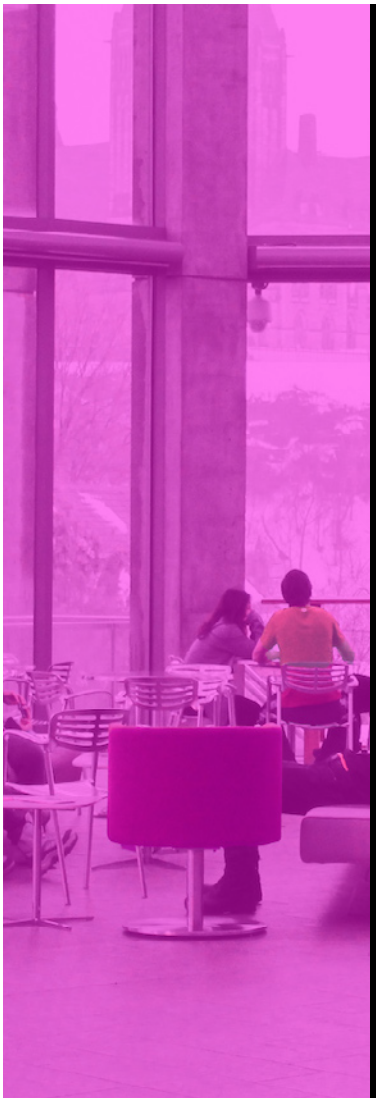
The Conference Board of Canada

In partnership with Future Skills Centre

Digital Occupation Pathways

From Vulnerable Jobs to Rapid-Growth Careers

Impact Paper | March 29, 2023



Future Skills Centre

The Future Skills Centre – Centre des Compétences futures (FSC-CCF) is a forward-thinking centre for research and collaboration dedicated to preparing Canadians for employment success. We believe Canadians should feel confident about the skills they have to succeed in a changing workforce. As a pan-Canadian community, we are collaborating to rigorously identify, test, measure, and share innovative approaches to assessing and developing the skills Canadians need to thrive in the days and years ahead.

The Future Skills Centre was founded by a consortium whose members are Toronto Metropolitan University, Blueprint, and The Conference Board of Canada.

If you would like to learn more about this report and other skills research from FSC, visit us at fsc-ccf.ca or contact info@fsc-ccf.ca.

fsc-ccf.ca

In partnership with: Toronto Metropolitan University, The Conference Board of Canada, Blueprint

Funded by the Government of Canada's Future Skills Program | Canada

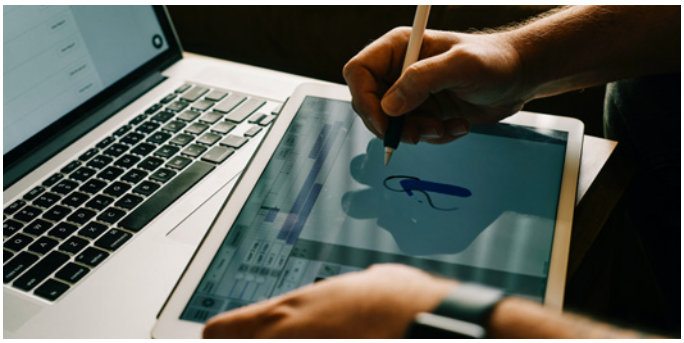
Contents

Key Findings

- Career pathways to rapid-growth occupations in the digital economy are open to all workers whose roles are at high risk of automation and who have limited career mobility. We refer to these vulnerable occupations as high-risk, low-mobility (HRLM) occupations.
- Digital occupations are often specialized in science, technology, engineering, and math (STEM) fields. Due to the nature of these positions, upskilling from HRLM jobs to digital economy occupations will often require one to three years of training.
- Only 22 of 92 HRLM occupations (such as accountants, administrative assistants, dental technologists) have at least one transition pathway available to them with six months of training. But the number of HRLM occupations with at least one desirable transition increases to 79 with one year of training.
- Based on projections over the next decade, the ability to transition is uneven across the provinces and territories. For example, Prince Edward Island, Saskatchewan, and Newfoundland and Labrador have a high automation vulnerability. Additionally, they have a low ability to transition workers in high-risk automation occupations into fast-growing ones in the digital economy.
- A growing segment of the labour force will be employed in the digital economy in the future, as digital technologies are more fully integrated into business processes. There are currently 880,000 workers in digital jobs that will grow by 12 per cent to 983,000 in 2030. Accordingly, the public sector needs to provide stronger support for reskilling and upskilling at-risk or displaced workers.

Introduction

Digitalization Is Reorganizing Economic Activities and the Labour Markets Supporting Them



Basically, digitalization means using the latest technology to do things more effectively or efficiently than before. Companies achieve digitalization by replacing manual (i.e., non-digital) processes with digital ones or replacing outdated digital technology with upgraded digital technology.[1]

Advances in digital and automation technologies are fundamentally changing how goods and services are produced and delivered and will have huge implications for the labour market. While investment in technology and the resulting productivity gains are a desired outcome for the economy, it creates uncertainty for workers whose skills become obsolete in this process.

The increased integration of digital processes into the physical production of goods and services implies a labour market in which software, communication, and data analysis skills dominate. However, Canada's labour market is unlikely to be ready for an increasingly digitalized economy. One survey found that 86 per cent of Canadians feel unprepared to meet the future digital skills requirements of businesses.[2] Another found that 80 per cent of businesses need more workers with digital skills. However, 68 per cent have trouble finding and hiring the talent with them.[3]

In one study of developed countries, jobs requiring digital skills accounted for 6 to 12 per cent of all vacancies posted online between 2012 and 2021. The share of digital occupations steadily increased over the same period.[4] For example, in Canada, online job postings for software development, programming, and engineering were more than three times higher in 2021 than in 2012. Online job postings for data scientists in Canada (along with the U.K. and the U.S.) increased more than 40 times between 2012 and 2021.[5]

1 Deloitte, "What Is Digital Economy?"
2 Salesforce Research, "Digital Skills Index."
3 KPMG, "Nearly 70 Per Cent of Canadian Businesses."
4 World Economic Forum, "Digital Skills."
5 Ranstad, *Digital Skills*.

These Changes Are Coalescing in the Digital Economy

Broadly, the digital economy comprises the "economic activity that results from billions of everyday online interactions among people, businesses, devices, data, and processes."[6] By 2025, digital ecosystems could account for more than $60 trillion in revenue or more than 30 per cent of global corporate revenue.[7] Similarly, an estimated 70 per cent of new business value over the next decade will be based on digitally enabled platforms.[8]

There are many industries relevant to the digital economy, encompassing a wide range of activities. This diversity reflects the ubiquity of digital transformation across the Canadian economy but makes it challenging to pinpoint the most relevant industries. We narrow our focus to industries centered on enabling infrastructure (i.e., hardware and software), e-commerce, and priced digital services (i.e., cloud, telecom, Internet, and data services). Examples of these industries include software publishers, electronic shopping, couriers, and telecom carriers.

The types of occupations we are most interested in are highly concentrated in our selected industries. Therefore, they are fundamentally important to the types of activity generated by the digital economy. Similarly, we are interested in occupations that we project to grow faster than average over the next decade. Examples include computer programmers, information systems analysts, technical sales specialists, and graphic designers.

(See Appendix B for the list of industries and occupations crucial to Canada's digital economy.)

Digital Transformation Presents Both an Opportunity and a Challenge for Canada

Currently, the role of digital technology is to enable fundamental innovation and disruption and no longer to be a driver of marginal efficiency.[9] The interconnectivity of business operations – via 5G and the Internet of Things (IoT) for example – empowers businesses to control every aspect of their operation. It also allows them to leverage unwieldy datasets for real-time insights that can boost productivity, improve processes, and drive growth. Digital services like these will improve productivity in sectors as varied as natural resources, manufacturing, healthcare, and finance.

These technological changes are driving businesses increasingly toward data-centric business models that require new skills and capabilities in the workforce. Because technology-intensive firms tend to grow faster than other types of firms,[10] organizations will need to understand how to identify, capture, and retain these skills to remain competitive.

As a result, there will likely be an increase in skill mismatches and long-term unemployment in transitioning to the digital economy.[11] Some occupations will see significantly higher wages as a result of increased labour demand for scarce skills. New and more specialized occupations that complement technology will emerge. Others will become redundant due to automation.[12]

Our previous work indicated that one in five jobs in Canada is at risk of being automated to some degree.[13] Successfully upskilling this vulnerable segment of the workforce for the digital economy will be necessary for sustained economic growth and has the potential to improve Canada's relatively low productivity.[14]

6 Deloitte, "What Is Digital Economy?"

7 Hirt, "If You're Not Building an Ecosystem."

8 World Economic Forum, "Shaping the Future of Digital Economy."

9 Weinelt, "What Are the Digital Industries of Tomorrow?"

10 Bank of Canada, *The Digital Economy.*

11 Weinelt, "What Are the Digital Industries of Tomorrow?"

12 Bank of Canada, *The Digital Economy.*

13 Gresch, *Responding to Automation.*

14 According to the Organisation for Economic Co-operation and Development, when measured as GDP in 2015 U.S. dollars, Canada's labour productivity in 2020 was US$56.9 per hour, while the average for G7 countries was US$64.7– a 14 per cent gap.

Objectives

There is greater demand than ever for people who have the know-how to develop, adopt, and use digital technologies. Despite Canadians' potential to adapt to this dramatic digital shift, we must better understand these enabling skills to prepare for the future of work.[15]

Here we assess the ability of the 92 HRLM occupations to transition into 21 rapid-growth occupations in the digital economy.[16] Understanding the occupational pathways from HRLM occupations into rapid-growth digital occupations will accelerate Canada's ability to undertake digital transformation and provide a roadmap for career transitions that can mitigate worker displacement. We aim to inform policy-makers and human capital professionals on three crucial areas of occupational transitions:

1. The first is to understand the training requirements for transitioning people from vulnerable occupations into high-growth ones in the digital economy. This includes the type of skills development and the length of time required to enable this upskilling.
2. The second is to provide a provincial and territorial breakdown of the high-growth digital employment potential and its relationship to automation vulnerabilities.
3. The third is to model the cost of skills development by province and territory. Knowing the cost of these transitions can help provinces prioritize where resources should go to speed up and strengthen transition pathways from HRLM to rapid-growth digital occupations. The modelling can also help academic institutions and job training organizations determine the types of programs most needed.

Workers in HRLM occupations are particularly prone to automation while facing limited opportunities for transitioning to more promising jobs in the absence of significant retraining efforts.[17] Previously, we modelled potential transition pathways from HRLM occupations to rapid-growth occupations in the clean economy and the sustainable blue economy.[18] Policy-makers must understand which of these transitions are the most desirable. They must also know what training is required and available so they can effectively and efficiently allocate resources to prepare Canada's economy for the future and achieve the greatest positive economic impact.

15 Hutchison, *Digital Skills for Today and Tomorrow*.

16 Rapid-growth occupations are those we project to grow at a faster rate than the economy average.

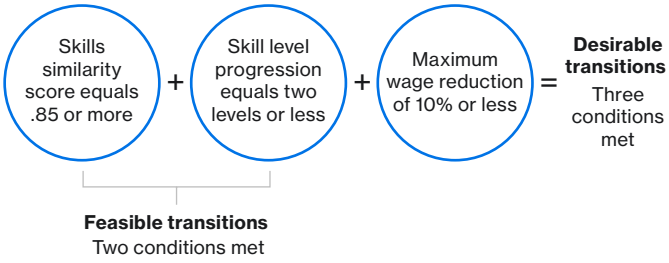
17 See Gresch, *Responding to Automation*, for the list of HRLM occupations.

18 Sonmez, Thomson, and Gresch, *Green Occupation Pathways*; and Carpenter, Sonmez, and Gresch, *Blue Occupation Pathways*.

Modelling Occupational Transitions

In modelling transitions from HRLM occupations to rapid-growth occupations in the digital economy, we must consider feasibility and desirability of each transition. As such, we examine three: skills similarity, mobility between skill levels, and wage differences (see Exhibit 1). This isn't to say that that these conditions are sufficient for upskilling to occur; however, they are necessary.

Exhibit 1
Three Conditions That Define Feasible and Desirable Occupational Transitions



Source: The Conference Board of Canada.

Transitions Must First Be Feasible

For a transition from an HRLM to a high-growth digital occupation to be feasible, the two occupations must have a high skills similarity score and a realistic progression to higher skill levels from training.

The skills in our similarity score component are classified into two broad categories: cognitive skills and task-based skills. These categories distinguish between two necessary workplace skills: general human capital (i.e., cognitive skills) and specific human capital (i.e., task-based skills and knowledge areas). We estimate cognitive and task-based skill distances between a given pair of occupations using the cosine similarity score.[19]

Skill levels are determined by the amount of training, education, and experience required and the complexity of work involved compared with other occupations. Moving from a lower to a higher skill level category almost always requires on-the-job training or additional formal education. Therefore, any upward progression is proportional to the training effort. There is no progression for a minor training effort,[20] one level of progression for a moderate training effort, and two levels of progression for a major training effort. We exclude progression beyond two levels and transitions that involve excess skills.[21]

19 Cosine similarity measures the angle between any two non-zero vectors. It is defined as the inner cosine product space of the angle between the two vectors. The values of cosine similarity range from 0 to 1. See Rao, Hindle, and Gabler, *Modelling Job Transitions in Canada* for a detailed explanation.

20 The minor training effort is necessary to transition to different occupations with the same skill level but is insufficient upward mobility on the skill ladder.

21 We exclude transitions that involve excess skills (i.e., resulting from transitions from higher-skill to lower-skill jobs) because they are undesirable for workers and unproductive from a societal perspective.

In addition to skills and skill levels, we include abilities, work activities, knowledge areas, education, training, and experience in the calculation of the overall similarity score. In this regard, modelled transitions recognize that most people bring more to bear on a career transition than just what's listed in a job description for their current role.[22]

How Training Translates to Improved Skills

Identifying feasible occupational transitions is methodologically challenging as it requires determining the equivalence between years of training and skill gains. There is currently a lack of empirical data to show the skills improvement gained from a year of education or on-the-job training, especially regarding task-based skills. To address this shortfall, we take the identified feasible occupational transitions, examine the distribution of skills shortages among them, and reasonably assume that:[23]

- six months of training can close the 25th percentile of a worker's skill shortages;
- one year of training can close the 50th percentile of a worker's skill shortages;
- three years of training can close the 75th percentile of a worker's skill shortages.

(See Appendix A for a more detailed discussion of skills gains.)

They Must Also Be Desirable

For a transition to be desirable, skills similarity and skill level progression must be combined with a quality of life similar to which a worker is accustomed. The Organisation for Economic Co-operation and Development estimates the average annual earnings loss of workers in five member countries one year after displacement as 10 per cent.[24]

Our model, therefore, allows a maximum wage reduction of 10 per cent for a desirable transition as workers are unlikely to move to other occupations if transitions entail large wage drops.

Other factors affect whether transitions are desirable, such as perceptions of the destination job and its associated job security and quality. Similarly, there are barriers to the process of upskilling for specific roles, such as a lack of financial support, a lack of labour market information, and the length of time it takes to upskill. However, these factors are not readily incorporated into our quantitative model.[25]

More Training Enables More Transitions

While there are 1,932 potential transitions between HRLM and high-growth digital occupations, not all of these are desirable (see Table 1). In fact, with up to six months of training only 146 of these transitions, or 7.6 per cent, are desirable. This number quadruples once retraining is upped to one year Yet, this still leaves less than half of transitions desirable. The number of desirable transitions increases further to 74 per cent after three years of training. This means that the majority of opportunities for HRLM workers to enter rapid-growth digital occupations would become available.

The fact that three years of retraining is still not sufficient to enable all transitions primarily reflects the large skill gaps between some HRLM and digital roles. Many rapid-growth digital occupations are dominated by STEM, with highly specialized skills across all the digital sub-sectors. Additionally, the drop in transitions from adding our desirability requirement indicates that some occupations in the digital economy would pay too little for HRLM workers.[26]

22 It is important to note that note all types of experience are equally transferable between occupations.

23 See Bechichi and others, *Occupational Mobility, Skills, and Training Needs* for the basis of these assumptions.

24 Organisation for Economic Co-operation and Development, OECD Employment Outlook 2013.

25 See Sonmez, Thomson, and Gresch, *Green Occupation Pathways* for an exploration of these factors via a survey of over 500 Canadian employees.

26 This wage desirability criterion is binding for 29 per cent, 11 per cent, and 7 per cent of transitions in the minor, moderate, and major training scenarios. Its impact decreases with training because more training enables transitions to higher paying jobs in the digital economy.

Table 1
Transition Pathways Increase Substantially With More Training
(number; percentage)

	All Transition Pathways	Feasible Transition Pathways		Desirable Transition Pathways		
Training scenario	All transition pathways	Number of transition pathways	Percentage of all transition pathways	Number of transition pathways	Percentage of feasible transition pathways	Percentage of all transition pathways
Minor training (i.e., six months)	1,932	206	10.7	**146**	70.9	**7.6**
Moderate training (i.e., one year)	1,932	891	46.1	**789**	88.6	**40.8**
Major training (i.e., three years)	1,932	1,548	80.1	**1,435**	92.7	**74.3**

Sources: The Conference Board of Canada; O*NET; Vicinity Jobs.

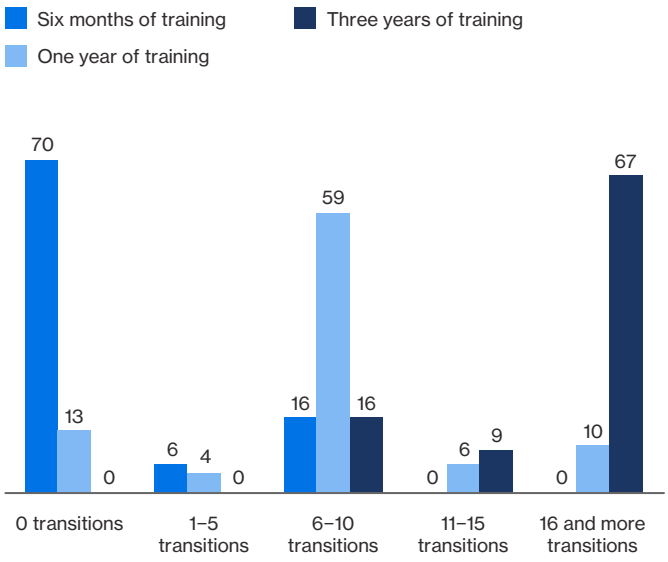
While six months of training enables a few desirable transition pathways for some (i.e., 22) HRLM occupations, one year of training enables transitions for most (i.e., 79) HRLM occupations (see Chart 1). However, three years of training opens up a minimum of six potential transitions for all HRLM workers. This provides the most choice to workers looking to enter the digital economy.

The minor training scenario provides a maximum of nine desirable transition pathways for 22 of the HRLM occupations, but no options for 70 of them. Due to this shortfall, the minor training scenario on its own is unlikely to provide a valuable return for HRLM job training programs in the digital economy. However, it is important to keep in mind that smaller training spells can potentially trigger follow-up learning and foster lifelong learning. While our model does not account for this, many short-cycle, modular learning experiences could underpin successful career transitions.

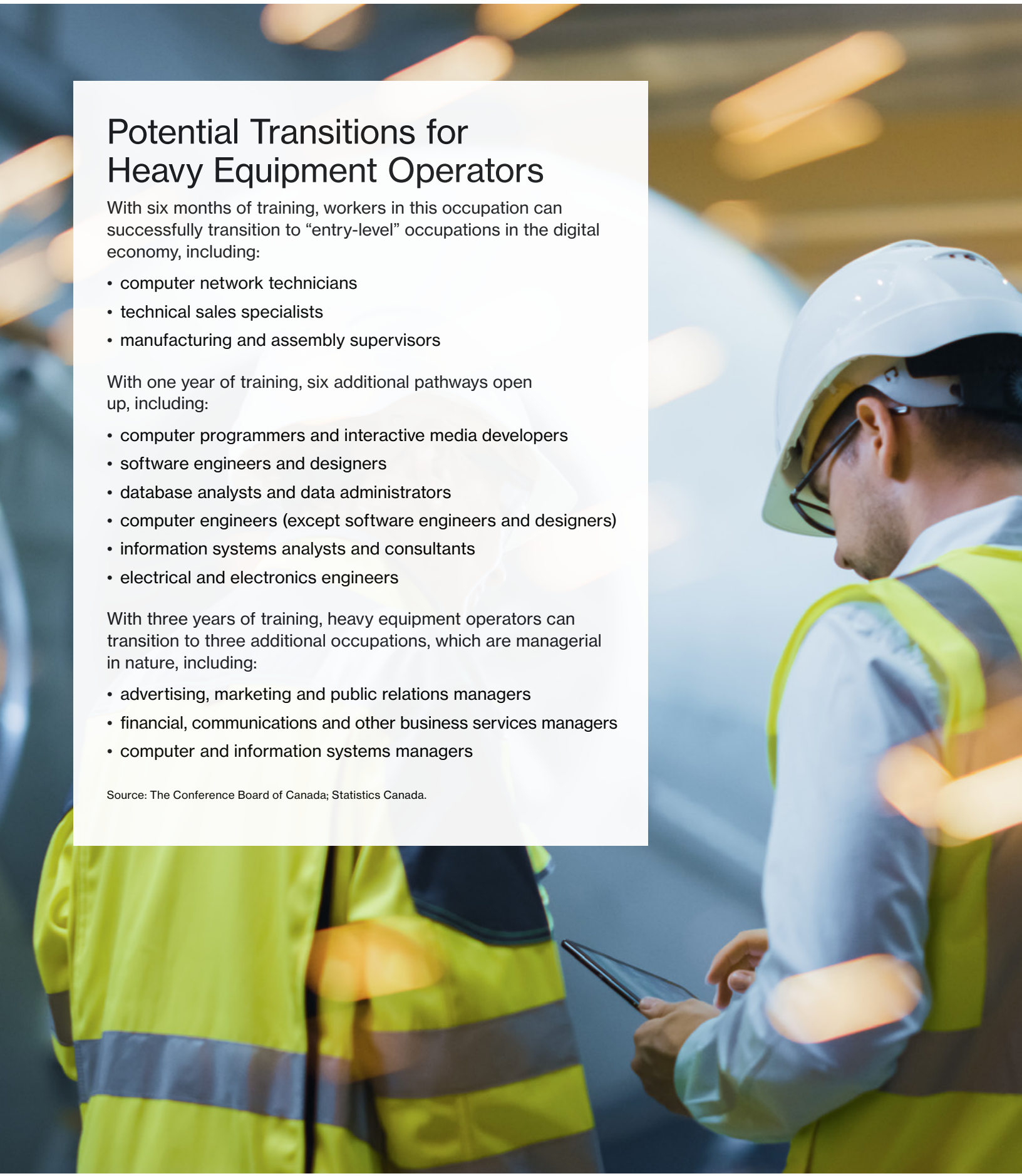
Given that the moderate training scenario provides at least one desirable pathway for nearly all HRLM workers, that level of retraining may provide the best return on investment for most people. It allows the largest number of HRLM workers to have options in the digital economy at the lowest costs in terms of time and training dollars.

(See Appendix C for examples of distinct occupation pathways between HRLM and digital jobs, as well as a detailed distribution of all available transition pathways.)

Chart 1
One Year of Training Enables High-Growth Digital Transitions for All HRLM Occupations
(number of HRLM occupations; number of desirable transitions)



Sources: The Conference Board of Canada; O*NET; Vicinity Jobs.



Potential Transitions for Heavy Equipment Operators

With six months of training, workers in this occupation can successfully transition to "entry-level" occupations in the digital economy, including:

- computer network technicians
- technical sales specialists
- manufacturing and assembly supervisors

With one year of training, six additional pathways open up, including:

- computer programmers and interactive media developers
- software engineers and designers
- database analysts and data administrators
- computer engineers (except software engineers and designers)
- information systems analysts and consultants
- electrical and electronics engineers

With three years of training, heavy equipment operators can transition to three additional occupations, which are managerial in nature, including:

- advertising, marketing and public relations managers
- financial, communications and other business services managers
- computer and information systems managers

Source: The Conference Board of Canada; Statistics Canada.

The Potential for High-Growth Transitions in the Digital Economy Varies Across Provinces

When looking at 2030 employment projections, the potential for HRLM-to-Digital transitions varies significantly across Canada (see Table 2). The Transition Potential Ratio can be understood as the number of digital jobs available for every HRLM job. Ontario and British Columbia are the provinces with the highest transition potential, and the Atlantic Region has a lower transition potential than other regions.

British Columbia has good employment growth prospects in the digital economy, reflecting the province's central status in Canada's digital technology supercluster. Similarly, Ontario has good employment growth prospects in the digital economy, reflecting the province's central status in Canada's advanced manufacturing supercluster.

The activities of these superclusters will likely only serve to increase their competitive positions as it relates to their growth prospects in the digital economy.

There is a negative correlation between automation vulnerability and transition potential (see Chart 2). Provinces and territories with lower Automation Vulnerability Index (AVI) scores generally have higher Digital/HRLM ratios, demonstrating their resiliency and high transition potential.[27] Newfoundland and Labrador, Prince Edward Island, and Saskatchewan have both high automation vulnerability and a low ability to transition workers in occupations at high risk of automation into fast-growing ones in the digital economy. Employees in the Atlantic and prairie provinces may seek high-growth employment in the digital economy in more promising provinces.

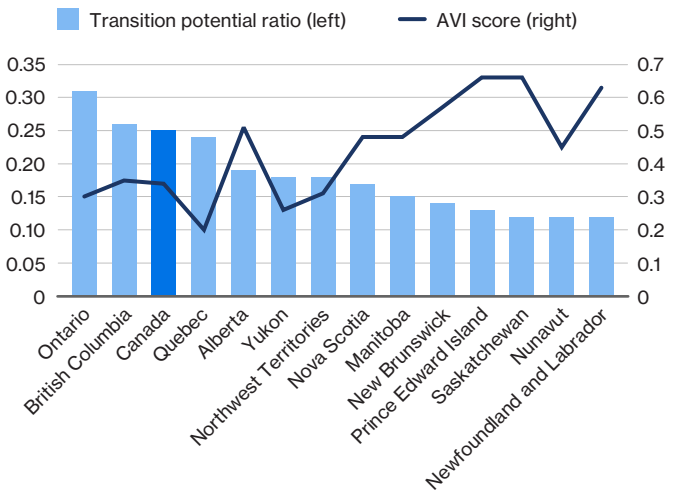
Table 2
The Potential for HRLM to Digital Transitions Varies Across Provinces and Territories
(number; share percentage)

	HRLM Employment, 2030		Digital Employment, 2030		Transition Potential Ratio
Province/Territory	**Number**	**Share**	**Number**	**Share**	
Ontario	1,555,511	18.8	481,122	5.8	0.31
British Columbia	508,985	18.5	132,842	4.8	0.26
Canada	**3,928,900**	**18.8**	**983,424**	**4.7**	**0.25**
Quebec	876,988	19.1	208,474	4.5	0.24
Alberta	481,988	18.1	89,775	3.4	0.19
Yukon	3,827	14.6	704	2.7	0.18
Northwest Territories	3,019	13.5	539	2.4	0.18
Nova Scotia	96,653	20.4	16,071	3.4	0.17
Manitoba	142,599	19.6	20,894	2.9	0.15
New Brunswick	71,965	20.6	9,900	2.8	0.14
Prince Edward Island	19,693	23.2	2,648	3.1	0.13
Saskatchewan	125,206	19.8	15,449	2.4	0.12
Nunavut	2,321	14.9	274	1.8	0.12
Newfoundland and Labrador	40,145	19.5	4,733	2.3	0.12

Sources: The Conference Board of Canada; O*NET; Vicinity Jobs; Statistics Canada.

27 See Sonmez, *Preparing Canada's Economies for Automation* for more information on the Automation Vulnerability Index.

Chart 2
Ontario and British Columbia Have Low Automation Vulnerability and High Transition Potential for HRLM Workers
(transition potential ratio; AVI score)



Sources: The Conference Board of Canada; O*NET; Vicinity Jobs.

The Cost to Transition Also Varies by Region

It is crucial for the federal, provincial, and territorial governments to inform their digital strategies and programs about the costs of training. The cost estimates provided in Table 3 are based on direct training costs and indirect opportunity costs for individuals to retrain. As well, they are averages of the previously identified desirable digital occupation pathways.

Although the major training scenario has the most potential career paths between HRLM and rapid-growth digital occupations, it is also the most expensive option. This is especially true in Alberta where there are high indirect costs because of the relatively high wages for HRLM positions.

(See Appendix C for a breakdown of direct and indirect costs.)

Table 3
The Cost of Transitioning Varies Greatly by Training Effort and Province
(C$)

Province/Territory	Minor Training (i.e., six months)	Moderate Training (i.e., one year)	Major Training (i.e., three years)	Average
Alberta	38,867	69,989	204,097	104,318
Saskatchewan	35,925	64,375	187,415	95,905
Nunavut	41,016	66,379	173,898	93,764
Prince Edward Island	34,122	62,558	182,463	93,048
Northwest Territories	34,324	62,219	177,082	91,208
Newfoundland and Labrador	34,599	57,696	166,439	86,244
British Columbia	31,590	57,695	169,195	86,160
Manitoba	31,632	56,763	166,117	84,837
New Brunswick	30,969	55,980	164,060	83,670
Canada	**30,710**	**55,314**	**161,707**	**82,577**
Yukon	30,592	56,053	160,134	82,260
Ontario	30,866	55,147	160,596	82,203
Nova Scotia	30,149	54,417	158,930	81,165
Quebec	25,819	46,822	136,861	69,834

Note: Costs do not increase proportionally between training scenarios because each comprises different pathways (i.e., transition pairs), and each pathway is associated with a different cost.
Sources: The Conference Board of Canada; O*NET; Vicinity Jobs; Statistics Canada.

While major training (i.e., three years) opens the most pathways, it may be more cost-effective for provinces to focus on the potential transitions that come alongside moderate training for HRLM individuals, given the difference in costs. Provinces may also look to prioritize pathways that are more cost-effective. For example, the total cost to upskill an administrative assistant to a computer network technician costs roughly $23,000 in Quebec, $26,000 in British Columbia, and $27,000 in Ontario.

Lastly, in the Atlantic provinces, the indirect costs of training are relatively low, but the direct costs are high. Therefore, it would be advisable for these provinces to find ways of lowering direct training costs to make it easier for workers to transition into occupations with more future potential.

Understanding Specific Transition Gaps

Identifying desirable occupation pathways and the associated training effort to realize these transitions is only one component of the equation. Workers and training providers must also know the specific knowledge, abilities, and skills upgrades needed to make those paths viable.[28] Using the same occupational survey data from O*NET and job posting data from Vicinity jobs, we examine detailed gaps between rapid-growth occupations in the digital and HRLM jobs.

Our analysis was also informed and expanded upon by a series of five roundtables with 16 individuals held between September and November 2022. Participants included experts from academia, government, private companies, Indigenous organizations, and training programs.

Some Skills Gaps Are More Important Than Others

In aggregate, the top knowledge areas in need of upgrading are mostly associated with STEM fields. In terms of abilities, digital occupations require workers to have more fluency of ideas, originality, written expression, and robust mathematical and deductive reasoning skills than workers in HRLM jobs. In terms of specific work activities, employment in the digital economy requires strong creative thinking, data analysis, knowledge development, and providing consultation and advice to others.

General Skills Provide a Solid Foundation

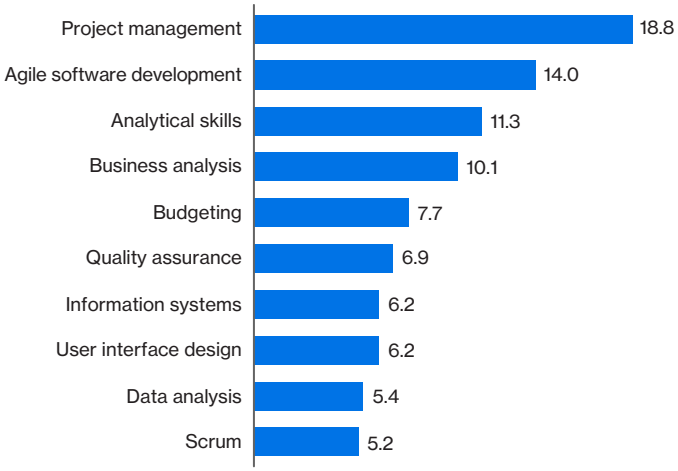
Among general skills, leadership is the most important skill that HRLM workers transitioning into the digital economy must acquire. This skill reflects the importance of leading by example and inspiring co-workers with creative thinking (see Chart 3). Communication is also an important skill to obtain as employers expect their workers to convey insights from complex analytical research. Leadership, communication, interpersonal, and teamwork skills are all quite similar social and emotional skills. Altogether, they demonstrate that core digital jobs don't just consist of deep work at a computer – there is a high importance in working closely with other individuals.

28 Oschinski and Nguyen, *Finding the Right Job*.

Chart 3
Soft Skills Are Top Skills When Transitioning to Digital Occupations
(percentage difference; top 10 skill differences)

Note: Differences in general skills correspond to the percentage difference in job postings between origin and destination occupations containing a given skill. For example, 18.3 per cent more job postings contained leadership for digital occupations than for HRLM occupations.
Sources: The Conference Board of Canada; Vicinity Jobs.

Chart 4
Project Management Is the Most Needed Specialized Skill
(percentage difference; top 10 skill differences)



Note: Differences in specialized skills correspond to the percentage difference in job postings between origin and destination occupations containing a given skill. For example, 14 per cent more job postings contained agile software development for digital economy occupations than for HRLM occupations.
Sources: The Conference Board of Canada; Vicinity Jobs.

Roundtable participants also noted that general skills not included in this list that may be specifically relevant for workers who are transitioning from HRLM to digital economy occupations. Adaptability is important, as HRLM workers may enter completely new work environments. Perseverance is also crucial as re-training can be difficult, time-consuming, and expensive. Lastly, the ability to take risks is another skill that could benefit HRLM workers. There may be no guarantee of employment depending on the method of reskilling or upskilling.

Specialized Skills Directly Support Digital Activities

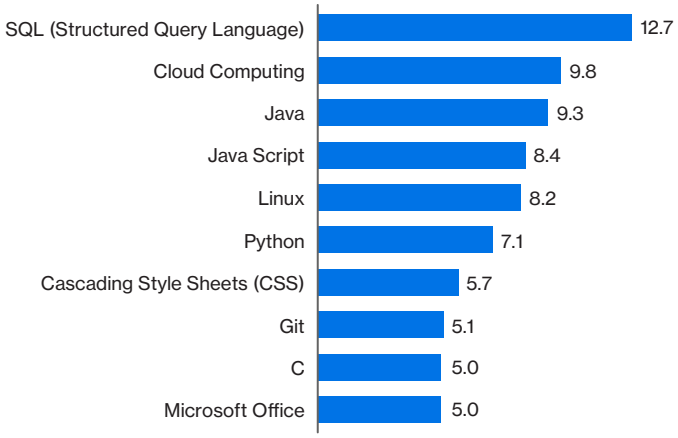
In terms of specialized skills, project management is the most important to acquire, reflecting the importance of managing agile sprints, implementing new technologies, or assembling and leading successful teams (see Chart 4). Given the fast-evolving nature of quantitative tasks, software development and training are also important skills for digital occupations.

HRLM workers with a background in these top skills may find it easier to transition to digital economy occupations. Roundtable participants noted that budgeting and financial skills can also be a pain point. They often train individuals with advanced technical skills who come into their organizations to compensate for this gap. Experts also noted that some of these specialized skills could also be time-frame specific. For example, Agile and Scrum are both popular now but could be replaced by other frameworks in the future.

Technical Skills Is Where It Gets Digital

These are the most specific among the three types of skills upon which we focus (see Chart 5). It is worth noting that while some tools are sector agnostic and useful for many different jobs (e.g., Microsoft Office), some are more useful for a limited number of jobs (e.g., C, Linux). Similarly, it is important to understand that the necessary technical skills change depending on the role, with some requiring the ability to create digital tools and others the ability to use them effectively.

Chart 5
Workers Transitioning to the Digital Economy Need to Know Different Types of Software, Depending on the Job
(percentage difference; top 10 skill differences)



Note: Differences in technology skills correspond to the percentage difference of job postings between origin and destination occupations containing a given skill. For example, 9.3 per cent more job postings contained Java for digital occupations than for HRLM occupations.
Sources: The Conference Board of Canada; Vicinity Jobs.

One shortcoming of this analysis is that we do not rigorously bundle skills into intuitive packages or skill sets that describe broader competencies, such as cybersecurity. But in the basic clustering we did, the largest gap overall is in programming languages (i.e., Java, Java Script, Python, CSS, and C). These are followed by data-related computing (i.e., SQL and Cloud Computing), an operating system (Linux), a version control tool (Git), and a ubiquitous software solution (Microsoft Office).

Building a base competency in a select few of these skills (e.g., Java and Microsoft Office) may be a more accessible option for HRLM workers to transition into the digital economy. Many of these tools, equipment, and technology could become easier to learn once proficiency in one of them is achieved and a successful transition into the digital economy has already happened.

An advantage for HRLM workers is that for most of these categories, a specific certification is not required or mandated, making it possible to be self-taught. However, there are populations in Canada that lack access to computers, digital infrastructure, and reliable Internet. For these individuals, the self-guided route to the digital economy is not possible and therefore requires more training investment by governments and employers.

After the end of the COVID-19 pandemic, it is also likely that the ability to work with collaboration tools such as Microsoft Teams or Zoom will be needed by HRLM workers who do not currently use these technologies. Roundtable participants also noted several other up-and-coming areas not reflected in this list – including data governance, business intelligence tools, and data visualization tools.

Digital Upskilling, Reskilling, and Training

Automation is both a threat and an opportunity to HRLM workers, but there is a growing consensus that it creates more jobs than it eliminates.[29] Similarly, automation is augmenting digital economy workers with AI and other technologies to enhance their productivity and allow them to focus on high-value tasks. As these opportunities continue to grow, governments, employers, and training programs must ensure that their upskilling efforts are well-focused.

There Are Numerous Different Training Pathways to the Digital Economy

Previous analysis from Skills Next and the Future Skills Centre created a taxonomy for digital training models that can help governments direct their investments and show employers where there are pools of digital talent.[30]

Formal Education Remains a Staple

This digital skills training model is the formal path of university degrees or college diplomas. Examples include undergraduate degrees or college diplomas in subjects, such as digital marketing, computer science, and cybersecurity. Graduate options, such as the Smith School of Business' "Master of Management in Artificial Intelligence" at Queens University, or the "Bell Research Intensive Cyber Knowledge Studies" program at the University of New Brunswick, would only be accessible to HRLM workers that have already acquired undergraduate education and a high degree of technical competencies.

This pathway into the digital economy is a long-term and expensive option for HRLM workers to reskill and upskill. However, this digital skills training model likely opens the most doors for HRLM workers, given that our transition model demonstrates that three years of training enables the most transitions. As a more traditional model, HRLM workers are also likely to have more access to training benefits (e.g., student loans), but will face a larger opportunity cost with multiple years of forgone income. The timeline also makes this option difficult for HRLM workers with familial responsibilities.

Continuing Education and Post-Graduate Certificates May Be More Accessible

The digital skills training model is shorter-term and less expensive for HRLM workers while still providing training from certified institutes. However, a university degree is often required, and this model may not be accessible to all HRLM workers. But programs like those from the University of Toronto's School of Continuing Studies are open to anyone, and they do provide financial aid options. Other examples of this model include the George Brown Postgraduate Cyber Security program and WatSPEED at the University of Waterloo.

29 *The Economist*, "Economists Are Revising Their Views."
30 Shortt, Robson, and Sabat, *Bridging the Digital Skills Gap*.

Work-Integrated Learning (WIL) Can Help Fill the Gaps

These are programs that have a training component that occurs directly in a workplace, which can be part of formal education or a standalone program. This option has the added benefit of potential employment with the training organization upon completion. Examples include the eTalentCanada WIL Digital program and the Toronto Metropolitan University Advanced Digital and Professional Training (AdaPT) program.

Bridging Programs Can Help New Canadians

These programs are often aimed at newcomers and help bridge internationally trained individuals into the Canadian workplace or different fields. This option is likely best for newly arrived HRLM workers. However, there is sometimes a requirement for information technology experience. Examples include:

- The Mennonite New Life Centre's *C-Women: Bridge for Immigrant Women Reskilling Into IT Coding Professions* program;
- Humber College's *IT Infrastructure – Bridging Program*;
- eTalent Canada's *Arrival to FinTech Ready* program;
- ACCES Employment's *Leadership Connections in Finance, IT and Consultancy* program.

Massive Open Online Courses (MOOCs) Offer the Most Flexibility

MOOCs are often low- or no-cost and can be a pathway for self-directed learning. However, without a certificate proving successful completion, this training model may not be as convincing to employers in the digital economy. Some workplaces do provide access to MOOCs for their employees to upskill and reskill. MOOCs are not usually specific to Canada, although the University of Alberta has partnered with Coursera to provide open online courses. Other examples include LinkedIn Learning, Udemy, MIT OpenCourseWare, and edX.

Programs Specific to Digital Upskilling Are Likely the Most Relevant to HRLM Workers Looking to Enter the Digital Economy

Training in the digital upskilling model can come from employers themselves or third-party organizations. Most micro-credential and boot camp programs are under this model. These programs are often intensive and may be the best model for HRLM workers, as the opportunity cost is significantly lower, and workers can quickly reskill and upskill. However, these programs can also be expensive or not accessible to individuals in rural and remote regions.

A prominent example is the Accelerated Cybersecurity Training Program at the Rogers Cybersecurity Catalyst. This program is a seven-month, fully funded program for non-technical individuals, which allows them to still work while taking the intensive training. The accessibility of this program makes it desirable for HRLM workers to transition into highly in-demand digital economy occupations. IBM and Microsoft have also invested significantly in training programs and credentials, such as the IBM Skills Build Program and Microsoft's Canada Skills Program.

An in-house employer example is Bell Canada's Bell U, which helps its workers reskill into key in-demand areas of the company. The program includes a work-integrated learning component to train in different business units.

In our roundtables, several organizations that provide training noted that they also provide opportunities for rotations and provide hours or days for employees to solely focus on upskilling. Roundtable participants also noted success with the boot camp and micro-credential style training, whether completed in-house or from a third-party organization.

Governments, Employers, and Training Programs Need to Reach Out to Equity-Deserving Groups

The technology sector still struggles with diversity and representation, especially with women and Black and Indigenous People of Colour (BIPOC) populations.[31] Similarly, a lack of access to technology and infrastructure makes digital transitions difficult for many regions. Equity-deserving populations in HRLM employment will likely face even greater barriers to entry into the digital economy. Some roundtable participants also wondered if there may be a difference in employer attitudes toward micro-credentials or non-traditional training certifications completed by BIPOC and other equity-deserving populations. This is an important topic for further study.

To increase representation and support the hardest hit HRLM workers, effort and investment should also target specific groups in transitioning to the digital economy. For example, IBM has created the IBM Tech Re-entry program to support women who have been on leave for several years to re-enter the workforce into the tech sector. Other examples include eTalent Canada's Digital Equity and Employability Pathways (DEEP) program and Elevate Talent programs.

However, it is not enough to simply want diversity in training programs. Training needs to be codeveloped with equity-deserving groups. Organizations must also ensure that there are mentorship opportunities with diverse leaders in their organizations for these groups. Organizations and training programs can use this diversity as an opportunity for non-traditional outreach, network building, and leveraging. Diversity can also expand their environmental, social, and governance (ESG) and diversity, equity, and inclusion (EDI) efforts across departments.

Lastly, job postings need to use clear, concise, and unambiguous language. This ensures that these positions are made more accessible for HRLM workers and equity deserving groups. A common theme noted in our roundtables was that employers inadvertently make transitions into the digital economy more difficult by crafting long and ambiguous job postings. A remedy to this barrier noted in a roundtable is to make three-to-five clearly stated qualifications mandatory, with the remaining communicated as desired but not necessary.

Indigenous Populations Face Significant Barriers to Entering the Digital Economy

Many Indigenous workers, especially those in HRLM jobs, will struggle to enter the digital economy due to a lack of access to digital infrastructure and technology. This is especially true for those in rural and remote regions. Therefore, it is crucial for governments to focus on infrastructure development and digital skills training for Indigenous populations across the country to ensure they don't fall further behind.

Some notable digital skills training programs for Indigenous populations include:

- NPower's Indigenous Tech Career Pathways;
- PLATO's Software Tester Training Program;
- AFOA Canada's IT Workshops;
- Nicola Valley Institute of Technology's Foundations in Innovation and Technology Certificate;
- Native Education College's Indigenous Digital Leadership Program.

While more training programs and infrastructure development are necessary, employers also need to look to hire Indigenous peoples from these programs and beyond.

31 Dice, "Equality in Tech Report."

The Indigenous populations with the least access to the digital economy are those in the North and Arctic regions. Among these populations, greater technology infrastructure investment and digital literacy training – alongside investments into housing and health access – are likely needed before advanced digital skills training can occur. However, this will provide new opportunities for all workers in these regions with respect to the digital economy and general poverty reduction.

As the digital economy continues to grow, there exists an opportunity to directly reach out to Indigenous populations that are in HRLM positions, or not yet in the workforce, to fulfill the increased demand. This ensures that the benefits of this growth are distributed throughout the country and across equity-deserving groups. One roundtable participant stated that they have found great success in reaching out and hiring Indigenous people for cybersecurity roles, as their access issues have provided them with great problem-solving skills. However, managers across the country who are hiring need to also look at Indigenous individuals who can easily demonstrate their tech skills but may not have formal degrees or certifications.

Transition Pathways Must Be Made Known and Accessible

There are numerous challenges to career transitions. We have described some of the "human" factors in previous research, which include fears around transitioning, familial and geographical constraints, and willingness to retrain.[32] Some of the challenges specific to the digital economy noted by our roundtable participants include:

- direct and indirect costs of transitioning for workers;
- lack of training resources within small and medium enterprises;
- lack of support for HRLM workers who are also caregivers;
- the time it takes to reskill and upskill;
- the learning curve in obtaining new skills;
- image issues in the tech sector;
- availability of training;
- paralysis from employers and governments worried about making the wrong training and investment decisions;
- the speed of change in the digital economy;
- technologies becoming even more advanced.

One overarching challenge that must be solved is the lack of knowledge about potential transitions and the training available for vulnerable workers. Many workers still do not understand the vast array of digital and technology-related careers that are accessible to them through upskilling and reskilling.

The digital economy may still be an elusive term for many HRLM workers, especially if those workers do not have strong professional or familial networks in the digital and technology sectors. Some may also see the digital economy simply as independent coding tasks and not the many less-technical roles like project management and leadership. Improving access to information on reskilling and upskilling possibilities is necessary for HRLM workers to even begin thinking about their transition potential.

Greater efforts in showcasing and providing reskilling and upskilling opportunities for HRLM workers can also reduce the degree to which vulnerable workers feel disenfranchised or disconnected. Ignoring this issue as technology continues to advance may exacerbate the degree to which certain segments of the population feel left behind and that their voices do not matter.

32 Sonmez, Thomson, and Gresch, *Green Occupation Pathways*.

Conclusion

Transitioning workers from vulnerable occupations to rapid-growth digital occupations mitigates two risks to the Canadian economy. First, it increases the likelihood that workers vulnerable to automation can access new labour market opportunities. Second, it strengthens the digital sector, which is critical for other sectors of the economy and productivity growth. As such, facilitating career paths in the digital economy should be one of the key components of successfully managing the transition to digitalization for Canada.

As Canadian businesses adapt to the dramatic digital shift, the demand for people who have the know-how and flexibility to adopt and use digital technologies will continue to increase. We must better understand digital skills in the current labour market to remain a competitive country and prepare for the future of work. New graduates can alleviate some of this demand, as can highly skilled workers transitioning from industries outside of the digital economy. However, companies will likely have to tap into other sources. One strategy is to facilitate career pathways from high-risk, low-mobility (HRLM) jobs to rapid-growth opportunities in the digital economy.

The opportunity to transition is different across the country. While provinces such as British Columbia and Ontario are projected to have a higher share of digital occupational employment by 2030, Newfoundland and Labrador, Prince Edward Island, and Saskatchewan have a low ability to transition workers into fast-growing ones in the digital economy.

Strengthening the digital workforce can lead to more innovation, higher productivity, and more resilient local and regional economies. There are many potential transitions from vulnerable occupations to rapidly growing ones in the digital economy. We aim to provide policymakers and human capital program managers with the necessary information to begin planning transitions and training these workers.

For Employers

HRLM workers are a large cohort that can be upskilled for in-demand positions that currently go unfilled. Many of these workers can be upskilled from inside the organization. Importantly, roundtable participants noted that a greater emphasis is needed on non-traditional approaches to hiring and skills, such as hiring based on micro-credentials, hiring for social and emotional skills and training in-house on technical skills, providing work rotations and training days, foregoing resumés in favour of behavioural assessments, and being open-minded to a diverse slate of candidates.

Employers should also make clear to the government what their current and future needs are to help guide training investment decisions. In addition, companies can look to partner with colleges, universities, established training programs, and equity-deserving groups to hire new candidates. Lastly, employers can upskill/reskill their own employees and advance their EDI and ESG efforts. Investing in these efforts will contribute to organizational competitiveness.

For Digital Skills Training Programs

HRLM workers are a crucial cohort to prioritize for reskilling and upskilling, especially those in equity-deserving groups. Upskilling programs should explore ways to improve their outreach and better market their services to this cohort. Similarly, these programs should seek more buy-in, partnership, and co-development with employers. The reason is that this program model may be more beneficial for workers who cannot afford the direct and indirect costs of transitions or take large risks due to familial circumstances.

Lastly, one notable point several roundtable participants had for digital skills training programs is to place a greater effort on providing participants with an awareness of their strengths and experiences, including how to articulate and translate those strengths to employers. Doing so will likely increase the success rate of digital skills training programs.

For Governments

Ideally, Canada would have a strong national strategy that cohesively ties government, academia, and industry to measurable upskilling outcomes, particularly for HRLM individuals. An example of this in action could be the provision of government funding to offset the cost of retraining programs when they demonstrate industry relevance, high levels of collaboration between industry and academia, well-defined assessment criteria, and the application of newer models, such as WIL.

HRLM workers are a significant share of the population who need clear articulation that they will be supported. While it may be tempting for governments to focus on the downside risk of automation, the fast-growing digital economy and its corresponding job growth provide an immense opportunity.

Focusing on this upside will require relevant departments to move faster in the short term while planning for the long term, as the digital economy continuously evolves. It will be more advantageous to create proactive programs that reskill and upskill prior to job losses. And while we cannot predict every new job that will be created, we can say with fair certainty that most new jobs in the 21st century will be digital and tech-related.

The Government of Canada has made large bets on AI with the Pan-Canadian AI Strategy and Cyber with the National Cyber Security Strategy. HRLM workers provide an opportunity to fulfill the in-demand needs of these strategic plans. Focusing on this sooner and more proactively is a mitigation strategy to protect against the downsides of automation.

Appendix A

Methodology

This project employs the methodology used in *Green Occupation Pathways* and *Blue Occupation Pathways*.[1] We applied this methodology to examine the feasibility of transitioning workers from occupations susceptible to automation to rapidly growing ones in the digital economy. We define this shift as a transition from high-risk, low-mobility (HRLM) occupations to rapid-growth digital occupations. In particular, we seek to identify the:

- extent of skills gaps and task and knowledge area differences between HRLM and rapid-growth digital occupations in Canada;
- time and monetary costs of skills development and training for a transition between any given HRLM occupation and rapid-growth digital occupations;
- regional variation, if any, in these transitions;
- specific skill, ability, and knowledge area gaps and existing programs that can address them.

Skills Similarity

We estimate cognitive and task-based skill distances between a given pair of occupations using the cosine similarity score. Cosine similarity measures the angle between any two non-zero vectors. It is defined as the inner product space of the cosine of the angle between the two vectors. The values of cosine similarity range from 0 and 1.[2]

The transition similarity scores are based on two different skills data sources: O*NET and Vicinity Jobs (see Table 1). We weighted each source to reflect the richness of the data. We gave more weight to O*NET (0.6) than Vicinity Jobs (0.4) because O*NET provides more varied information about the transition process (i.e., knowledge, skills, abilities; work activities; and education, training, and experience). Vicinity Jobs provides information about two broad categories (i.e., skills; and education and experience).

Table 1
Data Inputs Are Used in the Calculation of the Similarity Score

Source	Input	Dimensions	Definition
O*NET	Knowledge	33	Organized sets of principles and facts applying in general domains.
	Skills	35	Developed capacities that facilitate learning or the more rapid acquisition of knowledge.
	Abilities	52	Enduring attributes of the individual that influence performance
	Work activities	41	General types of job behaviours occurring on multiple jobs.
	Education, training, and experience	41	The frequency of categories for education, training, and experience of each occupation.
Vicinity Jobs	General/soft skills	52	General/soft skills that apply to most occupations.
	Specialized skills	147	Specialized skills apply to specific jobs.
	Equipment, tools, and technology	4,099	Equipment, tools, and technological skills entail knowledge of information and communication technologies and heavy machinery.
	Experience	2	The experience requirements for the stated occupation.
	Education	7	The education requirements for the stated occupation.

Sources: O*NET; Vicinity Jobs.

1 Sonmez, Thomson, and Gresch, *Green Occupation Pathways*; Carpenter, Sonmez, and Gresch, *Blue Occupation Pathways*.

2 See Rao, Hindle, and Gabler, *Modelling Job Transitions in Canada* for a detailed explanation.

Skill Level Categories

We assign 4-digit NOC occupations to skill levels identified by Economic and Social Development Canada (see Table 2).

Table 2
Economic and Social Development Canada
Skill Level Categories

Level	Description
0	Management jobs.
A	Professional jobs that usually require a degree from a university.
B	Technical jobs and skilled trades that usually require a college diploma or training as an apprentice.
C	Intermediate jobs that usually require high school and/or job-specific training.
D	Labour jobs that usually give on-the-job training.

Source: Economic and Social Development Canada.

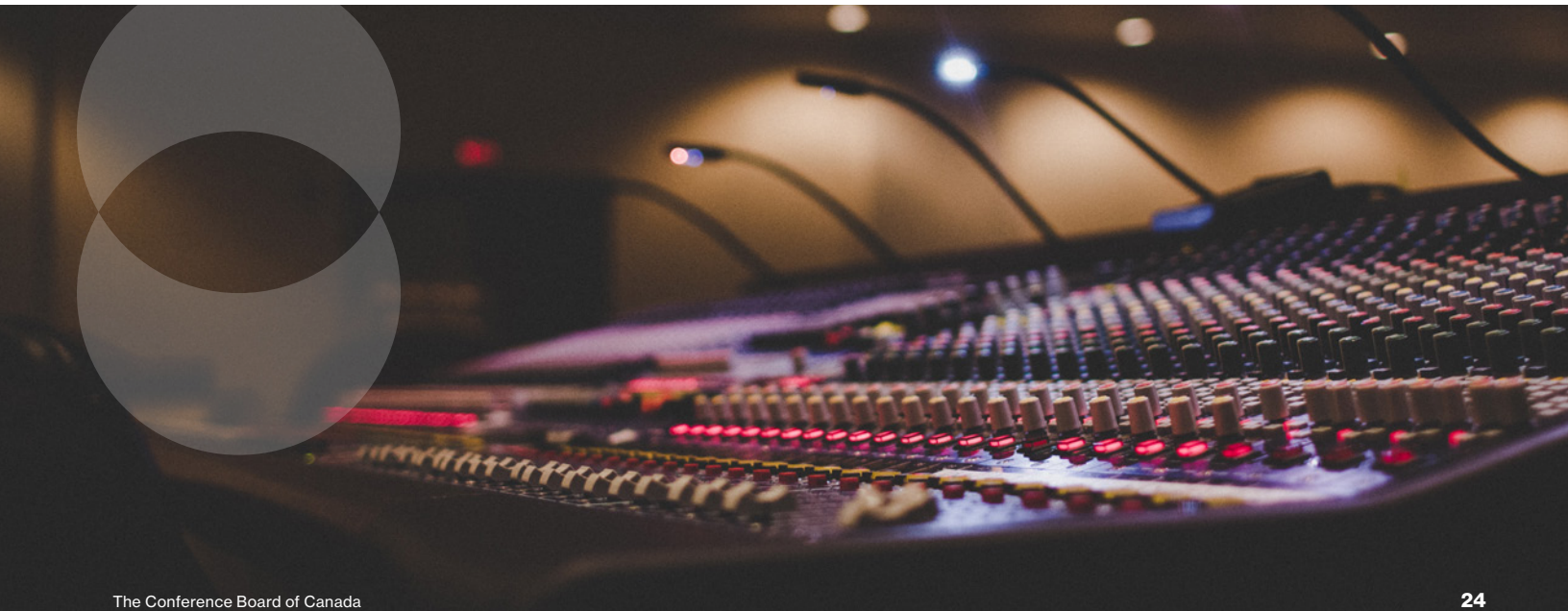
Skills Gains

The values in Table 3 correspond to the bottom, median, and top quartiles of the distribution of skills shortages among occupational transitions that do not involve skills excesses. A score of 1 refers to a perfect similarity between origin and destination occupations in our model (i.e., 100 per cent similarity). For example, 0.25 is the combination of cognitive and task-based skills gained from six months of training. In other words, after six months of training, the overall skill set of an employee becomes 25 percentage points more similar to the overall skillsets associated with the occupation to which they want to transition. The same logic applies to the longer training scenarios in our transition model.

Table 3
Skills Gains Increase With More Training

Level	Minor Training (i.e., six months)	Moderate Training (i.e., one year)	Major Training (i.e., three years)
Quartile	25th	50th	75th
Average skill similarity	0.25	0.3	0.34

Sources: The Conference Board of Canada; Organisation for Economic Co-operation and Development.



Appendix B

The Digital Economy

Economic Activities in the Digital Economy Are Concentrated in Three Categories[3]

Infrastructure

This encompasses basic physical materials and organizational arrangements that support the existence and use of computer networks and the digital economy – primarily information and communications technology (ICT) goods and services. Infrastructure products are categorized in terms of hardware and software.

E-commerce

This includes the remote sale of goods and services over computer networks. E-commerce products are presented separately for Business to Consumer (B2C) e-commerce (i.e., retail trade) and business-to-business (B2B) e-commerce (i.e., wholesale trade).

Priced digital services

This refers to services related to computing and communication that are performed for a fee charged to the consumer. Priced digital services products include cloud services, telecommunications services, Internet and data services, and all other priced digital services (see Table 1).

Table 1
Economic Activities in the Digital Economy Are Concentrated in Three Categories

Digital Economic Activity	NAICS Code	NAICS Title
Infrastructure (hardware and software)	3332	Industrial machinery manufacturing
	3339	Other general-purpose machinery manufacturing
	3341	Computer and peripheral equipment manufacturing
	3342	Communications equipment manufacturing
	3343	Audio and video equipment manufacturing
	3344	Semiconductor and other electronic component manufacturing
	3346	Manufacturing and reproducing magnetic and optical media
	3359	Other electrical equipment and component manufacturing
	3399	Other miscellaneous manufacturing
	5112	Software publishers
	5415	Computer systems design and related services
E-commerce	4541	Electronic shopping and mail-order houses

(continued ...)

3 Highfill and Surfield, *New and Revised Statistics*.

Table 1 (cont'd)
Economic Activities in the Digital Economy Are Concentrated in Three Categories

Digital Economic Activity	NAICS Code	NAICS Title
Priced digital services (cloud services, telecommunication services, Internet, and data services)	4853	Taxi and limousine service
	4921	Couriers
	4922	Local messengers and local delivery
	5121	Motion picture and video industries
	5122	Sound recording industries
	5151	Radio and television broadcasting
	5152	Pay and specialty television
	5171	Wired telecommunications carriers
	5172	Wireless telecommunications carriers (except satellite)
	5174	Satellite telecommunications
	5179	Other telecommunications
	5182	Data processing, hosting, and related services
	5191	Other information services
	5414	Specialized design services
	6114	Business schools, and computer and management training
	7211	Traveller accommodation
	8112	Electronic and precision equipment repair and maintenance

Sources: Statistics Canada; U.S. Bureau of Economic Analysis.

Occupations in the Digital Economy Are Diverse

We followed a four-step approach to identify 21 4-digit NOC-level destination occupations in the digital economy. First, we identified industries in which digital economic activities are concentrated. We used Statistics Canada's supply-use tables and the classification of digital economic activities from the U.S. Bureau of Economic Analysis. We then identified core occupations in digital industries using the industry occupation matrix.

We used a concentration quotient (CQ) to determine highly relevant occupations in the digital economy. The CQ measures the relative importance of any given occupation to each digital economy sector compared with the overall economy. The CQ formula is:

$$CQ = \frac{\text{Occupation's share of sectoral employment}}{\text{Occupation's share of national employment}}$$

Values greater than 1 indicate that a given occupation is more important to the digital economy than the overall economy. Values less than 1 indicate that a given occupation is less important to the digital economy than the overall economy. Values equal to 1 indicate that a given occupation is equally important to the digital economy and the overall economy.

We manually screened the resulting list to ensure that we did not exclude any relevant occupations or include occupations that may not be suitable for digital industries. Lastly, we examined the growth rate for those occupations in the next ten years to select those occupations that have higher than average growth rates over the next decade (see Table 2).

Table 2
Rapid-Growth Digital Occupations Are Found Across the Digital Economy

NOC	Occupation	Concentration Quotient (CQ)	Share in Digital Employment (percentage)	2022 Employment (number)	2030 Employment (number)	Growth Rate, 2022–30 (percentage)
5131	Producers, directors, choreographers, and related occupations	11.1	72.6	28,984	31,524	9.0
5227	Support occupations in motion pictures, broadcasting, photography, and the performing arts	9.8	63.9	11,125	12,585	13.0
2175	Web designers and developers	9.1	59.4	31,155	35,009	12.0
2173	Software engineers and designers	9.0	58.9	64,675	75,056	16.0
2174	Computer programmers and interactive media developers	8.9	58.2	118,091	128,645	9.0
2283	Information systems testing technicians	8.7	56.7	12,465	14,378	15.0
5226	Other technical and coordinating occupations in motion pictures, broadcasting, and the performing arts	8.3	54.2	17,776	20,684	16.0
5241	Graphic designers and illustrators	8.1	53.1	68,943	77,727	13.0
213	Computer and information systems managers	6.3	40.9	79,344	89,514	13.0
2171	Information systems analysts and consultants	6.2	40.6	191,629	212,677	11.0
9227	Supervisors, other products manufacturing and assembly	5.2	33.9	4,666	5,064	9.0
2281	Computer network technicians	5.2	33.8	76,141	82,348	8.0
2252	Industrial designers	4.5	29.7	11,345	12,930	14.0
2172	Database analysts and data administrators	4.2	27.6	30,280	35,851	18.0
2242	Electronic service technicians (household and business equipment)	4.1	27.0	58,172	63,024	8.0
13	Senior managers – financial, communications and other business services	3.3	21.5	76,012	86,407	14.0
2133	Electrical and electronics engineers	2.7	17.8	54,594	61,521	13.0
124	Advertising, marketing, and public relations managers	2.5	16.0	81,534	92,540	13.0
6221	Technical sales specialists – wholesale trade	3.6	23.6	95,134	104,524	10.0
211	Engineering managers	1.9	12.7	22,776	25,590	12.0
2147	Computer engineers (except software engineers and designers)	7.7	50.4	25,735	27,356	6.0

Sources: The Conference Board of Canada; Statistics Canada; O*NET.

One shortcoming of our 4-digit NOC analysis is that most of the occupations at this level are not solely in the digital economy sectors. Additionally, they may not fully reflect the diversity of roles within the digital economy – thus, our scoring by concentration and employment in the digital economy.

Still, these 21 occupations exist beyond the confines of the digital economy, and this should be kept in mind for this analysis.

Appendix C

Detailed Results

Example Transitions

Table 1
Top 10 HRLM Occupations That Can Transition to Database Analysts and Data Administrators
(with up to one year of training)

1	Financial auditors and accountants
2	Medical laboratory technologists
3	Administrative assistants
4	Forestry technologists and technicians
5	Other medical technologists and technicians (except dental health)
6	Contractors and supervisors, machining, metal forming, shaping and erecting trades,and related occupations
7	Court reporters, medical transcriptionists, and related occupations
8	Dental technologists, technicians, and laboratory assistants
9	Cooks
10	Machinists, and machining and tooling inspectors

Notes: Occupations are in descending order in terms of the ease of transition based on skills similarity.
With 18.4 per cent, database analysts and data administrators is the fastest growing digital occupation during the 2022–30 period.
Sources: The Conference Board of Canada; O*NET; Vicinity Jobs.

Table 2
Top 10 HRLM Occupations That Can Transition to Software Engineers and Designers
(with up to one year of training)

1	Financial auditors and accountants
2	Medical laboratory technologists
3	Administrative assistants
4	Contractors and supervisors, machining, metal forming, shaping and erecting trades, and related occupations
5	Forestry technologists and technicians
6	Other medical technologists and technicians (except dental health)
7	Court reporters, medical transcriptionists, and related occupations
8	Dental technologists, technicians, and laboratory assistants
9	Power engineers and power systems operators
10	Machinists, and machining and tooling inspectors

Notes: Occupations are in descending order in terms of the ease of transition based on skills similarity.
With 16.1 per cent, software engineers and designers is the third fastest growing digital occupation during the 2022–30 period.
Sources: The Conference Board of Canada; O*NET; Vicinity Jobs.

Table 3
Top Digital Occupations to Which Cashiers Can Transition
(with up to three years of training)

Support occupations in motion pictures, broadcasting, photography, and the performing arts
Other technical and coordinating occupations in motion pictures, broadcasting, and the performing arts
Technical sales specialists – wholesale trade
Electronic service technicians (household and business equipment)
Supervisors, assembly and fabrication
Graphic designers and illustrators
Information systems testing technicians
Industrial designers
Computer network technicians

Note: Occupations are in descending order in terms of the ease of transition based on skills similarity.
Sources: The Conference Board of Canada; O*NET; Vicinity Jobs.

Table 4
Top Digital Occupations to Which Administrative Assistants Can Transition
(with up to six months of training)

Support occupations in motion pictures, broadcasting, photography, and the performing arts
Other technical and coordinating occupations in motion pictures, broadcasting, and the performing arts
Technical sales specialists – wholesale trade
Electronic service technicians (household and business equipment)
Graphic designers and illustrators
Supervisors, assembly and fabrication
Information systems testing technicians
Computer network technicians
Industrial designers

Note: Occupations are in descending order in terms of the ease of transition based on skills similarity.
Sources: The Conference Board of Canada; O*NET; Vicinity Jobs.

Detailed Distribution of Pathways

Table 5
Detailed Distribution of the Number of Occupations by the Number of Desirable Transitions

Minor Training (i.e., six months)		**Moderate Training** (i.e., one year)		**Major Training** (i.e., three years)	
HRLM occupations	Desirable transitions	HRLM occupations	Desirable transitions	HRLM occupations	Desirable transitions
70	0	13	0	2	7
1	1	1	2	2	8
1	2	1	3	12	9
4	3	1	4	2	12
2	6	1	5	6	13
3	7	1	6	1	14
1	8	1	7	1	16
10	9	2	8	53	17
		55	9	2	18
		3	13	1	19
		2	14	1	20
		1	15	9	21
		1	16		
		9	17		
Average	**5**	**Average**	**7**	**Average**	**15**

Sources: The Conference Board of Canada; O*NET; Vicinity Jobs.

Direct and Indirect Cost Breakdowns

Table 6
The Average Direct (i.e., Training) Cost of Transitions Varies by Training Scenario and Jurisdiction
(C$)

Province/Territory	**Minor Training**	**Moderate Training**	**Major Training**	**Average**
Prince Edward Island	13,808	27,349	82,220	41,126
Alberta	12,257	24,150	72,582	36,330
New Brunswick	11,552	22,744	68,353	34,216
Saskatchewan	11,388	22,414	67,358	33,720
Manitoba	10,245	20,187	60,669	30,367
Nova Scotia	9,759	19,236	57,813	28,936
Northwest Territories	9,101	18,339	55,199	27,547
British Columbia	8,990	17,721	53,259	26,657
Newfoundland and Labrador	9,001	17,717	53,243	26,654
Nunavut	8,721	17,442	52,326	26,163
Ontario	8,823	17,392	52,269	26,161
Canada	**8,734**	**17,216**	**51,742**	**25,897**
Yukon	7,697	15,253	45,915	22,955
Quebec	6,228	12,276	36,896	18,467

Note: Costs do not increase proportionally between training scenarios because each comprises different pathways (i.e. transition pairs), and each pathway is associated with different costs.
Sources: The Conference Board of Canada; O*NET; Vicinity Jobs; Statistics Canada.

Table 7

The Average Indirect (i.e., Opportunity) Cost of Transitions Varies by Training Scenario and Jurisdiction

(C$)

Province/Territory	Minor Training	Moderate Training	Major Training	Average
Alberta	26,609	45,839	131,516	67,988
Nunavut	32,295	48,937	121,572	67,601
Northwest Territories	25,223	43,879	121,883	63,662
Saskatchewan	24,537	41,962	120,056	62,185
Newfoundland and Labrador	25,597	39,979	113,196	59,591
British Columbia	22,599	39,974	115,936	59,503
Yukon	22,895	40,800	114,219	59,305
Canada	**21,976**	**38,098**	**109,966**	**56,680**
Ontario	22,043	37,755	108,328	56,042
Manitoba	21,387	36,576	105,447	54,470
Nova Scotia	20,390	35,181	101,116	52,229
Prince Edward Island	20,314	35,209	100,243	51,922
Quebec	19,591	34,545	99,965	51,367
New Brunswick	19,417	33,236	95,707	49,454

Note: Costs do not increase proportionally between training scenarios because each comprises different pathways (i.e. transition pairs), and each pathway is associated with different costs.

Sources: The Conference Board of Canada; O*NET; Vicinity Jobs; Statistics Canada.

Appendix D

Bibliography

Bank of Canada. *The Digital Economy.* Ottawa: Bank of Canada, 2017. Accessed January 9, 2023. https://www.bankofcanada.ca/wp-content/uploads/2017/05/boc-review-spring17-dsouza.pdf.

Bechichi, Nagui, Stéphanie Jamet, Gustave Kenedi, Robert Grundke, and Mariagrazia Squicciarini. *Occupational Mobility, Skills, and Training Needs.* OECD Science, Technology and Industry Policy Papers, no. 70 (2019). Paris: OECD Publishing, 2019.

Carpenter, Dan, Zafer Sonmez, and Darren Gresch. *Blue Occupation Pathways: Career Transitions to the Sustainable Blue Economy.* Ottawa: The Conference Board of Canada, 2023.

Deloitte. "What Is Digital Economy?" Accessed November 10, 2022. Accessed January 9, 2023. https://www2.deloitte.com/mt/en/pages/technology/articles/mt-what-is-digital-economy.html.

Dice, "Equality in Tech Report: Welcome." 2021. Accessed January 9, 2023. https://www.dice.com/recruiting/ebooks/equality-in-tech-report/welcome/.

Gresch, Darren. *Responding to Automation: How Adaptable Is Canada's Labour Market?* Ottawa: The Conference Board of Canada, 2020.

Highfill, Tina, and Christopher Surfield. *New and Revised Statistics of the U.S. Digital Economy, 2005–2020.* Suitland, MD: Bureau of Economic Analysis, 2022. Accessed January 9, 2023. https://www.bea.gov/system/files/2022-05/New%20and%20Revised%20Statistics%20of%20the%20U.S.%20Digital%20Economy%202005-2020.pdf.

Hirt, Martin. "If You're Not Building an Ecosystem, Chances Are Your Competitors Are." Accessed January 9, 2023. https://www.mckinsey.com/capabilities/strategy-and-corporate-finance/our-insights/the-strategy-and-corporate-finance-blog/if-youre-not-building-an-ecosystem-chances-are-your-competitors-are.

Hutchison, Jane. *Digital Skills for Today and Tomorrow: Perspectives From Canadian Employers and Industry Leaders.* Ottawa: The Conference Board of Canada, 2022.

KPMG. "Nearly 70 Per Cent of Canadian Businesses Struggling to Find Skilled Talent." Accessed January 9, 2023. https://www.newswire.ca/news-releases/nearly-70-per-cent-of-canadian-businesses-struggling-to-find-skilled-talent-893065566.html.

Organisation for Economic Co-operation and Development. OECD Employment Outlook 2013. Paris: OECD Publishing, 2013. Accessed January 9, 2023. https://www.oecd-ilibrary.org/employment/oecd-employment-outlook-2013_empl_outlook-2013-en.

Oschinski, Matthias, and Thanh Nguyen. *Finding the Right Job: A Skills-Based Approach to Career Planning.* Montréal: Institute for Research on Public Policy, 2022. Accessed January 9, 2023. https://irpp.org/research-studies/finding-the-right-job-a-skills-based-approach-to-career-planning/#:~:text=Rather%20than%20relying%20on%20an,alternative%20options%2C%20possibly%20in%20a.

Randstad. *Digital Skills: Unlock Opportunities for All.* Diemen, The Netherlands: Randstad, 2022. Accessed January 9, 2023. https://www.randstad.com/s3fs-media/rscom/public/2022-10/Insights.pdf.

Rao, Sheila, Thomas Hindle, and Nachum Gabler. *Modelling Job Transitions in Canada.* Ottawa: The Conference Board of Canada, 2021.

Salesforce Research. "Digital Skills Index." Accessed January 9, 2023. https://public.tableau.com/app/profile/salesforceresearch/viz/DigitalSkillsIndex/CountryDB?publish=yes.

Shortt, Denise, Brian Robson, and Magdalena Sabat. *Bridging the Digital Skills Gap: Alternative Pathways.* Ottawa: Public Policy Forum, 2020.

Sonmez, Zafer. *Preparing Canada's Economies for Automation.* Ottawa: The Conference Board of Canada, 2021.

Sonmez, Zafer, Joel Thomson, and Darren Gresch. *Green Occupation Pathways: From Vulnerable Jobs to Rapid-Growth Careers.* Ottawa: The Conference Board of Canada, 2022.

The Economist. "Economists Are Revising Their Views on Robots and Jobs." January 22, 2022. https://www.economist.com/finance-and-economics/2022/01/22/economists-are-revising-their-views-on-robots-and-jobs.

Weinelt, Bruce. "What Are the Digital Industries of Tomorrow?" Accessed November 10, 2022. https://www.weforum.org/agenda/2015/09/what-are-the-digital-industries-of-tomorrow/.

World Economic Forum. "Digital Skills: How Businesses And Policymakers Can Respond to Future Demand in the Labour Market." Accessed December 8, 2022. https://www.weforum.org/agenda/2022/11/digital-skills-labour-market-future/.

—. "Shaping the Future of Digital Economy and New Value Creation." Accessed January 9, 2023. https://www.weforum.org/platforms/shaping-the-future-of-digital-economy-and-new-value-creation.

Acknowledgements

This impact paper was prepared with financial support provided through the Future Skills Centre. The Conference Board of Canada is proud to serve as a research partner in the Future Skills Centre consortium. For further information about the Centre, visit the website at https://fsc-ccf.ca/.

The following members of the Conference Board's team contributed to this research: Daniel Carpenter, Research Associate; Zafer Sonmez, Senior Research Associate; Darren Gresch, Senior Research Associate; Alain Francq, Director of Innovation and Technology; and Michael Burt, Vice-President.

We also thank the members of the Research Advisory Board who supported this research:

- Shawn Gervais, VP, Foresight + Talent Development, Digital Technology Supercluster
- Tony Bonen, Executive Director, Labour Market Information Council
- Sanjeev Gill, Associate Vice-President, University of Waterloo
- Behzad Ghotb, Senior Manager, Research and Insights, Google Canada

Digital Occupation Pathways: From Vulnerable Jobs to Rapid-Growth Careers
The Conference Board of Canada

To cite this research: Conference Board of Canada, The. *Digital Occupation Pathways: From Vulnerable Jobs to Rapid-Growth Careers.* Ottawa: The Conference Board of Canada, 2023.

Where insights meet impact

The Conference Board of Canada

Publication 12042
Price: Complimentary

conferenceboard.ca