge cannot actualize its full potential.

• **Digital Technical Skills**: These skills are about computer and software usage, applying security measures and others. These skills are critical to function well in today’s workplaces enabled by digital technologies. These skills are about the medium of the digital technology rather than the content of digital information.

• **Digital Information Processing Skills**: These are high level cognitive skills with respect to information processing, for instance activities such as searching and synthesizing information; assessing, applying, creating and communicating information. Professionals of today’s information-age work with immense amount of data and information on a daily basis, and critical skills that are cognitively used range from accessing to creating digital information.

Although above mentioned skills are comprehensive, it is important to include business and entrepreneurship skills into this framework. Entrepreneurship in digital economies has been gaining a new meaning as digital technologies have been rapidly transforming economies and communities.

**Digital Entrepreneurial Skills**: Over and above the digital skills, entrepreneurial skills combined with leadership skills are required in the new economy, especially in management positions (European Commission, 2012). Entrepreneurs in the digital economy can fall into two categories: first, those who leverage existing digital technologies as an integral part of their products and services, and second those who invent new digital innovations. Digitally savvy professionals with strong entrepreneurial skills understand the cutting edge digital technologies such as e-commerce, data analytics, mobile, cloud, and social media and successfully adopt them. Entrepreneurs who create new digital technologies take the latest R&D technological innovations and package them into products or services that are sold on the market. Both kinds of these entrepreneurs need to manage multidisciplinary teams and effectively communicate with other businesses and professionals. Entrepreneurs possess critical skills such as spotting new trends, creativity, long-term strategic thinking, risk-taking and risk-assessment, ability to evaluate different scenarios, networking, finding the right digital talent for the right positions, resilience, and focus (Aileron, November 26, 2013).

They also possess excellent interpersonal and business skills to maximize market opportunities. Similarly, they have strong commercialization skills such as capital-raising, sales and marketing, and ability to implement new products into the marketplace (The Conference Board of Canada, 2013a).

**ICTC’s framework**

A synthesis of the variety of skills listed above – including digital, technical, and interpersonal skills, as well as comprehensive frameworks addressing core digital skills or skills in the new economy – supports creating a skills spectrum critical for employers in the digital economy (see Figure 5). While low-skilled jobs require mainly foundational skills and basic business and interpersonal skills, medium and high skilled jobs increasingly require digital and technical skills as well as informational skills, with high level proficiencies in business and interpersonal skills.

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Foundational Skills

- Foundational skills
  - Basic Numeracy
  - Basic Literacy (reading and writing)
  - Document use

Business and Interpersonal skills

- Communication skills:
  - Active listening and clear verbal communication
  - Effective writing

- Interpersonal / social skills:
  - Relationship building and ability to relate to others
  - Mitigating conflicts
  - Inspiring and developing others

Creativity / innovation skills:

- Elaborating, identifying problems and potential solutions, refining, analyzing and evaluating one’s own ideas
- Being open to new perspectives, seeking different points of view
- Ability to develop original/worthwhile ideas using brainstorming and other techniques
- Experimenting ideas, assessing and taking risks, tolerating ambiguity and keeping focus for the goals

Sales / marketing skills:

- Dedication to customer service and effective relationships building
- Knowledge of market
- Effective listening and writing, storytelling and trust building
- Understanding digital or social media marketing
- Ability to understand business analytics and customer segmentation reports
SKILLS IN THE DIGITAL ECONOMY
WHERE CANADA STANDS AND THE WAY FORWARD

- Business perspective:
  - Understanding business goals and strategy
  - Integrating business goals in everyday activities

- Management skills:
  - Inspiring and motivating others
  - Demonstrating professional integrity and honesty
  - Analyzing problems and solving issues
  - Driving the team for results, developing others
  - Communicating, collaborating and promoting teamwork
  - Displaying technical and professional expertise as well as a strategic perspective

- Continuous learning:
  - Gathering information and identifying one’s learning and developmental needs
  - Continually acquiring new knowledge to improve job performance
  - Strategically planning and undertaking new content and learning activities targeted to specific developmental needs

  Digital and Technical skills

- Computer/ ICT literacy:
  - Computer and technical skills including basic interaction with computers
  - Configuring computer and software options
  - Troubleshooting, problem solving
  - Setting up a Wi-Fi network, solving network problems, connecting devices and sharing files, printing documents and other traditional computer skills

- Using office productivity software:
  - Successful interaction with key office programs (e.g., using the e-mail processor)
  - Using features of key software interface (e.g., writing and formatting a Word document or entering data to Excel)
  - Configuring software options or using advanced features for more complex operations (e.g., using formulas in Excel, formatting or editing for visual effects)
  - Other productivity skills including basic photo and video editing, converting file formats, blogging, online banking and others

- Using SMAAC technologies:
  - Understanding Social media, Mobile technologies, Apps, basic Analytics and Cloud technologies or Internet-based systems
  - Using social media platforms for outreach
  - Using mobile devices, apps and cloud systems for productivity

- Using sector or enterprise-specific programs:

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Using sector or enterprise-specific programs (e.g., HRM, CRM and/or business specific apps)
Using specific programs across different platforms (desktop applications, internet-based or mobile apps)

- Digital communication and project collaboration:
  - Working with multiple team members working remotely and using digital interfaces
  - Managing projects online, understanding digital collaboration opportunities
  - Effectively exercising traditional business competencies using digital tools (e.g., working on the same cloud document, interacting through web communication platforms)

- Working with IIoT technologies (Industrial Internet of Things):
  - Working with automated manufacturing technologies
  - Ability to work with smart sensors, remote monitoring systems and digital interfaces

Informational skills

- Digital information processing skills:
  - High level digital literacy and information-processing skills
  - Defining information needs, accessing, assessing, organizing, integrating, applying, creating and communicating information
  - Search and research capability, effectively using research tools

- Data literacy and intermediate data analytics:
  - Understanding structure of data and data presentations
  - Transforming data and preparing for analysis
  - Conducting basic data analytics (e.g., descriptive statistics)

- Information security and privacy (cybersecurity):
  - Ensuring cybersecurity while effectively using pervasive digital systems
  - Password protection and understanding cloud system security

Attention management:

- Managing information load from multiple devices
- Identifying priorities
- Managing time required to process information

Entrepreneurial Skills

- Digital Entrepreneurship
  - Excellent business knowledge of SMAAC technologies (Social, Mobile, Apps, Analytics Cloud)
  - Ability of spotting new trends quickly
  - Investment skills
  - Sales, marketing, and business development
  - Bring new products and services to market

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Digital skills are important for the prosperity of every economy to compete in a globally hyper-connected world. Digital skills, entrepreneurial skills and other complementary skills are the foundations of any economic productivity and there is an increasing need for digitally skilled workforce for technological adoption and innovation. Although it is known what skills are critical for the digital economy, there is evidence that Canadian workforce lacks the digital skills required for a productive economy.

- Networking and finding the right digital talent for the right positions
- Leadership and ability to manage multidisciplinary teams
5. SKILLS GAP: THE REALITY, THE COST AND THE CAUSES

Canada's global standing and national studies on skills gap

Canada has one of the most educated and skilled workforces among members of the OECD, supporting the innovation and adoption of new technologies. As such, if skills gap really exists in Canada seems a superfluous question on face value, and consequently, whether skills gap is a global reality – or is a very Canadian reality – has not been explored in too much depth. A few relevant studies shed some light on the topic. The Global Talent Index Report by the Economist Intelligence Unit finds that 28% of employers worldwide are either neutral or pessimistic about the ability to attract and retain workers with the appropriate blend of skills (Economist Intelligence Unit, 2015a).40 A third (32%) of the hiring employers are either neutral or dissatisfied with the skills offered by their new hires in specialized positions. One of the most frequently cited (43%) reasons for dissatisfaction with the skills of new hires is the limited pool from which they had to be selected (see Figure 6). Other prominent reasons for this dissatisfaction include lack of internal processes or programs to integrate new hires (25%), quality of education (18%), and government policies hindering immigration and/or free movement of labour (12%).

FIGURE 6. REASONS FOR DISSATISFACTION WITH THE QUALITY OF NEW HIRES AMONG GLOBAL FIRMS

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is a limited pool of experienced managers and/or specialised workers in this country</td>
<td>43%</td>
</tr>
<tr>
<td>Our pay/benefits package is not good enough to attract sufficiently strong candidates</td>
<td>38%</td>
</tr>
<tr>
<td>Our brand is not good enough to attract sufficiently strong candidates</td>
<td>35%</td>
</tr>
<tr>
<td>Quality of tertiary and/or management education in this country is generally low</td>
<td>31%</td>
</tr>
<tr>
<td>Our company has a limited process or programme for integrating new hires</td>
<td>25%</td>
</tr>
<tr>
<td>Quality of primary and secondary education in this country is generally low</td>
<td>18%</td>
</tr>
<tr>
<td>Government policy regarding immigration and/or free movement of labor hinders the ability of good candidates to meet demand</td>
<td>12%</td>
</tr>
<tr>
<td>Other</td>
<td>12%</td>
</tr>
</tbody>
</table>

Source: The Global Talent Index Report, Economist Intelligence Unit, 2015

In the Global Talent Index of the Economist Intelligence Unit (2015a), with respect to firms’ ability to attract and retain skilled talent, Canada was ranked 8th in 2015, climbing notably from 14th in 2011, largely perceived to be a result of the strong macroeconomic conditions in the interim. Now that the Canadian economy has slowed down considerably as a result of the declining oil prices, it would be interesting to see the changes in Canada’s standing in the next iteration of this ranking. These findings are evidence that skills gap is a global phenomenon impacting every continent, also backed up by the findings of other relevant studies. The Manpower Group, in their 2015 Talent Shortage Survey, finds that 38% of global employers face difficulties filling vacancies in their organizations (Manpower Group, 2015, see Figure 7).41 Canada is reported to be below the average with 32%. Worldwide, some of the roles that are particularly difficult to fill are skilled trade workers, sales representatives, engineers, and skilled technicians. Among the top difficulties in filling vacancies, lack of available applicants (35%), lack of technical competencies (34%), lack of experience (22%), and lack of workplace competencies (17%) feature prominently. What’s worse is the apparent lack of any concerted efforts to address the skills shortages, as over 20% of global employers report not having any strategy in place (Manpower Group, 2015).

SKILLS IN THE DIGITAL ECONOMY
WHERE CANADA STANDS AND THE WAY FORWARD

FIGURE 7. COMPARISON OF COUNTRIES ON DIFFICULTY IN FILLING JOBS DUE TO SKILLS AND TALENT MISMATCH

Data collected by ICTC in 2014 confirms the 32% figure reported above: When asked “How often do you have difficulty in filling ___________________ positions due to skills mismatch?”, 34% of Canadian employers reported some difficulty in hiring in ICTC’s survey (See Figure 8).

FIGURE 8. DIFFICULTY IN HIRING FOR ICT POSITIONS IN CANADA DUE TO SKILLS MISMATCH

In a recent survey conducted by the Canadian Council of Chief Executives, three-quarter (73%) of the respondents convey shortage of skilled workers to be a moderate to significant problem in their respective industry. Some of the sectors where this
shortage is felt more acutely include energy, utilities, mining, construction, manufacturing, retail and food services, and insurance (Canadian Council of Chief Executives, 2014). The survey also finds that Engineering, IT, general business, and skilled trades are the occupations in which finding skilled talent is currently difficult and expected to get increasingly more so over the next five to ten years. More than 70% of the executives acknowledge that the shortage of skilled workers in these occupations is the primary barrier, while 60% of the respondents predict skills shortages to have medium to high impact on major projects and investments in Canada.

Hays Global Skills Index (2015a) measures the labour market pressure on national and international markets based on equally weighted seven criteria: Education flexibility, labour market participation, labour market flexibility, talent mismatch, overall wage pressure, wage pressure in high-skill industries and wage pressure in high-skill occupations. Each country obtains an average value from 0 to 10. An average scores above 5.0 indicates a relatively ‘tighter’ labour market, and a score below 5.0 indicates a relatively ‘looser’ labour market (Hays, 28 September 2015). Canada’s overall score in this index is 5.7 (Hays Global Skills Index 2015b), indicating a slight overall pressure on the labour market. However, it is important to note that the highest pressure on Canadian labour market comes from talent mismatch with a score of 6.6, while labour market flexibility relieves the pressure (3.9, see Figure 9).

Comparison of Canada with Australia, Germany, the UK and the US indicates that Canada is doing better than the last three countries, but Australia experiences a relatively lower pressure on its labour market than Canada (See Figure 10). Interestingly, the differences between Canada, the UK and the US are very significant especially on talent mismatch scores (see Figure 11). The UK and the US experience maximum level of talent mismatch pressures with scores of 9.7 and 10.0, respectively. Germany’s talent mismatch issue seems to be relatively minimal (3.3), possibly due to quality of its workforce and strong apprenticeship programs.

46 “This indicator measures the gap between the skills that businesses are looking for and the skills available in the labour market. A higher score indicates that businesses are facing a serious problem in matching available candidates with unfilled jobs. A lower score suggests employers are having an easier time finding workers with the skills they need.” See Seven indicators make up the Hays Global Skills Index
47 “Governments play an important part in determining how well labour markets function. For instance, they can cut red tape, avoid laws that discourage hiring and adapt policies that welcome talented people from abroad. The lower the score, the better aligned governmental policies are with labour market dynamics. A higher score means there are more barriers restricting the local labour market.” See Seven indicators make up the Hays Global Skills Index
FIGURE 9. HAYS GLOBAL SKILLS INDEX, 2015 - CANADA’S SCORES ON LABOUR MARKET PRESSURE DIMENSIONS

HAYS GLOBAL SKILLS INDEX 2015 - Canada’s scores on seven dimensions of labour market pressure

Source: Hays Global Skills Index, 2015

FIGURE 10. HAYS GLOBAL SKILLS INDEX 2015 - COMPARISON OF AVERAGE SCORES: CANADA WITH AUSTRALIA, GERMANY, UK AND THE US

HAYS GLOBAL SKILLS INDEX 2015 - Comparison of average score of Canada with Australia, Germany, UK and the US

Source: Hays Global Skills Index, 2015
OECD findings

Over 2011-2014 among OECD countries, the demand for ICT specialist skills increased by 3.7%. Similarly, the demand for ICT generic skills has also increased by 3.1%. With respect to importance of ICT complementary skills, PIAAC surveys indicate that ICT intensity at work is positively correlated with work tasks and activities such as cooperation, horizontal and client interaction, self-direction, management, influence, problem solving and others. Another evidence on the criticality of ICT complementary skills is provided by The Occupational Information Network (O*NET) of the US Department which covers 1100 occupations since 1998. The results indicate that the importance of ICT complimentary skills increases in time as the importance of ICT use increases in time (as measured by “interacting with computers”, OECD, 2015). These skills include interacting with others, mental processes, conducting complex technical tasks, dealing with information input and even conducting physical and manual tasks.

OECD (2014) has recently reported that there is a lack of (generic) ICT skills in the economy. Globally, between 7% to 27% of adults have no fundamental ICT experience such as using a mouse. These adults are mostly composed of senior workers (55-65), people in semi-skilled occupations and people with less than upper secondary level of education. These groups have the highest risk of losing their jobs. Additionally, there is mismatch between strong ICT skills and skills usage at work. Although youth has the strongest ICT skills, the employment level among youth is not comparable to prime age and older adult groups, who tend to have weaker ICT skills.

The costly gap

According to International Data Corporation’s global research conducted in the US, the UK, France, Germany, Australia and Japan, information workers and IT professionals waste a significant amount of time due to challenges related to creating and managing documents, as well as collaborating around them and working on mobile devices (International Data Corporation, 2015).
2012). In fact, the predictions indicate that inadequate digital skills cause 21.3% loss in an organization’s total productivity. According to Grovo, a learning solutions company, the implication is that this digital skills gap costs the US economy an estimated $1.3 trillion USD.$51$52. The Conference Board of Canada estimates that skills shortages costs the Ontario economy (which produces the 36.6% of Canadian GDP) over $24 billion in lost GDP annually, with key economic sectors bearing the brunt (The Conference Board of Canada, 2013a). $53$ Similarly, it is estimated that skills deficit costs BC economy up to $4.7 billion in foregone GDP (The Conference Board of Canada, 2014a). $54$ The Conference Board of Canada’s estimate for Ontario implies a $65 billion loss in overall Canadian economy.

Causes of digital skills gap

Skills gap is a critical labour market challenge that needs to be addressed early and adequately for Canada’s future competitiveness. Canadian employers’ demand for the right blend of technical, interpersonal, and business skills which makes the demand-supply imbalance further challenging. From ICTC’s ongoing in-depth consultation with Canadian employers and organizations, as well as review of the pertinent literature, a clear picture emerges as to the main contributing factors for Canada’s existing and persisting skills gap. Among them are rapid technological advancements and adoption, inadequate industry-education alignment, Canada’s aging workforce, and others.

Technological innovations

Global economic growth and technological advancements have intensified the need for a highly-skilled workforce, with countries and companies competing for top talent. Today’s employers seek both entry-level graduates and experienced professionals who are capable of information processing as well as high-level cognitive and computational skills. The successive waves of technological change have made it increasingly difficult for new graduates to understand and identify the skills needed by industry.

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 (Cisco, 2011). As this rapid connectivity shapes up, the demand has intensified for a skilled workforce that offers a fusion of technology, business, computational, entrepreneurial, creative, and interpersonal skills.

FIGURE 12. DIFFICULTY IN FINDING REQUIRED SKILLS DUE TO TECHNOLOGY ADOPTION AMONG CANADIAN EMPLOYERS

<table>
<thead>
<tr>
<th>In what way has technology adoption impacted skills requirements in your organization? Would you say that because of digital technology adoption, required skills are...</th>
<th>0%</th>
<th>5%</th>
<th>10%</th>
<th>15%</th>
<th>20%</th>
<th>25%</th>
<th>30%</th>
<th>35%</th>
<th>40%</th>
<th>45%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Much easier to find</td>
<td>3%</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Somewhat easier to find</td>
<td>18%</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Same as before</td>
<td></td>
<td>28%</td>
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<tr>
<td>Somewhat harder to find</td>
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<td></td>
<td>10%</td>
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<td></td>
<td></td>
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<tr>
<td>Much harder to find</td>
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<td></td>
<td></td>
<td>41%</td>
<td></td>
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<td></td>
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</tbody>
</table>

51 Based on annual wage of 50K.

SKILLS IN THE DIGITAL ECONOMY
WHERE CANADA STANDS AND THE WAY FORWARD
Rapid technological advancements and adoption have made the required skills more difficult to find for half of the Canadian businesses, while the other half of the employers are having an easier time than previously (see Figure 12).

**Rapid adoption of new technologies**

New technologies are emerging and being adopted quicker than ever before, requiring fast upskilling of the workforce. However, it is argued that half-life of skills is only about 2.5 to 5 years due to rapid pace of technological changes in the workplace (Deloitte, 2014). In other words, technical skills professionals possess today will only be half marketable two years from now (Bloom, October 24, 2011).

The speed of technology adoption has to match upskilling of the employees so that businesses can benefit from the adoption optimally. For instance, deriving intelligence from big data and its analytics is predicated on employees of the company being well versed in it. Innovation cycle for new technologies has become shorter and new technologies have been constantly changing how businesses operate. This change is often too fast with which most educational institutions and employers find difficult to stay abreast. Once business and operational benefits of a new technology is understood by the organization, next challenge to address is to find skills needed to operate in the new technology-adopted environment. Digital literacy and digital skills that have become part and parcel of a modern day working professional are closely connected with these recently emerged technologies:

- **Digital platforms**: Digital platforms include social media (e.g. Twitter, Facebook, and LinkedIn), user generated dynamic platforms (e.g. YouTube), curated content sources (Pinterest, Instagram or SlideShare) and meeting applications (e.g. WebEx, GoToMeeting).

- **Mobile technologies**: Mobile technologies include mobile devices (e.g. phone and tablets, laptops etc.) network infrastructure (e.g. wireless technologies), and mobile applications and services (e.g. a mobile business process application).

- **Apps**: Apps compose an entirely new field of mobile technologies combined with advances in cloud services. Apps engage customers to products and services as well as enable workers with functional business process applications that improve productivity, save time and reduce costs.

- **Cloud-based technologies**: Cloud computing is one of the critical developments in digital technologies, which is shifting business operations from traditional IT infrastructure and software models to internet-based applications. Cloud is an enabling technology that supports enterprises by reducing capital IT expenditures and increasing scalability, access to data analytics, mobility and productivity.

- **Big data and analytics**: Digital economy creates immense amount of information every second, resulting in large datasets, or Big Data. With the advent of Internet of Things, speed of data accumulation increased tremendously. Businesses aim to derive intelligence from their big data resources, however analyzing data is inherently a complex activity that requires knowledgeable professionals specialized in this domain (ICTC, 2015b).

**Industry-education alignment issues**

Post-secondary education often provides foundational skills. As technological innovations drive the economy, fundamental technical skills become more and more important to remain productive in the digital economy. All Canadians need to have the

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basic STEM literacy. In reality, however, more than half of high schoolers drop science and math courses, while 70 per cent of Canada’s top jobs require an education in those fields (Let’s Talk Science & Amgen, 2013).69

On average, Canadian youth perform well in almost all areas (writing, math, sciences). 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 (Amgen & Let’s Talk Science, 2012).60 This extends to post-secondary education as well, but it does not necessarily mean that students are digitally literate. Research indicates that while young generations tend to be good at operational digital skills, their digital information processing or digital content-related skills need improvement (van Deursen, Van Dijk, & Peters, 2011).61 In addition, Elementary and secondary schools vary in their curriculum when it comes to teaching the digital skills such as problem solving, computational learning, locating, assessing and using digital information.

Employers consistently point the gap between the quality of graduates and what they look for in vacancies. Most graduates don’t gain industry-specific skills or company-specific-application skills during college or university years. For example Imperial Manufacturing Group points that one of the key challenges they experience is to find people with hybrid technical skills who understand all aspects of technical production process and people who can function with new technologies, including specific applications (See Case Study 2). This is only possible through experiential learning which becomes more and more important as new technologies are invented daily basis and customized for specific industries.

Lack of interpersonal and business skills

Although STEM skills are necessary in a world of rapid technological developments, they are not sufficient for business productivity and growth. Soft skills such as communication, creativity, and adaptability, as well as leadership and entrepreneurial skills are complementary in business processes. As stated previously, recent data collected for ICTC’s Digital Talent Strategy 2020 indicates that interpersonal/soft/social skills and business/entrepreneurial skills are most valued and they are considered as top “must haves” to succeed in today’s workplaces (see Figure 3 in previous section).

However, most of these skills are gained by experience and gaining experience is more and more difficult because of rising difficulties among youth in securing their first job. Canadian employers have identified gaps in the nature of skills graduates bring to the workforce and industry needs a blend of technical, entrepreneurial, creative, business, management, and interpersonal skills to help power an economy driven by science and technology. Internships and co-op placements with industry is an excellent way of acquiring the employability skills that are so crucial for moving Canada’s innovation agenda forward.

Intergenerational differences

Ageing workforce

The labour force participation rate among those aged 55 and above has increased significantly, from 51% in 2000 to 64% in 2012, and projected to be 68% in 2022 (ESDC, 2013).62 This age group was composing 12% of the workforce in 2002, projected to compose 17% by 2022. Nearly a quarter (22%) of the workforce will be composed of post-retirement age individuals (65+) by 2022. While experience never gets old and an aging workforce possess valuable experience, difficulty in upskilling new technologies and adapt to new work environments is often an onerous challenge for Canadian employers. Research indicates that older employees are better than younger ones at content related digital skills such as locating digital information and taking advantage of the online resources with the right actions to reach their goals (van Deursen, Van Dijk, & Peters, 2011).63 Their difficulty lies mostly on the operational and formal digital skills such as technically operating with a browser and navigating on the Internet, at which younger generations are better. Also, with many close to retirement, even for those who have
digital skills, organizations lose the accumulated knowledge and experience when the individual leaves the workforce — meaning the organization needs to fill that knowledge gap.

Millennials

Overall the Canadian workforce is older, but more educated, and diverse than ever before. Every generation of workers come with certain potentials and limitations when it comes to skills. For example, most employers report that the new generation of workers are literate in communicating with multiple mobile devices; fearless in the face of technology change; and stimulated by variety and challenge. They prefer a management that measures results rather than hours logged in, and they enjoy team work and collaboration (Brandel, August 23, 2010). However, they may not understand security issues when they disclose information, may not have the big-picture of how businesses and projects run (see Case Study 1 in Appendix A2), and prefer independence and autonomy. Millennials (Generation Y) tend to be more informal than other generations (i.e., Generation X and baby-boomers), enjoy social networks, and are adept multitaskers. However, they may lack face-to-face relationship building skills and other critical business and interpersonal skills that mid-career professionals (Generation X) possess. Hence, every generation of workers bring certain advantages and disadvantages to the digital economy.

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6. ADDRESSING THE GAP: TRENDS AND CHALLENGES

In their quest to benefit from adopting digital technologies, Canada’s employers face many critical skills-related challenges. Finding employees with the right blend of business, interpersonal, technical, and digital skills stands out as the biggest challenge, while attracting skilled professionals to the organization and training to staff for skills specific to new and emerging technologies follow closely behind. Retaining skilled employees, lack of experience-based and leadership skills and not understanding skills requirements for productivity are also noted challenges (See Figure 13).

FIGURE 13. KEY SKILLS-RELATED CHALLENGES FACING CANADA’S EMPLOYERS

Addressing these issues is vital to businesses success. In the Labour Market Outlook 2016 Survey, significant number of employers felt that addressing skills-related challenges would enable them to more effectively grow (see Figure 14).

FIGURE 14. WOULD ADDRESSING SKILLS-RELATED CHALLENGES IMPROVE EMPLOYEE PRODUCTIVITY AND BUSINESS GROWTH?


Continually upskilling the workforce to be in-tune with the latest technology advances is a must for businesses to remain competitive and innovate. So what are the strategies and approaches to bridging the digital skills divide? There are several ways to address the digital skills gap:

- Training, development, and workforce upskilling at the organizational level
- Human resources practices
- Education at the elementary, secondary, and post-secondary level

**Training, development, and workforce upskilling**

In the *Digital Talent Strategy 2020 Participant Survey*, training and the capacity to innovative and grow were mentioned among the top human capital challenges (see Figure 15).

**FIGURE 15. TOP CHALLENGES ORGANIZATIONS ARE ENCOUNTERING**

<table>
<thead>
<tr>
<th>The top 3 human capital challenges organizations are encountering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attracting and recruiting employees</td>
</tr>
<tr>
<td>Capacity to innovate and grow</td>
</tr>
<tr>
<td>Compensation and benefits costs</td>
</tr>
<tr>
<td>Ability to train and develop your workforce</td>
</tr>
<tr>
<td>Productivity improvement</td>
</tr>
<tr>
<td>Leadership capacity</td>
</tr>
<tr>
<td>Ageing workforce</td>
</tr>
<tr>
<td>Retaining employees</td>
</tr>
<tr>
<td>Managing a diverse workforce</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>


These challenges are being felt by individual professionals as well. For example, the *Digital Talent Strategy 2020 Participant Survey* also 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%).

However, providing meaningful training and development opportunities is a challenge for a number of Canadian organizations. Previous research has shown that Canadian organizations offer fewer training opportunities compared to their OECD counterparts (Council of Canadian Academies, 2015). Conference Board of Canada data has shown that organizations invest less in training and development than they use to and to our American counterparts (The Conference Board of Canada, 2014b). For example, Canadian organizations’ learning and development expenditure per employee has dropped by about 40% in 20 years — from a high of $1,207 per employee in 1993 to $705 per employee in 2013. Investing in training and development is critical to bridge the digital skills gap.

A 2013 Conference Board of Canada survey of 198 organizations — across all geographic areas and sectors — explored some of the training approaches Canadian organizations used to develop their employees’ skills (Conference Board of Canada, 2014b).
2014b). With respect to the delivery method of training, in-classroom formal training (95%) was the most utilized training medium for Canadian organizations. This was followed by self-paced online learning (73%), face-to-face collaborative learning (57%), instructor-led online (45%), instructor-led blended (45%), and online collaborative learning (24%). In terms of the content, management skills, health and safety, new employee orientation, and interpersonal skills were some of the top subject-matter areas with respect to percent of training content within an organization and percent of organizations offering training in these areas. Information technology (IT) skills training, sales, quality, competition, and business practices were lower on the list.

Generally speaking, professionals understand the value of enhancing their ICT and digital skills. A survey by the Economist Intelligence Unit (2015b) found that nearly a quarter of professionals cited mastering new technology as one of their top three ways to achieve career aspirations. For continued workforce participation, employers must continue to invest in and offer learning opportunities, such as training, mentoring, and on-the-job learning to their employees to build their digital skills.

**Training courses**

As technological change occurs at an increasingly fast pace, organizations will have to place a higher priority on ensuring employees training and development needs are met in order to stay ahead of the curve. Training has to move from a “nice to have” to a higher priority and “must have” that continually takes place throughout the year (Accenture, 2016). Training courses, especially in-person courses, is the most common method we tend to think of when developing and upskilling employees. Despite its popularity, a lack of time and financial organizational realities, especially for SMEs, can make it difficult for organizations to send employees away for training several times a year. Digital training platforms, such as massive open online courses (MOOCs), are a potential solution to this challenge because they provide just-in-time training and are more scalable and less costly than other training mediums (Accenture, 2016). Partnerships with bootcamps or rapid-skills training vendors — to train hired graduates and existing employees on coding or analytics — is another potential avenue to build employees' digital skills.

**Mentoring and on-the-job training**

Mentoring and on-the-job training are other tactics that organizations can use to bridge skills gaps. For example, PSI Engineering (Case Study 1) provides mentoring for the new hires, particularly new graduates, to develop their interpersonal and business skills during their first 6 months. A number of Canadian organizations currently offer mentoring and on-the-job learning opportunities. The Conference Board of Canada found that of the 198 Canadian organizations they surveyed, 84% offered mentorship programs, 85% offered job rotation and job shadowing, and 90% had coaching programs (Conference Board of Canada, 2014b). However, barriers such as lack of time and cost can prevent interested employers from adopting these techniques (Conference Board of Canada, 2013a).

**Sharing knowledge and social learning**

Sharing knowledge or peer-to-peer learning and social, predominantly online, learning encourage and involve current employees communicating and sharing their knowledge and skills (interpersonal, business, digital or otherwise) with other employees looking to improve their knowledge and ability in these areas. Peer-to-peer and social learning are becoming increasingly popular training mediums (Conference Board of Canada, 2014b). Some reasons why the prevalence of this method has increased is due to a larger need for knowledge transfer across the organization, cost effectiveness, employees self-initiating these methods and more leadership support (Conference Board of Canada, 2014b).

**Skills gap analysis and development plans**

Skills gap analysis is a useful technique for identifying skills gaps across the organization. Generally, a skills gap analysis involves the organization evaluating the skills of individual employees against the skills the organization needs (now and future) or the skills the individual needs to advance to a higher-level role. The results of the analysis can then be used to inform what

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training individual employees or teams require. This allows for organizations to be more strategic and purposeful about training and development investments. It is important to remember that the process and results of a skills gap analysis is not meant to be disciplinary in nature. Rather, it is an opportunity to further develop employees’ skills for today and the future. Additionally, skills gap analyses can be married with general strategic workforce planning and used as a benchmarking tool to ensure the organization recruits the right talent that meets its current and future skills needs.

**Human Resources Practices**

Human resource practices also play a role in addressing skills gap. Talent attraction, retention, and compensation have a skills side as well. Making sure organizations attract the most skilled talent within and beyond Canadian borders is critical. Then once these employees are hired, organizations need to make sure this talent is satisfied and engaged so that they stay. This includes creating a flexible, inclusive and welcoming work environment. Lastly, how much an organization is willing to or can afford to pay talent with in-demand skills is another consideration. As skills become more in-demand and harder to find, wages and salaries can increase.

**Education**

Education is also important component in bridging the skills gap. There are several components to consider within this realm; curriculum for K-12, post-secondary curriculum and experiential learning.

**Post-secondary**

Building a workforce with the right digital skills requires extremely strong and up-to-date educational programs that offer a blended curriculum and experiential learning opportunities.

**Curriculum**

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.

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. While programs that promote a mix of business, interpersonal and technical skills do exist (such as the University of Waterloo’s WAT PD program), very few make learning business or soft skills a mandatory requirement.

**Experiential learning**

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. 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, colleges, and industry have integrated the internship and co-op program model into their programs, even more workplace-integrated learning is needed.

A 2013 Conference Board of Canada survey of 1,538 Ontario employers found that 41% of organizations have paid co-ops, 38% student mentoring, 36% apprenticeships, 29% unpaid internships, 33% have staff who sit on a college advisory committee, and 22% collaborate with students for in-class industry projects (The Conference Board of Canada, 2013a). Interestingly, for all these options, there was either just as many or more organizations that didn’t have these programs, but interested in

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implementing them as those who did have these programs. The survey also found that the barriers that impede employers from adopting these programs include cost, administration, and lack of time to mentor and manage students.

For prospective entrepreneurs, 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 institutes provide future entrepreneurs with a safe place to test the potential for commercialization, build their professional network, and learn about various investment and funding avenues — all crucial skills and experiences required for successful entrepreneurship.

**K-12 curriculum amendments**

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 ensure that youth are digitally literate and equipped with the skills to participate in the workforce and as entrepreneurs. As discussed earlier in the report, while today’s youth are digital natives they are not necessarily digitally literate.

Problem solving, analytical skills and creativity are the building blocks for innovation. These skills can be integrated into the curriculum in fun and engaging ways that inspire digital learning while still promoting a balanced education (Let’s Talk Science & Amgen, 2013). Furthermore, promote critical thinking, analytics and abstractions will help teach foundational digital skills without necessarily having a heavy emphasis on technology. The move from STEM to “STEAM” (Science, Technology, Engineering, Arts, and Math) is gaining a lot of traction in K-12 education. This perspective advocates for inter-disciplinary approach to integrating technology and digital skills into all subject areas, including arts. In the Digital Talent Strategy 2020 Participant Survey, we found that a number of employers ranked digital literacy and use of emerging technologies in the classroom as the top components that need to be included in K-12 curriculum (see Figure 16).

**FIGURE 16. RANKING OF K-12 EDUCATION COMPONENTS**

<table>
<thead>
<tr>
<th>Skill</th>
<th>Rank</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching basic digital literacy skills in K-12 should be compulsory</td>
<td>1</td>
<td>4.04</td>
</tr>
<tr>
<td>Educators should include the use of emerging technologies in their day-to-day teaching practices</td>
<td>2</td>
<td>3.11</td>
</tr>
<tr>
<td>Communication about the breadth of ICT career opportunities needs improvement in K-12 schools</td>
<td>3</td>
<td>2.93</td>
</tr>
<tr>
<td>K-12 curricula should include lessons on coding and programming</td>
<td>4</td>
<td>2.7</td>
</tr>
<tr>
<td>A national multi-stakeholder forum to discuss ICT talent development in schools needs to be established</td>
<td>5</td>
<td>2.44</td>
</tr>
</tbody>
</table>


Provinces such as British Columbia, New Brunswick, and Nova Scotia are leading the way in terms of incorporating digital skills and applied learning and computational thinking into all aspects of K-12 curriculum. Internationally, the United Kingdom has introduced a new national computing curriculum designed to enhance youths’ digital skills profile. Altering K-12 curriculum to include digital skills is an important tactic in ensuring our digitally-native youth are also digitally skilled for the jobs of tomorrow.

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7. CONCLUSIONS AND POLICY RECOMMENDATIONS

The findings of this study indicate that skills gaps is a reality in the Canadian context, and shed light on the various associated factors. In addition, a clear understanding of the skills required in the digital economy emerges from this analysis. Basic digital skills needed to function effectively in today’s connected digital workplaces have expanded. Closing the gap between the demand for and the supply of skills will help accelerate Canada’s digital advantage in an increasingly connected global environment. Based on the research and findings in this report, ICTC recommends that three areas — investing in training to improve digital adoption, strengthening digital skills for professionals and youth, and fostering digital entrepreneurial talent — should be given priority to ensure that the Canadian workforce has the digital skills needed to be high-performers in today’s increasingly hyper-connected and competitive global economy. These evidence based recommendations will assist Canadian businesses in taking full advantage of digital technologies, and develop innovative entrepreneurs — key elements for Canada’s success in the new economy.

Investing in training to improve 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 businesses 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 technology paradigm, they are redefining organizational capacity and creating new opportunities for productivity gains across all sectors. Yet only half of Canadian enterprises have enabled mobile solutions across their entire workforce (ICTC, 2013). 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.

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 upskilling and digital adoption. The potential loss of earning while the employee is absent from the workplace adds to the cost to SMEs.

Additionally, there is a role to be played by high schools, universities, colleges, and government in providing greater access to opportunities for youth to gain the experiences that will build their digital skills. 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. However, integrating work placements at the necessary scale is challenging when the large majority of Canadian enterprises are SMEs and practical constraints prevent them from participating in these initiatives.

Altogether, this means that a successful focus on training requires multi-stakeholder participation. Without support, SMEs do not have the time or money to fully support the training needed to bridge the digital skills gap, which is crucial for enhancing digital adoption, productivity, and innovation.

Recommendations:

- Industry should increase the priority they place on investing in and offering training and development opportunities to promote continuous learning and enhance employees’ digital skills. This could include:
  - Implementing a mandatory number of hours devoted to upgrading digital skills;
  - Conducting organization wide digital skills gap analyses;
  - Increasing the amount of funding devoted to training and development activities; and
  - Providing more training, mentoring, peer-to-peer and on-the-job learning opportunities.

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 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 workforce. This can be achieved by scaling existing wage subsidy programs to reach a greater number of SMEs.

Educators should incorporate mandatory for-credit experiential learning in all secondary and post-secondary educational programs. This could include offering co-ops, internships, apprenticeships, or applied in-class industry projects.

**Strengthening digital skills for professionals and youth**

Strong digital literacy for all citizens will enable people of all ages, backgrounds, and abilities to effectively and confidently navigate the increasingly digital world. Furthermore, 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. Government, industry, and educators all have a role to play in enhancing Canadians’ digital literacy, a critical component to creating a competitive advantage for Canada in the global digital economy.

**Professionals**

Across all sectors, digital skills are becoming increasingly important in supporting effective participation, inclusion, and innovation in the new economy (WDM-Consultants, 2011). 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. However, some professionals in Canada still do not have the skills needed to succeed in an increasingly connected, digital, and competitive global economy. By being digitally literate, professionals from all backgrounds can better apply digital technologies to their context to solve business problems. Already, more and more employers expect all 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. 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.

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 (The Economist Intelligence Unit, 2015b). 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 (The Economist Intelligence Unit, 2015).

**Youth**

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 digital skills needed to be global leaders. To ensure future success and systemic change, Canada needs to ensure its youth are not just digitally savvy, but also digitally literate, and this starts in elementary and secondary education.

Enhancing youth engagement in STEAM during their formative education years is critical to ensuring more youth develop the fundamental digital skills they will need to be successful in the workforce. Tools and programs that support computational learning and integrate new ways of teaching and experiencing STEAM and ICT will better prepare youth for their future careers.

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Incorporating computer science across all areas of the K-12 curriculum will ensure that students develop digital skills regardless of which subject matter area they eventually gravitate towards. While elementary and secondary curricula are not in the federal government’s domain, there is still a role for them to play in supporting and facilitating provincial governments to incorporate digital literacy into K-12 education.

With the digital technologies permeating almost all areas of work, it is increasingly important to our nation’s prosperity that professionals and youth are equipped with strong digital skills in order to thrive in the evolving and hyper-connected global environment.

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 and industry should offer incentives (financial or otherwise) to professionals of all backgrounds to partake in training to enhance their digital skills. This will assist in creating an atmosphere of continuous learning and promote digital upskilling in the workforce.

- 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.

- Educators should provide more information about career paths and occupational roles that require computer science, information technology, and more broadly STEAM learning.

Fostering digital entrepreneurial talent

The primary aim of nurturing Canada’s future entrepreneurial capacity is to create new industries, and spur growth in all sectors of the economy. While Canada has a strong R&D capacity and entrepreneurial culture, we struggle when it comes to translating these innovations into commercialized products and services. Not having the right skills is one of the barriers to effectively innovating and commercializing new products and services (The Conference Board of Canada, 2013a). Having the right entrepreneurial skills is not just important to individual innovators and start-ups — it is something companies are requiring employees to have as well. To foster entrepreneurial talent with the right skills for success, government, academia and industry must collaborate to better prepare students for entrepreneurship and the workforce. In turn, this has the potential to attract more digital entrepreneurs and companies to Canada, creating more jobs and overall prosperity for Canadians.

We must allow for the seamless continuity between research conducted in universities and colleges and the skills that students acquire in the process and the journey of the product to the marketplace. Access to advanced laboratories (and incubators) can provide undergraduate and graduate students with the experiences and skills they need to become entrepreneurs and commercialize their technological advancements (Government of British Columbia, 2016). 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 (The Economist Intelligence Unit, 2014). 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, post-secondary 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 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.

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

Recommendations:

- Post-secondary academics should focus students’ research assignments on projects that have the potential for commercialization. This will help students build the innovation and commercialization skills they need to be successful entrepreneurs.

- Post-secondary educators (academics and administration) should incorporate mandatory material or courses that develop students’ interpersonal and business skills. Materials could be developed in conjunction with industry.

- Education, industry and government should strategically enhance their work together to build education programs that better align with industry needs and improve student entrepreneurial and employment outcomes.
8. APPENDIX A1: INTERVIEW GUIDE FOR CASE STUDIES

- **PSI Engineering**: PSI Engineering designs and manufactures high speed material handling automation and packing station automation equipment geared to the fulfillment operations for manufacturing, distribution centers, 3PL, packaging and e-Commerce customers. There are 30 employees working in the organization.

- **Imperial Manufacturing Group**: Imperial Manufacturing Group (IMG) in New Brunswick designs, develops, assembles and distributes thousands of value-added metal and plastic products daily. IMG employs more than 850, working from 8 facilities across North America.

**INTERVIEW QUESTIONS**

- Explanation of the study and background of ICTC.
- Understanding the background of the company.
  - Sector, history, products or services, number of employees.
- Asking about adopted technologies and adoption benefits.
  - Which technologies?
  - What benefits?
- Understanding skills requirements of new technologies: any skills gaps in the organization?
  - Which skills are difficult to find?
    - Hard skills and soft skills
  - Providing a definition of digital skills and probing on the need for digital skills: is there an increasing need for digital skills, especially among non-ICT employees?
- What are the skills-related challenges in the organization?
  - What does the organization do about the skills-related challenges: any strategies?
- What are the broader HR-related challenges?
  - Probing: How are they related to skills needs, especially digital skills?
  - What does the organization do about HR-related challenges: any adopted HR practices?
- Closing
9. APPENDIX A2: CASE STUDIES

The case studies presented in the following pages summarise how companies address different aspects of the ever changing skills landscape of the Canadian labour market. They have all endeavoured to design and implement skills strategies to foster business growth. Elements of these strategies have been identified as good practices from which others can learn and which can be adapted to different settings.

The case studies presented in the following pages include:

Case study 1: Emerging Skills Challenges and Solutions at the PSI Engineering – A Case Study of Best HR Practices

Case study 2: Imperial Manufacturing Group
CASE STUDY 1 – PSI Engineering

The Background

PSI Engineering designs and manufactures high speed material handling automation and packing station automation equipment geared to the fulfillment operations for manufacturing, distribution centers, 3PL, packaging and e-Commerce customers. The company is also a leader in the high volume laser printer field and constantly improves its product lines to meet the requirements of customers, including government or education institutions and different organizations using high volume printing. In-house, there are about 30 professionals employed in the organization.

The Challenges

One of the key challenges PSI Engineering has experienced is the lack of business and interpersonal skills among new generation of young workers. Young professionals at PSI Engineering are talented in using digital technologies or ICTs in general and they are focused on the technical tasks assigned to them. However, issues emerge in their understanding of the big picture in the organization; when they need to develop the system they work with; when they need to solve a critical problem; and when they need to effectively communicate with their co-workers or customers. For example, customer demands may change fast and young workers have to adapt well in response to fast changing environment. There is a “generation gap” felt in the organization in the sense that many young workers have a difficulty of functioning in multi-faceted, demanding and fast changing environments that require critical social skills such as problem solving, customer service, sales, marketing, and communication.

A similar challenge is finding mechanical and software engineering graduates who are adaptable in terms of adjusting themselves for changing technical and business requirements. Most graduates are functional in their own technical field, however, there are multiple technical platforms one should be open to learn. In addition, a worker should be integratable to the organization and emerging problems should be solved by workers, without an expectation of top-down spoon-feeding. Hence, problem solving, flexibility, trying different approaches, initiative taking, taking ownership of one’s work are the critical competencies required in PSI Engineering.

Our Customer profile is changing. We sell fully automated systems to eCommerce distribution centers. Some customers have a problem in finding workers to operate these fulfillment lines. When we automate the troubleshooting process with videos and mobile solutions, it works well for workers with digital skills. Sometimes, other customers cannot find people to work with fully automated systems, then they have a skills gap issue which may influence their adoption of automated technologies.”

~ Nancy Panunto
Director of Marketing
PSI Engineering

“Definitely, there are generational issues in the workforce today. Often, new people we hire are waiting for us to tell them what the next task is to be completed. Younger workers are quick, task focused and digitally skilled, but often they lack ability to fully understand and integrate business processes in their technical activities. They are challenged to understand the total business process and as a result their internal and external communication skills may not be adequate”

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Another HR-related challenge PSI Engineering experienced was about the quality of communication between the engineering, production, service support and accounting departments. When engineers design/build a system, the system requirements need to be effectively communicated from the production department to service and support department line, including the accounting department. Each of these departments should be able to connect well with other departments in explaining business requirements. In other words, departments have been talking different ‘languages’. The critical point here is about communication between different skills sets (engineering, software, production, accounting) and having effective systems in place to make interdepartmental communication effective.
The Solutions

- Facing mostly interpersonal-business skills-related challenges, especially among the young generation of professionals, PSI Engineering has been using an effective strategy: Investing in skills for a minimum period of 6 months and monitoring the professional development among the new hires. The new hires use the opportunity to develop and practice their newly learned interpersonal and business skills. PSI Engineering creates for itself an opportunity to test the potential for adaptation among the new hires through mentoring, multi-skilling and monitoring during this critical period of time.

- In terms of communication challenges between departments, PSI Engineering placed an Interdepartmental Communication Protocol and updated the Enterprise Resource Planning system activities in order to reconcile different “departmental” languages. The protocol makes explicit the essential procedures of communication, hence prevents further misunderstandings between departments.

The Impact

PSI Engineering has been overcoming its skills-related challenges effectively and as a result the company has been experiencing:

- increased productivity
- better performance
- increased sense of ownership among workers
- increased trust and collaboration between departments and employees
- cost savings due to decreased time losses

“We had the pleasure to hire young individuals who went to school for basic IT education after they could not find employment in their field of study or did not want to be in a job working on repairing computers. We took the initiative and hired them, understanding they didn’t have specific technical skills. We invested in hands on training in our organization, 6 months of mentoring and monitoring for each professional, and today they are successfully working globally with our customers installing order fulfillment systems and training staff on how to operate them within their distribution centers.”

~ Nancy Panunto
Director of Marketing
CASE STUDY 2 – Imperial Manufacturing Group

Background

Imperial Manufacturing Group (IMG) in New Brunswick designs, develops, assembles and distributes thousands of value-added metal and plastic products daily. The firm has become a world class leader as a manufacturer of heating, venting and air conditioning, stove, fireplace maintenance and building products. IMG employs more than 850 people, working from 8 facilities across North America.

The Challenge

One of the key challenges of IMG is to find people with hybrid technical skills who understand all aspects of technical production process and people who can function with new technologies. As new technologies are produced everyday basis, it is important to adopt technology on time and make sure that the talent is ready in house. However, in New Brunswick, technology of the production systems are not quickly updated using automation and robotics, as are done in Ontario. One of the key challenges is to find people who can work with legacy systems and new digital technologies. For example, when regular mechanical or electrical engineers graduate, they don’t have specific application skills, no experience, except a basic internships experience.

IMG wants to get to next level of production and adopt automation technologies. However, the products in HVAC manufacturing (heating, ventilating, and air conditioning systems) contribute to a high variety of different products. Hence, the low return on investment and high level of costs for receiving training from automation companies don’t allow quick adoption of automation. Instead, IMG makes sure that technological qualifications or skills are first available in house and then phases out its investments for the technological change.

The Solution

Currently, IMG is implementing new technologies and it has limited certified personnel. To mitigate the risk of skills gap, IMG prepares training and upskilling sessions for its current employees. New technologies require new digital skills which are usually at a higher level than what the legacy systems require. Given the presence of aging employees who have been working with the old systems, the company may need new people with digital skills, who can work with different digital interfaces. For example, company may need to hire new technicians and operators for their higher skills such as proficient computer usage. Workers will also need to have a common knowledge and comprehension of how the new system works and how it would work more efficiently.

The (expected) impact

IMG is in the process of technology adoption and anticipates better productivity, performance, lesser production stoppages and cost savings in its manufacturing processes.

“It is easy to find a great mechanic and electrician but what is hard to find, is someone who understands how the electrical system ties in the mechanical system and how to use the current technology. We need to access new people that will give us the opportunity to use new technology in our operating procedures. Because of our wide variety of product we need to develop our own automation solutions.”

~ Michel Bourgoin
Automation Engineer
Imperial Manufacturing Group

“What we are going to do is create training sessions and educate our current employees on the new technologies implemented. Eventually, there will be new hires such as technicians or operators who have a certain skills set that are a bit more advanced and they will have to know how to use a computer and other digital devices more frequently than what we used to have.”

~ Michel Bourgoin
Automation Engineer
Imperial Manufacturing Group
REFERENCES


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SKILLS IN THE DIGITAL ECONOMY
WHERE CANADA STANDS AND THE WAY FORWARD

48


