SKILLSNEXT

Bridging the Digital Skills Gap
Alternative Pathways

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Denise Shortt, Brian Robson & Magdalena Sabat
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The Future Skills Centre is a partnership between:

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The Diversity Institute conducts and co-ordinates multi-disciplinary, multi-stakeholder research to address the needs of diverse Canadians, the changing nature of skills and competencies, and the policies, processes and tools that advance economic inclusion and success. Our action-oriented, evidence-based approach is advancing knowledge of the complex barriers faced by underrepresented groups, leading practices to effect change and producing concrete results. The Diversity Institute is a research lead for the Future Skills Centre.

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ABOUT THE PROJECT

Canadians’ needs for skills training are changing rapidly. Through Skills Next, the Public Policy Forum and the Diversity Institute—in its role as a research lead for the Future Skills Centre—are publishing a series of reports that explore a number of the most important issues currently impacting the skills ecosystem in Canada. Each report focuses on one issue, reviews the existing state of knowledge on this topic, and identifies areas in need of additional research. This strong foundation is intended to help support further research and strengthen policymaking. A diverse set of authors who are engaged in the skills ecosystem through various roles, including through research, activism, and policymaking, have been carefully selected to provide a broad range of perspectives while also foregrounding the Canadian context. Their varied backgrounds, experiences, and expertise have shaped their individual perspectives, their analyses of the current skills ecosystem, and the reports they have authored.

Skills Next includes reports that focus on:

- Global comparison of trends to understand the future of skills
- Knowns and unknowns about skills in labour market information
- Rethinking the relationship between technology and the future of work
- Defining digital skills and the pathways to acquiring them
- Barriers to employment for immigrants and racialized people in Canada
- Barriers to employment for persons with disabilities
- The return on investment of industry leadership in skills and training
- Approaches to improving the transitions of university graduates from education to the workforce
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EXECUTIVE SUMMARY

Digital skills are increasingly in demand across many industries. Recent industry reports argue that a shortage of people in the workforce skilled in information and communications technology (ICT) is inhibiting the growth of innovative companies around the world. Some argue that in Canada, this global challenge is exacerbated by Canadian firms’ historic tendency to adopt new technologies at a slower than average speed — a hesitancy many argue is itself the result of previous shortages of skilled technology workers.

While the origins and extent of the “digital skills gap” may be the source of some disagreement, this paper argues that the existence of this gap is real, provided a gap is understood as a lack of candidates with the skills required by particular employers. Critically, however, its causes may be more complex than are commonly understood. For example, the under-employment of skilled immigrants and under-representation of women and other groups in the ICT industry suggests that recruitment and retention policies and practices of the very firms complaining about this gap may be contributing to the problem.

While there are multiple pathways to “digital careers,” accessing them requires innovations in skills development and in approaches to defining these roles. Yet a review of the most relevant digital skills frameworks shows there is little common understanding of the actual skills or knowledge that contribute to the skills gap; little common understanding of the dimensions of learning and training needed to improve it; muddled distinctions between areas of knowledge, competencies, skills and tools needed for 21st-century learning or work; and very little identification of skill levels.

In Canada, the National Occupational Classification (NOC) system provides standardized language to describe occupations in the Canadian labour market. But in this classification system, as in others, there is often confusion between a job, the skills and competencies needed to perform the job, and
the specific tools and techniques needed for the job. Moreover, the NOC’s usefulness is also somewhat limited in the context of digital skills, as it has not kept pace with the emergence of technology-based occupations, such as cloud engineer, nor has it developed a clear way of including hybrid roles.\(^1\)

Opening new pathways to digital skills, especially for those who are currently under-represented, will require the development of a better understanding around the deployment, monitoring and assessment of emerging approaches to digital skills identification, development and employment. Standard definitions and approaches need to be identified, established and supported. We need better case studies to appreciate the effects of innovative approaches to developing and recruiting digital talent including inclusive training and recruitment practices; reconsidering credentials and assessment; and new forms of training and upskilling. Our approach to developing and applying digital skills will need to evolve, but for this evolution to be successful, we first need to understand what works, what is not working, and how to use inclusion to expand the talent pool.

\(^1\) The NOC codes are next scheduled to be updated in 2021 and may incorporate new job titles at that time.
OVERVIEW AND CHALLENGES

Digital skills are increasingly in demand. In a 2016 report, the Information Technology Association of Canada (ITAC) pointed out that "the shortage of skilled ICT talent in the technology sector is a major issue hampering the growth of innovative companies in Canada." The Information and Communications Technology Council (ICTC) notes that traditional industries that need to adopt and use new technologies to innovate are especially impacted by these shortages. At the same time, however, the Organisation for Economic Co-operation and Development (OECD) points out that while the skills gap is significant for those firms facing skilled talent shortages, the "shortage of ICT skills remains small" and suggests that "only a small share of enterprises are looking for ICT specialists."

The ICTC estimates that in 2020, 218,000 information and communications technology (ICT) positions will need to be filled in Canada.

While the origins and extent of the "digital skills gap" may be contested—something explored in detail below—this paper argues that the existence of this gap is real, provided a gap is understood as a lack of candidates with the skills required by particular employers. One consequence of this gap is that a number of efforts have been undertaken to remedy it, many of which have focused on "upskilling" as a potential solution. In brief, upskilling refers to "the development of skills an employee will need to perform the same role in the future." But, while much research in this area has focused on increasing capacity in digital skills for graduates and mid-career employees alike, it is also important to recognize that the basic skills required by the workplaces of the future will not be solely technical in nature. For

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6 The digital skills gap discussed in this paper would thus fall into the category of "skills shortage" according to the taxonomy outlined by Braham and Tobin (p. 5) if seen from the employers' perspective. As is discussed below, however, this categorization may not be completely accurate given employers' inability to recognize the potential of the talent that already exists in the labour market.
example, the World Economic Forum has projected that emotional intelligence, judgment and creativity will all figure in the top-10 skills needed to thrive in the workforce in 2020.  

Similarly, authors of an RBC report encourage policy-makers and employers not to lose sight of the importance of the liberal arts, arguing that alongside widespread demand for various digital and ICT capacities, the workplaces of the future will require foundational skills such as critical thinking, coordination and social perceptiveness. In fact, business schools are increasingly offering programs designed to target and improve non-cognitive "soft-skill" capacities, with some leaders in business education even suggesting that these soft skills are harder to teach than technical ones. These perspectives support a drive towards upskilling and reskilling efforts rather than increased recruitment into traditional ICT-specific roles.

Some have questioned the existence of a digital skills gap entirely, pointing to a lag between the market demanding more candidates with digital skills and the market rewarding those candidates with the rising wages one would expect to see in a tight market for skilled ICT labour. In other words, economic indicators seem to reflect skills mismatches rather than acute shortages. For example, the under-employment of skilled immigrants is offered as evidence that the problem is recruitment and retention practices, not a shortage of skilled workers. Moreover, women and other groups are under-represented in ICT roles. Finally, it may be the case that the credentials employers require for many jobs rely on outdated assumptions about what those jobs involve rather than an analysis of the skills required to perform the role.

The evidence suggests there are multiple ways to acquire digital skills and multiple pathways into roles that require them. But opening these pathways further will require innovation in skills training and development. It will also require changes in how businesses, governments and individuals define

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11 Finnie, R., Mueller, R., and Sweetman, A. (2018). *Information and communication technology talent: the skills we need — framing the issues.* Canadian Public Policy, 44(S1), Siii-Six.


those basic skills which they see as required, as well as in employer approaches to recruiting, training and retaining workers.

It is urgent that Canada develop these pathways. The ICTC estimates that in 2020, 218,000 information and communications technology (ICT) positions will need to be filled in Canada. According to ICTC’s projection, about half of these will be new ICT positions while the other half will be replacements for workers leaving the industry. Only 29,000 ICT graduates are expected to join the workforce every year, which is not enough fill these positions through local supply.

In an ICTC survey of employers, 53 per cent of ICT organizations said attracting and retaining skilled employees was a top human resource challenge, and 34 per cent faced at least some difficulty in filling ICT positions. An Engineers Canada assessment of the challenge produced similar results. But, while industry groups report acute skills challenges, the OECD has stated that "the measurement of both the demand for and the supply of such skills falls short of the evidence base that is necessary to inform education and training policies." Nonetheless, while this lack of available and timely data and labour market information represents a challenge in the design of education and training policies aimed at tackling the problems employers report, governments, post-secondary institutions and community organizations have all launched projects to “bridge the skills gap” and build the digital talent pool.

Still, Canada lags behind its international peers. Canada receives high scores in terms of the number of digitally skilled youth who are preparing to enter the workforce and in the widespread use of digital skills in the average person’s daily life. Concurrently, however, Canada also receives only average scores in the area of "leveraging innovation to stimulate skills use." This inability to quickly integrate innovative technologies into the economy, and use the skills needed to apply them productively,

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20 Ibid.
suggests that Canada’s comparative strength in digital skills is being under-applied. Other jurisdictions, including the European Union, Australia and Singapore, have made much greater progress in developing the sorts of skills infrastructure, such as programs and taxonomies for digital skills—including digital skills toolkits, roadmaps and frameworks—that are needed.

This paper begins by considering the challenge of defining digital jobs and industries. It then reviews an international sample of digital skills frameworks (i.e., taxonomies and assessment tools) to understand approaches that differentiate between occupations, skills, tools and techniques. Next, it identifies emerging approaches to developing and recruiting digital talent, with a focus on Canadian initiatives, including inclusive training and recruitment practices; reconsidering credentials and assessment; and training and upskilling. The paper concludes with a summary of insights and potential next steps.
DEFINING DIGITAL JOBS AND INDUSTRIES

The nature of digital skills and technology jobs can change quickly, challenging efforts to define and measure the digital labour market. Labour market projections depend on a range of factors and, while important for informing policy, are often inaccurate. This is particularly true in the ICT sector where the direction of technological change may be apparent, but its pace is unclear. Current trends in ICT include a shift towards digitization of government services, telecom growth, demand for platform and storage solutions, automation and a blurring of sector boundaries.\textsuperscript{31, 32} The pace of industry change is mainly defined by technology adoption, which is comparatively slow in Canada.\textsuperscript{33}

But, given the changing nature of work and the limitations of current occupational classifications, efforts at classification are focusing less on “jobs” and more on “skills” and “competencies.” Skills and competencies are abilities an individual acquires through training and experience. Skills are specific, learned activities that range in terms of complexity, while competencies have to do with behaviours that demonstrate the abilities needed to perform job requirements.\textsuperscript{34} Skills and competencies can be generic, crossing occupations and levels, or be very specific and tied to particular professions. The evidence suggests both are important for employee success. Current labour-market measurement

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\textsuperscript{31} FitchSolutions. (2018). \textit{Canada information technology report: Includes 5-year forecast to 2022.}
\textsuperscript{32} Gonzales, E. (2019). All systems go: Recovering private investment will lead to increased use of industry services. IBISWorld.
approaches, however, are limited in their ability to accurately measure in-demand skills and competencies.

Classification Confusion

According to the Government of Canada, ICT is a $184-billion industry with 623,000 workers employed at over 40,000 companies in Canada. More than half (55 per cent) of the ICT workforce have university degrees, and the annual average salary is $77,600.\(^{35, 36, 37, 38, 39, 40, 41}\) However, the digital workforce extends far beyond the ICT sector.\(^{42}\) Digital skills shortages have been identified in sectors including financial services, manufacturing, health care and the public sector. In fact, the Brookfield Institute for Innovation + Entrepreneurship has reported that 5.1 per cent of the Canadian workforce (roughly 935,000 workers) are working in digital occupations, but that the majority are in “digital” jobs (681,000 workers) and not “high-tech” occupations (254,000 workers).\(^{43}\) In this report, Viet Vu, Creig Lamb and Asher Zahar define digital occupations as “those that typically contribute to the development of computer hardware or software solutions (e.g. software developers or technology architects),” whereas high-tech occupations are those that “require advanced technical skills in which computers are used as a means to other ends (e.g., engineers or scientists).”\(^{44}\)

The researchers’ estimate helps to illustrate how the vast majority of the need for digital skills competencies is outside of the ICT sector. This is an important point because this fact has been a source of confusion for attempts at classification of digital jobs and occupations. Normally, the Government of Canada’s National Occupational Classification (NOC) system is used to define and classify occupations in the Canadian labour market. In this classification system, as in others, there is often confusion between occupations (the job), the basic skills and competencies needed to perform the job (e.g., computer programming, which typically takes years to develop), and the specific tools


\(^{44}\) Ibid.
and techniques needed for the job (e.g., JavaScript or Python, which can be taught easily when someone has the foundational skills). Digital jobs vary considerably in terms of key competencies, skills and tools. While often seen as synonymous with engineering and computer science, digital jobs are wide-ranging and do not all require in-depth technology skills (see Figure 1).

Figure 1: Skill Type and Educational Level

<table>
<thead>
<tr>
<th>Deep Technical and Content Creation</th>
<th>Business/Technology Skills</th>
<th>Basic Digital Literacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge, skills and awareness needed to:</td>
<td>- Develop innovative ICT infrastructure, products, and services</td>
<td>- Build consumer and commercial markets for ICTs</td>
</tr>
<tr>
<td></td>
<td>- Grow the ICT industry</td>
<td>- Private sector productivity and competitiveness</td>
</tr>
<tr>
<td></td>
<td>- Create digital media content advantage</td>
<td>- Start up and build SMEs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Capacity to innovate using digital technology</td>
</tr>
<tr>
<td>K-12 and PS Education</td>
<td>Occupational Training</td>
<td>Self-Study/Social Interaction</td>
</tr>
<tr>
<td>Knowledge, skills and awareness needed to:</td>
<td>- Participate in the digital economy</td>
<td>- Enhance personal opportunities and quality of life</td>
</tr>
<tr>
<td></td>
<td>- Use digital technologies to access products and services</td>
<td></td>
</tr>
</tbody>
</table>


Rise of the hybrids

Unfortunately, the NOC framework does not currently capture the full range of ICT jobs. Specifically, “hybrids,” are often missed or poorly categorized. (Hybrids are individuals who possess deep skills in sales, marketing, project management, regulatory processes, business management, strategy and organizational change, content development and more, but also possess enough knowledge of technology to work directly with technicians or developers.) For example, of the five most in-demand digital jobs in Alberta, four—UX/UI designer, data scientist, full stack developer and backend developer—are not even currently included in the NOC. Similarly, the most in-demand digital job, software developer, is classified as falling under NOC 2174, Computer Programmers and Interactive

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Media. This NOC category includes job titles such as “graphic user interface designer” and “interactive media developer” but excludes “graphic designers and illustrators” (NOC 5241) and “software engineers and designers” (NOC 2173). Further, the NOC 2174 employment requirements specify educational requirements that do not take into account UX/UI designers. Overall, job titles that include “design” are particularly prone to mis-categorization because they tend to include diverse training as well as hybrid skills and job roles.

Similarly, a 2015 Burning Glass Technologies study analyzed job postings to find that three of the four most in-demand job categories — customer relationship management, digital media and design and social media tools and search engine analysis — were all hybrid roles (see Figure 2). Critically, these positions all required the ability to use common software, not sophisticated technology skills.

Figure 2: High-Priority Digital Skills and Occupations

<table>
<thead>
<tr>
<th>Advanced Digital Skills</th>
<th>Top Occupations</th>
<th>Top Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Relationship Management</td>
<td>Sales Representative</td>
<td>Sales Manager</td>
</tr>
<tr>
<td>Digital Media &amp; Design</td>
<td>Graphic Designer / Desktop Publisher</td>
<td>Marketing Coordinator / Assistant</td>
</tr>
<tr>
<td>Social Media Tools and Search Engine Analysis</td>
<td>Recruiter</td>
<td>Graphic Designer / Desktop Publisher</td>
</tr>
</tbody>
</table>


Hybrid workers are particularly valuable because, contrary to people with strictly technical skills, they are able to work effectively with both clients and developers. Consequently, demand for hybrid roles is growing quickly. For example, between 2015-16, demand in Canada for telecommunications services/operations/facilities managers grew by 40 per cent and demand for electronics technicians

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grew by 12 per cent. While deep technical skills are necessary for some roles, basic digital literacy and general business and technology skills are sufficient for many day-to-day business functions.

**Shifting roles**

Another challenge to classifying jobs and skills is the emergence of roles that combine skills from previously distinct positions. A recent Brookfield Institute report emphasizes the emergence of these hybrid roles. Often, employers are looking for a special blend of digital and non-digital skills. To further understand the demand, Viet Vu, Creig Lamb and Rob Willoughby have developed a new measure for digital skills, where specific skills are placed on a continuum based on relative digital intensity and then grouped into four clusters, ranging from most-general and least digitally intensive to specific and most digitally intensive. A notable takeaway from their study is that “the least digitally intensive skills are the most widely demanded.” Further, their report underlines opportunities for skill transfers between roles, especially given the spectrum of digital skills.

Examples of the importance of this sort of analysis can be found if we look at Calgary’s 2015 economic downturn. At this time, high rates of displacement were observed among highly skilled “deep” technology occupations such as petroleum engineers and geoscientists, while roles that blended digital skills and competencies, such as software developers, data analysts and UX/UI designers, were in demand. Yet while many people in “deep” technology occupations have the skills for other types of roles—for example, the average geoscientist has nearly 60 per cent of the core skills and competencies needed to become a data analyst—they lacked the skills needed to transfer their expertise to in-demand positions. This was compounded by employers being unaware of these transferrable skills, which represents a significant lost opportunity when the average time required to upskill these workers is a year or less. An improved classification system could potentially alleviate some of these problems and help to ameliorate the digital skills gap.

Research further supports the idea that better mapping of skills and competencies could help employers find the workers with the skills they need and help workers better use the skills they have to find the jobs they want. Alexandra Cutean and Ryan McLaughlin used the U.S. Department of Labor’s Occupational Information Network (O*NET) database to map occupational codes to skills and

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51 Ibid.

found that there is demand for a broad range of skills beyond pure technology.\textsuperscript{53, 54} Critical thinking, creativity and flexibility were identified as the most important skills in the hiring process, while active listening, oral expression and inductive reasoning were identified as strongly associated with high-growth occupations.

Companies are increasingly recognizing the importance of multiple disciplines as pathways to jobs that rely on digital skills.\textsuperscript{55} For instance, a recent survey of skills required to work in artificial intelligence confirmed the importance of deep technology skills as well as sales, marketing and product-management abilities.\textsuperscript{56} Some companies have said that it is easier to take someone with those skills and teach them about technology than to take someone with deep technology skills and teach them how to effectively sell.\textsuperscript{57} Accumulating research stresses the importance of non-technical skills even in the technology sector.\textsuperscript{58, 59, 60, 61} This message is also echoed by employers, who are looking for candidates with digital capacity and who are fluent with digitally intensive tools, but not at the expense of soft skills, namely “strong interpersonal, project management and problem-solving skills.”\textsuperscript{62}

**Essential skills**

Economic and Social Development Canada’s (ESDC) Essential Skills Framework defines nine essential skills and is used to design and assess various skills development initiatives across the country (see Figure 3). According to ESDC, essential skills are the foundation for learning all other skills, and they are what enable people to prepare for, get and keep a job, as well as enable them to adapt and succeed at work.\textsuperscript{63}


\textsuperscript{58} Adecco Group. (2017). *The soft skills imperative*.


\textsuperscript{61} Walker, V., Bowkett, G., and Duchaine, I. (2018). *All companies are technology companies: preparing Canadians with the skills for a digital future*. Canadian Public Policy, 44(S1), S153–S158.


Figure 3: ESDC Nine Essential Skills

Academics and organizations are mapping these essential skills to other taxonomies and frameworks and are considering additional skills. Annalise Huynh and Andrew Do have proposed that communication, collaboration, critical thinking, problem-solving, flexibility, creativity, entrepreneurial thinking and organizational skills should be included as 21st-century skills.\(^{64}\) Will Markow, Debbie Hughes and Andrew Bundy suggest including critical thinking, creativity, communication, collaboration, and analytic skills.\(^{65}\)

The World Economic Forum breaks 21st-century skills into foundational literacies (how students apply core skills to everyday tasks) including literacy, numeracy, scientific literacy and ICT literacy; competencies (how students approach complex challenges) including critical thinking/problem solving, creativity, communication and collaboration; and character qualities (how students approach the

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changing environment) including curiosity, initiative, persistence/grit and social and cultural awareness.66

While there are common themes among these and other skills frameworks, there is little consistency in the categories and definitions; limited evidence that they can be objectively defined and tested; and challenges translating them into frameworks that can be commonly used by employers and other stakeholders.

DIGITAL SKILLS FRAMEWORKS

As was discussed in the preceding chapter, digital skills and labour shortages are exacerbated by the lack of common nomenclature to define digital skills and a lack of clarity over what qualifies a person to work in a role with significant digital skill requirements. Consequently, various stakeholders have developed digital skill structures, including digital skills maps, toolkits and frameworks to serve educators, students, policymakers, employers and others. One example, developed by Vu, Lamb and Willoughby, groups digital skills on a continuum to better understand where jobs and skills occur on the spectrum from least digitally intensive to most, and where the demand is. Notably, this framework incorporates common soft skills that appear with digital skills, such as teamwork, collaboration, and problem-solving.67

Unfortunately, in terms of general knowledge and specific ICT knowledge, there are no clear similarities between frameworks, skills maps and toolkits, other than an emphasis on “soft” or “human” skills (see Appendix A). Most frameworks are structured as general learning and pedagogical tools to widely improve digital literacy (e.g., the EU’s DigComp 2.0 map and ITU Digital Skills Toolkit). A few frameworks focus on addressing the digital skills gap in order to support workers in the digital era (e.g., the Brookfield Skills Map and the BTM Learning Outcomes map). Importantly, most frameworks do not identify skills or learner levels, except for Wendy Cukier and colleagues’ Digital Skills and Business School Curriculum68 and ITU’s Digital Skills Toolkit,69 which articulate three skill levels.

Global attempts

Definitions of ICT professionals’ knowledge, competencies and skills also vary, but, on the whole, frameworks tend to put more emphasis on skill levels.70 The European e-Competence Framework (e-CF) provides a reference of 40 competencies as applied to the ICT workplace, using a common language for competencies, skills, knowledge and proficiency levels across Europe.71 The e-CF was created to provide a generic set of typical roles performed by ICT professionals in any organization and covers the full ICT process. Its five e-CF areas—plan, build, run, enable and manage—are broken down into required competencies and five e-competency levels, from low- or entry-level competency to advanced. Each area provides example skills and knowledge, which allows for individual-level

measurement of each competency and specification of skills. It is a comprehensive tool that enables the identification of competencies and skills that are required to successfully perform duties in the ICT workplace.

Other countries have made similar attempts to define an ICT professional’s knowledge, competencies and skills. Below, three such frameworks are discussed: the ICT Profession Core Body of Knowledge (CBOK), the Skills Framework for ICT and the Body of Knowledge. Appendix A contains a table that summarizes and compares the frameworks discussed below, as well as other relevant frameworks. The expanded descriptions below are provided to demonstrate the breadth and the lack of agreement across professional associations globally on how to define the knowledge, competency and skills relating to digital skills generally and ICT specifically. It also shows that there is little agreement on how to distinguish or measure levels of expertise.

Australia’s ICT Profession Core Body of Knowledge (CBOK)

The Australian Computer Society (ACS) has defined an ICT Profession Core Body of Knowledge (CBOK), which includes six areas of ICT Professional Knowledge: 72

1. ethics;
2. professional expectations;
3. teamwork concepts and issues;
4. interpersonal communication;
5. societal issues/legal issues/privacy; and
6. understanding the ICT profession and general ICT knowledge (hardware and software fundamentals, data and information management, networking and technology-building).

The ACS CBOK links to the ICT occupations contained within the Australia and New Zealand Standard Classification of Occupations, identifying 30 different job titles within the ICT field. However, unlike the EU’s e-CF, it does not articulate or map specific competencies and skills, or levels of those skills, to the areas of knowledge identified.

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Singapore’s Skills Framework for ICT

In Singapore, the Skills Framework for ICT was developed by the Infocomm Media Development Authority and SkillsFuture Singapore in consultation with ICT industry stakeholders. It lists seven domains for ICT: data, infrastructure, professional services, security, sales and marketing, software and applications and support. Each knowledge domain is subdivided into knowledge categories that include pathways for general skills and ICT-specific skills and diagrams illustrating varying pathways to ICT professions, including vertical progressions and lateral movements.

Canada’s ITAC Body of Knowledge

ITAC has developed a detailed Body of Knowledge on specific topics for the Business Technology Management Program, a standard program in business schools across Canada. The Body of Knowledge includes four core knowledge areas: information technology (it), information systems (is), is-it management and business technology management, with six ICT specific knowledge areas within each core area. However, it does not articulate skills that are linked to those areas or levels of those skills.

EMERGING AND INNOVATIVE APPROACHES TO CLOSING THE SKILLS GAP

Despite the definitional and taxonomical problems discussed above—such as the lack of a commonly agreed-upon taxonomy of digital jobs and digital skills—efforts are underway by Canadian governments, educational institutions and businesses to address digital skills and labour shortages. Emerging approaches to developing and recruiting digital talent focus on inclusive training and recruitment practices; reconsidering credentials and assessment; and training and upskilling.

Inclusive training, recruitment and hiring practices

One of the most obvious anomalies present in the data that describes the skills gap is that even while there exists a clear shortage of skilled technology workers and hybrid workers with digital skills capacities, a variety of equity-seeking groups—particularly highly skilled immigrants and women—are underrepresented in ICT roles and throughout the ICT pipeline.74

Despite many explicit corporate commitments to diversity, decades of initiatives designed to advance women in technology have scarcely had an effect: The proportion of women in engineering and computer science in Canada has changed little in 25 years.75, 76, 77 Women in STEM are paid less than men,78, 79, 80 and technology fields fail to attract and retain women. More than 52 per cent of women leave private-sector jobs in science, engineering and technology, with the exit rate highest in the technology sector (56 per cent).81 Compared with women in other professional fields, women who leave STEM are also less likely to return.82 Furthermore, false naturalistic narratives are perpetuated across industries, for example, that women are naturally less risk-seeking than men. These kinds of myths are driven by systemic problems in hiring and recruitment practices.83

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Women are not the only group who could help fill the digital skills gap but are being inhibited from doing so. People with “foreign-sounding” last names, for example, are less likely to be interviewed for positions even if they have the same qualifications as other applicants. Many racialized minorities, as well as First Nations, Inuit and Métis people, face unconscious bias and limited career opportunities, particularly within small- and medium-sized enterprises.\(^{84, 85}\)

Immigrants are often stuck in precarious and low-paying jobs, despite having high levels of skill and education, in part because foreign work experience and credentials are generally devalued in Canada.\(^{86, 87}\) University graduates with severe disabilities have the same employment outcomes as those without a high school diploma.\(^{88}\) People who face multiple barriers, such as disability, age, gender, religion and ethnic or racialized identity have compounding challenges to employment and advancement.\(^{89, 90}\)

The underrepresentation of First Nations, Inuit and Métis people in STEM fields is of particular importance in the Canadian context. In 2014, Indigenous Canadians accounted for less than two per cent of post-secondary STEM graduates (university and college level) despite representing almost four per cent of the adult population.\(^{91}\) Looking to the future, Indigenous youth, one of Canada’s fastest-growing populations,\(^{92}\) comprise merely 1.2 per cent of ICT workers.\(^{93}\)

To fully understand and address skills gaps in First Nations, Inuit and Métis communities, it is necessary to account for the impact of the inter-generational and systemic under-education,\(^{94, 95, 96}\)

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the disproportionate number of Indigenous children who have navigated the care system and overall conditions of systemic and long-standing disadvantage. All these factors and more contribute to disproportionately low high school and post-secondary graduation rates amongst First Nations, Inuit Métis youth and adults. Workplace anti-Indigenous discrimination represents a significant additional barrier to Indigenous candidates accessing and/or remaining in the workforce. The multiple systemic and organizational barriers specific to technology education and fields, particularly in credential assessment, recruitment and hiring practices only add additional obstacles to the already challenging path into digital occupations faced by Indigenous Canadians.

Limited progress addressing persistent barriers for diverse groups across employment sectors compounds labour and skills shortages. Strategies such as recruitment from particular communities, diversity training and mentoring programs have produced uneven results. Organizations may have significant representation of underrepresented groups, but expect them to conform in the workplace. In workplaces where this expectation exists, the gains that can be had from diversity are constrained. Consequently, attention has shifted to the creation of “inclusive” organizations that

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103 Many of the barriers that contribute to this underrepresentation are discussed in other Skills Next papers. See Ng, E., Gagnon, S. (2020). Employment gaps and underemployment for racialized groups and immigrants in Canada: Current findings and future directions. Skills Next. Public Policy Forum, Diversity Institute at Ryerson University, Future Skills Centre.


espouse a commitment to integrating different identities and valuing them.\textsuperscript{110, 111} This move aligns with research that has highlighted the importance of a deep understanding of complex interactions between context and organization and individual initiatives and change, rather than focusing only on individual perceptions.\textsuperscript{112, 113, 114} Without systemic change, everyday bias persists,\textsuperscript{115} as does the risk of backlash against diversity initiatives.\textsuperscript{116}

As recruiting diverse talent has proven a challenge, employers are developing new recruitment practices. For example, many organizations partner with Specialisterne to provide employment pathways for people on the autism spectrum.\textsuperscript{117} Other stakeholders have developed new event-style approaches to recruitment, such as Capital One’s use of hackathons to recruit women to work with the firm,\textsuperscript{118} or have focused on international recruitment to fill gaps or have even relocated closer to the talent pools they need. There are also dedicated HR firms and HR professionals in general HR agencies whose role is to search for tech talent. Tech-specific networking websites and websites that connect employers directly with freelancers or entrepreneurs are also common.

But for many communities, even these techniques will not be effective. Understanding the specific community in question is essential to successful recruitment. For instance, workplaces can significantly improve the experience of Indigenous employees by providing measures such as mentorship and peer-support schemes for Indigenous members of staff and cultural awareness training amongst non-Indigenous employee groups.\textsuperscript{119} Ultimately, however, the continued underrepresentation of many equity-seeking groups shows that significant innovation and work are still needed.

\textsuperscript{117} For more information, see Specialisterne. (n.d.). Welcome to Specialisterne Canada.
\textsuperscript{118} For more information, see Capital One. (n.d.). About.
Credentials, Assessment and Measurement

Historically, employers have viewed credentials as strong indicators of the skills and competencies possessed by an applicant. But with the pace of technological change continuing to accelerate, examining credentials may no longer be the best way of assessing a candidates’ job readiness. Google, Apple and IBM have decided that a university degree is no longer the best indicator of a candidate’s aptitude, and technology companies including Shopify, Telus and Slack are either relaxing or phasing out educational requirements and identifying talent in new and novel ways.\textsuperscript{120} Thus, even though studies suggest that post-secondary education, particularly in STEM fields of study, increases the likelihood of acquiring employment in an ICT occupation by as much as 15 per cent,\textsuperscript{121} there are increasingly other pathways into tech jobs. Indeed, most of the women who lead the largest ICT companies in the U.S. do not have computer science or technology degrees.\textsuperscript{122, 123, 124}

Employer and recruiter perspectives vary on the importance of traditional credentials, depending on the job title and skills required. For instance, Randstad, a human resources services firm, states that business systems analysts typically need to hold an undergraduate degree in an IT-related field, and some may need a graduate degree. However, web developers can have a degree or diploma from a wider range of fields, including computer science, communications, business or design. A computer science degree and a design degree are very different, yet both may be suitable for the same job. Further, in some cases, self-taught web developers with an impressive portfolio of work may be able to altogether bypass formal education requirements.\textsuperscript{125} This message is echoed in the report by Vu, Lamb and Willoughby, where their analysis emphasized the importance of mixed skills. Notably, their data are reflective of employer beliefs about the roles and skills needed for their organization, which did not always reflect credentials.\textsuperscript{126}

\textsuperscript{120} The article references research conducted by Glassdoor, see Counter, R. (2018). \textit{Want a job in Canadian tech? Don’t worry about that university degree.} Canadian Business.
\textsuperscript{123} Tandon, N. (2012). \textit{A bright future in ICTs: Opportunities for a new generation of women.} International Telecommunication Union.
\textsuperscript{125} See Randstad “web developer” page and description: Randstad. (n.d.). \textit{Web Developer job postings.}
In *Future Computed*, Microsoft president Brad Smith and executive vice president of artificial intelligence and research Harry Shum emphasize that lessons from a liberal arts education are necessary for the proper development of people who work with artificial intelligence (AI), stating that:
... skilling-up for an AI-powered world involves more than science, technology, engineering and math. As computers behave more like humans, the social sciences and humanities will become even more important. Languages, art, history, economics, ethics, philosophy, psychology and human development courses can teach critical, philosophical and ethics-based skills that will be instrumental in the development and management of AI solutions.127

Employers are finding it increasingly difficult to evaluate the legitimacy and quality of training and education programs.128 In response, portfolio approaches (including e-portfolios), “badging platforms,” hackathons and work-integrated learning are increasingly being used by employers to assess competencies, particularly as more job-seekers have diverse backgrounds and as jobs are changing. New techniques designed to test and recognize these credentials are emerging, including self-assessments to test attitudes and behaviours; general standardized tests to assess essential skills; and tests to measure skills in specific tools or techniques (with the latter often provided by the industry leader who makes or distributes the tool as shown in Appendix C). But it’s not clear whether individuals can accurately and objectively assess their own skills and skill levels, and there is debate about whether the onerous, often time-consuming and unpaid assessment and interview process is fair to candidates; some see it as exploitation in the recruitment process.129, 130, 131

Training and upskilling programs

Post-secondary institutions are developing programs to better respond to industry needs. Examples include the Queen’s University MBA in Artificial Intelligence and the George Brown College Bachelor of Digital Experience Design.132, 133 The changes are not limited to post-secondary institutions; there is growing emphasis on digital skills in public elementary schools, and many provinces are making coding a mandatory part of the primary or secondary curriculum.134

131 Popomaronis, T. (2019). Here’s how many Google interviews it takes to hire a Googler. CNBC.
At the same time, traditional educational institutions take a long time to add to or adapt curricula or programs, which has meant that higher education often lags behind industry. The resulting education and training void has increasingly been filled by innovation centres in post-secondary institutions, public online platforms, private training companies and government-funded upskilling programs.

Short training programs (e.g., Bitmaker, Brainstation, Miami Ad School) focus on specific tools or techniques. Some company and public-sector organization upskilling programs—such as those at AT&T, the Government of Canada and Amazon Web Services—upskill existing employees. Work-integrated learning (WIL) programs (e.g., nPower and ADaPT) and community-based models (e.g., Canada Learning Code) are also working to upskill and reskill workers. New programs, such as Skills for Change, develop pathways for internationally educated individuals in ICT trades and professions to shift from one sector to another or seek to level the field for underrepresented groups in technology. Appendix B identifies some of these training and upskilling models.

The ADaPT (Advanced Digital and Professional Training) program is one example of a stand-alone, employer-driven WIL skills development and work placement program for recent graduates, run by Ryerson University. ADaPT addresses the skills gap between employer needs and graduate skills by providing intensive training for university graduates or senior students that is adjacent to, but not embedded in, formal programming. It is conducted in collaboration with employers and industry partners in the form of a paid work term. This program is particularly innovative because it recruits from across the social sciences, offering graduates from non ICT-specialist programs an opportunity to grow their capacities in digital literacy, communications and business financials. Short work placements with industry partners help graduates amplify their non-cognitive soft skills with practical experience and technical know-how. WIL programs such as ADaPT are designed to respond to changing trends in global workforces that forecast a growing demand for these non-technical skills.

Many companies and organizations outsource to third-party training companies to train employees in digital skills. For example, Google, RBC, Uber and Deloitte use Brainstation to offer courses in design, data and development. Udacity has been used by companies such as AT&T to train staff in data science, machine learning and artificial intelligence, business and marketing, web programming,

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138 See BrainStation. (n.d.). BrainStation 2019 Outcomes Report Data & Methodology.
cutting-edge technology and mobile programming.\textsuperscript{139} Galvanize is similar to Udacity in its training delivery, but focuses on training employees in a range of technology skills using cloud computing.\textsuperscript{140}

Training and upskilling is big business. Coding boot camps alone are estimated to be a $240-million business in North America.\textsuperscript{141} Lighthouse Labs, Red Academy, HackerYou and others offer intensive coding training (in as few as 10 weeks) focused on hands-on experience and placing participants in jobs. Lighthouse Labs claims that 93\% of its graduates are hired within 120 days of program completion.\textsuperscript{142}

While the approaches to addressing the skills gap discussed above provide a sense of both the problem and potential solutions, much is still unknown about the effectiveness and outcomes of relying upon different skills frameworks. Further, where different methods are being applied to try to close the skills gap, there is as yet inadequate data to understand whether these actions are serving to address skills and labour-market shortages.

\textsuperscript{139} Udacity’s “nanodegrees” have been offered for mostly coding. For more information on Udacity and AT&T training partnership see, Udacity. (n.d.). \textit{AT&T Software Development Internships 2019}.

\textsuperscript{140} For more information, see Galvanize. (n.d.). \textit{Accelerate Innovation with Enterprise Education}


\textsuperscript{142} For more information, see Lighthouse Labs. (n.d.). \textit{Homepage}. 
NEXT STEPS

Digital skill and labour shortages are the product of multiple overlapping challenges, including the limitations of ICT occupational definitions; the difficulties inherent in identifying “digital skills;” the lack of consistency around digital skills/competency frameworks; and employers limiting their recruitment and retention practices in ways that disproportionately exclude certain populations. Opening new pathways for people to work in digital jobs—or to acquire the necessary digital skills to do their job in workplaces of the future—requires clarity and consistency in defining jobs and skills, innovation in skills development programming, and changes to how employers’ hire, train and retain skilled workers.

There is general agreement that there is a need to reduce the conceptual confusion between a job, the skills needed to perform a job and the tools used to complete it. Part of this problem stems from the fact that existing classification systems, while helpful for more traditional occupation groupings, are not yet capturing emerging or hybrid-roles sufficiently.

There is also increasing acceptance of the need to focus on skills rather than credentials. In support of this, there are a number of emerging and innovative approaches that can, and are increasingly being used to, fill the perceived shortage of skilled workers, including corporate-upskilling initiatives, event-style recruitment (Hackathons) and HR services dedicated to sourcing tech-talent. This report’s appendices provide data on digital skills frameworks (Appendix A), digital training models (Appendix
B) and assessment tools (Appendix C). This data may form the foundation for research and further reviews on the state of the field of approaches to addressing the skills gap.

Moving forward, there is a need to promote the development, identification and support of a larger group of standard definitions and approaches to make significant progress on digital skills. Indeed, an over-abundance of skills frameworks, training models and assessment tools is one of the sources of existing confusion and uncertainty around the best way to make progress in this area. Achieving agreement on a set of standard definitions and approaches will not be simple or easy, but doing so will be an important step forward because it will help provide a foundation for the deployment, monitoring and assessment of new and emerging approaches to digital skills identification, development and employment. In so doing, such agreement will help open new pathways to digital skills, especially for those who are currently underrepresented, thereby creating an exciting opportunity to close the digital skills gap.
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### Appendix A - Comparing Digital Skills Frameworks

<table>
<thead>
<tr>
<th>Model</th>
<th>Date</th>
<th>Aim</th>
<th>Core demographic</th>
<th>Sample of core knowledge identified</th>
<th>Sample of ICT-specific knowledge identified</th>
<th>Dimensions identified to address skills gap</th>
<th>Levels identified</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Digital Skills Frameworks</strong></td>
<td></td>
<td></td>
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<tr>
<td>&quot;DigComp 2.0: The Digital Competence framework for Citizens,&quot; European Commission</td>
<td>2014</td>
<td>General tool for improving digital literacy for EU citizens</td>
<td>General: EU citizens</td>
<td>Communication; content creation; safety; problem-solving</td>
<td>Information-processing</td>
<td>5 competence areas</td>
<td>--</td>
</tr>
<tr>
<td>&quot;Digital Skills and Business School Curriculum,&quot; Cukier, Smarz and Grant</td>
<td>2017</td>
<td>General pedagogical tool for business school curriculum mapping and development</td>
<td>K-12 grade school students; students/ occupational training level; general audience (self-study/ social interaction)</td>
<td>Start up and build SMEs; enhance personal opportunities and quality of life</td>
<td>Develop innovative ICT infrastructure; capacity to innovate using digital technology</td>
<td>3 levels x 3 age groups = 9 dimensions</td>
<td>3: Basic literacy; business/ technology skills/deep technical and content creation</td>
</tr>
<tr>
<td>&quot;Digital Skills Toolkit,&quot; International Telecommunications Union</td>
<td>2018</td>
<td>To address the digital skills gap globally and support youth employment</td>
<td>General audience; youth</td>
<td>Word processing; using keyboards and touch screens</td>
<td>AI; cybersecurity; IoT</td>
<td>3, reflecting the levels</td>
<td>3: Basic; intermediate; advanced</td>
</tr>
<tr>
<td>&quot;New Vision for Education: Unlocking the Potential for&quot;</td>
<td>2015</td>
<td>General pedagogical tool</td>
<td>General audience</td>
<td>Numeracy; literacy; financial</td>
<td>ICT literacy</td>
<td>3: Foundational literacies; competencies; character qualities</td>
<td>--</td>
</tr>
<tr>
<td>Source/Model</td>
<td>Year</td>
<td>Audience</td>
<td>Purpose</td>
<td>Problem-solving</td>
<td>Collaboration</td>
<td>Creative expression</td>
<td>ICT literacy</td>
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<tr>
<td>“Brymawr College Digital Competencies Framework,” Bryn Mawr College</td>
<td>2016</td>
<td>General pedagogical tool</td>
<td>General audience</td>
<td>Digital survival skills; digital communication</td>
<td>Data analysis and presentation; data management and preservation</td>
<td>5 competencies</td>
<td>4: unclear</td>
</tr>
<tr>
<td>“JRC Conceptual Model,” Pete Cranston/Euforic Services/ITAD</td>
<td>2011</td>
<td>General tool for improving digital literacy for citizens</td>
<td>General audience</td>
<td>Problem-solving; collaboration; creativity and expression</td>
<td>ICT literacy; information management; application skills for networked visual and dynamic media</td>
<td>4: unclear</td>
<td></td>
</tr>
<tr>
<td>“Brookfield Skills Map,” Do and Huynh, Brookfield Institute</td>
<td>2017</td>
<td>General tool to address the digital skills gap and support workers in the digital era</td>
<td>Labour force</td>
<td>Problem-solving; flexibility; entrepreneurial thinking; collaboration</td>
<td>Computational thinking</td>
<td>3: technical skills; cognitive abilities; critical thinking</td>
<td>3: Baseline; workforce; professional</td>
</tr>
<tr>
<td>“BTM Learning Outcomes,” BTM Forum and ITAC</td>
<td>2009</td>
<td>General tool to address the digital skills gap and support workers in the digital era</td>
<td>Labour force</td>
<td>Project management; teamwork; organizational learning; decision-making</td>
<td>Data-warehousing; digital-marketing; packaged software</td>
<td>3: foundations; roles and skills; outcomes Sub-divided into 7: 1) integrative; 2) personal and interpersonal; 3) business; 4) technology; 5) technology in business, 6) innovation; 7) processes, projects and change</td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td>Year</td>
<td>Description</td>
<td>Core Skills</td>
<td>Additional Skills</td>
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<tr>
<td>&quot;All Aboard: Digital Skills in Higher Education&quot;</td>
<td>2017</td>
<td>Pedagogical tool for post-secondary educators</td>
<td>Students; teachers</td>
<td>Presentation skills; project management; producing content; time management; Operating systems; coding; app development</td>
<td></td>
<td></td>
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<tr>
<td>&quot;New Foundational Skills of the Digital Economy: Developing the Professionals of the Future.&quot;</td>
<td>2018</td>
<td>Pedagogical tool and general use tool to address the digital skills gap and support workers in the digital era</td>
<td>Students; teachers; working professionals in the labour force</td>
<td>Analytical skills; critical thinking; project management; Digital design; digital security and privacy; analyzing data</td>
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<tr>
<td><strong>ICT Specific Skills Frameworks</strong></td>
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<tr>
<td>&quot;Business Technology Management (BTM) Body of Knowledge (BOK) Framework.&quot;</td>
<td>2017</td>
<td>Tool for stakeholders working in, training and hiring business technology professionals</td>
<td>HR professionals, employers, BTM professionals</td>
<td>People and knowledge management; project management; services management; business analysis; System integration; software; model-driven engineering</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;European Framework for ICT Professionals/e-Competence Framework.&quot;</td>
<td>2018</td>
<td></td>
<td>HR professionals; employers; ICT professionals</td>
<td>Needs identification; project and portfolio management; relationship management; Application design; technology trend monitoring; systems engineering</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;ICT professional Core Body of Knowledge.&quot;</td>
<td>2015</td>
<td>Tool for ICT professionals; employers and employers</td>
<td>HR professionals; employers; 1) ethics, 2) professional expectations</td>
<td>Hardware and software fundamentals; 4: Problem solving, abstraction and design; ethics and professionalism;</td>
<td></td>
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</tr>
<tr>
<td><strong>Organization</strong></td>
<td><strong>Year</strong></td>
<td><strong>Classification</strong></td>
<td><strong>Skills</strong></td>
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<tr>
<td>Skills Next 2020</td>
<td></td>
<td>Other stakeholders in the labour market</td>
<td>ICT professionals</td>
<td>3) teamwork concepts and issues, 4) interpersonal communication, 5) societal issues/legal issues/privacy, and 6) understanding the ICT profession</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skills Future SG (Singapore)</td>
<td></td>
<td>Skills mapping to strengthen adult training infrastructure</td>
<td>Aspiring ICT professionals</td>
<td>6 levels of proficiency mapped for numerous skills</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O*NET</td>
<td>Current</td>
<td>Classification of occupation-based skills</td>
<td>General</td>
<td>Comprehensive database</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WEF</td>
<td>2018</td>
<td>Classification of skills used, based on O*NET content model</td>
<td>General stakeholders</td>
<td>Numerous competencies bundled by broader areas — e.g. emotional intelligence</td>
<td></td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td>Technology selection, monitoring and control</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>26 bundles of competencies</td>
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</tbody>
</table>

**Notes:**
- **CBOK:** Australian Computer Society
- **O*NET:** Current Classification of occupation-based skills
- **WEF:** 2018 Classification of skills used, based on O*NET content model
- **Levels 1 to 6**
### Appendix B - Digital Training Models

<table>
<thead>
<tr>
<th>Model Type</th>
<th>Stakeholders offering this training</th>
<th>Typical focus of training</th>
<th>Target demographic</th>
<th>Method of delivery</th>
<th>Examples of Innovative Approaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary and high school new curriculums focused of digital skills; extracurricular curriculums</td>
<td>Public and private primary and secondary schools</td>
<td>Coding; gaming; problem-solving using digital tools; math and digital tools</td>
<td>Children and youth</td>
<td>Embedded in elementary and high school curriculum</td>
<td>Sylvan Learning, Coding for Kids, Techy School, Coding and Programming for Kids Grade 6+ online</td>
</tr>
<tr>
<td>University degree or college diploma/formal undergraduate or graduate training</td>
<td>Universities, colleges</td>
<td>Computer science, btm, engineering, information science, digital media degree programs</td>
<td>Youth, undergraduates</td>
<td>Paid</td>
<td>Queen’s MBA in Artificial Intelligence, George Brown Bachelor of Digital Experience Design, MIT, Bachelor of Science in Computer Science, Economics, and Data Science</td>
</tr>
<tr>
<td>Work integrated learning (WIL)</td>
<td>Universities, colleges, public organizations, not-for-profits</td>
<td>Diverse</td>
<td>Youth, mid-career working professionals</td>
<td>Can be part of formal undergraduate training or standalone</td>
<td>Diversity Institute, Ryerson University, AdaPT, NPower Canada, Palette, TalentX Bridge</td>
</tr>
<tr>
<td>Continuing education/formal post-graduate certification</td>
<td>Universities colleges, innovation centres,</td>
<td>Analytics, Digital Media, Intensive</td>
<td>Working professionals</td>
<td>Continuing education courses in skills training; fee per user</td>
<td>George Brown College, Information and</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Professional Development Programs</th>
<th>Coding, Technology Certifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bridging programs</strong></td>
<td><strong>Communications Technology program</strong></td>
</tr>
<tr>
<td>Public, not-for-profit</td>
<td>British Columbia Institute of Technology, Web Technologies</td>
</tr>
<tr>
<td>Diverse</td>
<td>Harvard, IT Academy</td>
</tr>
<tr>
<td>Internationally trained individuals (ITI) Professionals bridging from one field to another</td>
<td>Humber College, Bridging Programs, ex. IT Infrastructure</td>
</tr>
<tr>
<td>Online, in person</td>
<td>Calgary Catholic Immigration Society, Information and Technology Bridging Program</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Massive open online courses (MOOCs)</th>
<th><strong>LinkedIn Learning</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Public, private, and not for profit</td>
<td><strong>Lynda.com</strong></td>
</tr>
<tr>
<td>Diverse</td>
<td><strong>Khan Academy</strong></td>
</tr>
<tr>
<td>Typically those with existing credentials</td>
<td><strong>edX</strong></td>
</tr>
<tr>
<td>MOOCs could be free or fee-based</td>
<td><strong>Coursera</strong></td>
</tr>
<tr>
<td>Online multimedia including video and text. Typically, non credit, no grades and no/low costs for the courses. Certification often is for a fee.</td>
<td><strong>FutureLearn</strong></td>
</tr>
<tr>
<td><strong>Friday Institute, MOOC-Ed</strong></td>
<td><strong>EMMA MOOC Aggregator</strong></td>
</tr>
<tr>
<td><strong>ALISON</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Upskilling or training programs</th>
<th>Firms providing individuals and corporations with skills courses; fee-based; upskilling and corporate training mainly Delivered in-person and online</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employers, public and not for profit</td>
<td><strong>Brainstation</strong></td>
</tr>
<tr>
<td>Intensive training for coding, analytics, UX etc.</td>
<td><strong>Bitmaker GA</strong></td>
</tr>
<tr>
<td>Mainly working professionals</td>
<td><strong>Canada Learning Code</strong></td>
</tr>
<tr>
<td>Current employees,</td>
<td><strong>Red Academy</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Hacker U</strong></td>
</tr>
<tr>
<td>Programs with specific demographic focus</td>
<td>Varied</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Interns, candidates</td>
<td></td>
</tr>
<tr>
<td>Intensive programs (often online) that teach advanced computer skills, e.g. Coding schools/ coding camps</td>
<td></td>
</tr>
</tbody>
</table>
## Appendix C – Assessment Tools

<table>
<thead>
<tr>
<th>Test for Skills and Competencies</th>
<th>Assessment focus</th>
<th>Method</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-assessment tests</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>PIAAC</td>
<td>Measures key cognitive and workplace skills</td>
<td>Home interviews, computer survey</td>
<td>Understand how education and training systems can nurture skills</td>
</tr>
<tr>
<td>OECD ESO (Education Skills Online)</td>
<td>Literacy, numeracy, problem-solving, use of tech</td>
<td>Online test</td>
<td>Benchmarks test-takers against global demographic</td>
</tr>
<tr>
<td>Lumina Spark</td>
<td>Psychometric</td>
<td>Online questionnaire</td>
<td>Self-knowledge, fit within work teams</td>
</tr>
<tr>
<td><strong>Standardized tests to measure essential skills</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESDC Essential Skills Indicator</td>
<td>Numeracy, document use, reading,</td>
<td>Online pre- and post-tests up to 3 levels</td>
<td>Individual skill assessment, identify skill and improvement levels</td>
</tr>
<tr>
<td>Towes</td>
<td>General, sector, domain-specific, web-based</td>
<td>Paper-based and online</td>
<td>Employers assess workers’ skills Employees, students and job-seekers identify and develop skills Trainers develop strategies</td>
</tr>
<tr>
<td>ESKARGO Initial Skills Assessment</td>
<td>Skills, Knowledge and Attitudes</td>
<td>Print</td>
<td>Adult and continuing ed practitioners</td>
</tr>
<tr>
<td>Canadian Adult Reading Assessment (CARA)</td>
<td>Reading patterns</td>
<td></td>
<td>Diagnostic tool for adult literacy education</td>
</tr>
<tr>
<td>CABS: Common Assessment of Basic Skills</td>
<td>Reading, writing, numeracy, technology (basic computer skills)</td>
<td>Online</td>
<td>Adult learners and career practitioners</td>
</tr>
<tr>
<td>The Essential Skills Group</td>
<td>Three online assessments (reading, document use, numeracy) for numerous occupations</td>
<td>Online Tests</td>
<td>Occupational fit</td>
</tr>
<tr>
<td><strong>Tests to Measure Specific Tools or Techniques</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pega CSA Exam</td>
<td>Knowledge of Pegasystems platform</td>
<td>Online</td>
<td>Used by Pegasystems to grant certification</td>
</tr>
<tr>
<td>Salesforce</td>
<td>Salesforce platform</td>
<td>Online through Pearson Vue</td>
<td>Certification</td>
</tr>
<tr>
<td>Criteria Pre-employment testing</td>
<td>Skills tests on MS Office programs, basic computer literacy, typing, etc.</td>
<td>Web-based</td>
<td>Employers for screening applicants</td>
</tr>
<tr>
<td>TOSA Digital Solutions</td>
<td>Adobe Creative Suite, OS skills</td>
<td>Web-based platform</td>
<td>Assessment tests for HR, certification tests for individuals</td>
</tr>
</tbody>
</table>