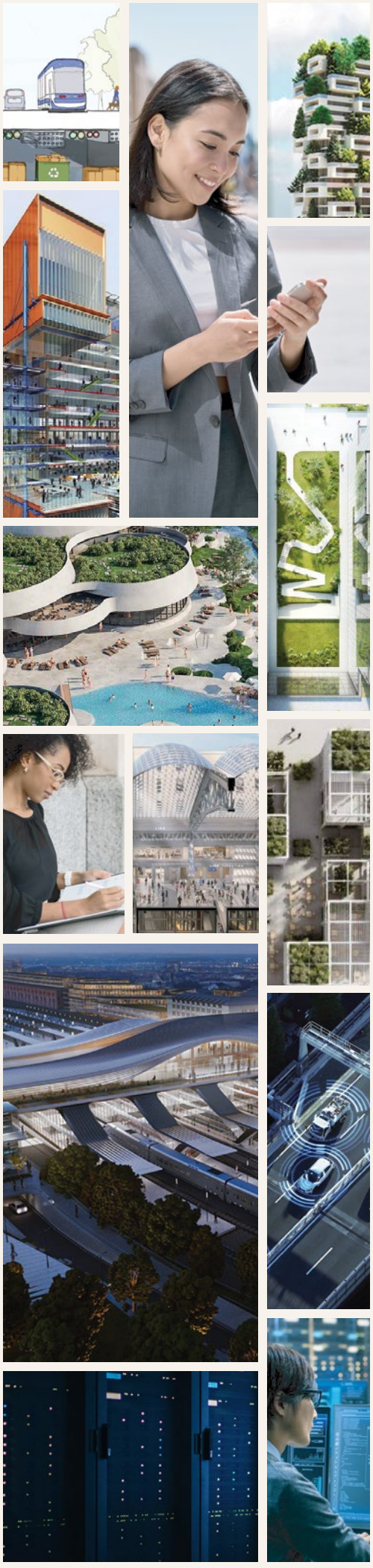

BRINGING A "SMART CITY" TO LIFE

Understanding Talent Development, Attraction, and Retention

ICTC CTIC

Research by

The Information and Communications
Technology Council

Canada

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Preface

The Information and Communications Technology Council is a not-for-profit, national centre of expertise for strengthening Canada's digital advantage in a global economy. Through trusted research, practical policy advice, and creative capacity-building programs, ICTC fosters globally competitive Canadian industries enabled by innovative and diverse digital talent. In partnership with an expansive network of industry leaders, academic partners, and policy makers from across Canada, ICTC has empowered a robust and inclusive digital economy for over 30 years.

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The opinions and interpretations in this publication are those of the authors and do not necessarily reflect those of the Government of Canada.

Abstract

This paper investigates the talent that supports a "smart city," (a city that uses technology and data collection to improve urban design and decision-making). It identifies smart cities-related occupations, investigates the types of educational backgrounds and programs that lead to those occupations, and then asks how municipalities of all sizes in Canada can best attract and retain smart cities workers. Key discussions in this paper include a comparison between longer-degree programs and shorter competency-based credentials, a discussion of workforce diversity in smart cities occupations, and a look at how the rise of remote work is changing workforce attraction and retention policy. The latter discussion involves an Atlantic Canada case study, with a focus on workforce attraction and retention in light of the COVID-19 pandemic. Overall, this paper shows that there are many pathways into smart cities work. In addition, it emphasizes that labour demand alone is not enough to retain smart cities workers: municipalities must also consider housing affordability, quality of life, and digital literacy and infrastructure for everyone who lives in a smart city.

Key terms:

Smart City	Work-integrated Learning	Education
Talent Supply	Post-Secondary Education	Immigration
Workforce Development	Micro-credential	Equity

This report is part of a set of three reports that culminates a multi-year research project on smart cities-related jobs, skills, training programs, and the social impacts of smart cities in Canada conducted by the Information and Communications Technology Council (ICTC).

1 Moving Toward an Inclusive Smart Economy for Canada:
The Human Talent Engine that Powers Smarter Cities

2 Bringing a "Smart City" to Life:
Understanding Talent Development, Attraction, and Retention

3 Technical Supplement:
Labour Market Forecasts for Canada's Inclusive Smart Economy

Studying the labour market implications of smart city development across Canada, this set of reports addresses key issues on both the demand and supply side. The overall structure of the analysis follows a labour market forecasting exercise and includes an assessment of growth outlook and demand drivers for smart city projects, and the implications for the kinds of jobs and skills that will be sought in the short and long term. On the supply side, the study looks at the key building blocks—first-time entrants to the workforce, migration and the ability of smart cities to attract skilled workers from within and outside Canada, and other factors affecting labour supply such as career transitions, re-entries to the workforce, and freelance and gig workers.

The quantitative analysis of economic and labour market data, and short- and long-term forecasts for the demand and supply of labour for key occupations in Canadian smart cities is presented in the *Technical Supplement*. There are, however, several salient trends and nuances that complement the statistical analysis in the forecasting report, and these are addressed in greater detail in the two larger reports.

Understanding the key jobs that will be needed in smart cities over the next 10 years involves assessing how smart cities will evolve and grow in this span, and how this will impact job and skills demand. *Moving Towards an Inclusive Smart Economy for Canada* builds this understanding through a review and assessment of various types of smart city projects across Canada and other comparable economies, the impact of legislation and regulations, and recent shifts in consumer and investor priorities such as the emphasis on decarbonization, clean energy, and issues of social and environmental equity. This is combined with data analysis and insights from primary sources including surveys, focus groups, and web scraped data from job boards.

An assessment of labour supply for smart cities in Canada includes studying education and training pathways for new entrants to Canada's workforce, municipal development, and the ability of cities to attract and retain a talented, diverse workforce. *Bringing a "Smart City" to Life* analyzes these key drivers while also looking at the impact of trends such as the increased prevalence of non-traditional educational pathways, especially for technology jobs; the importance of upskilling and reskilling to help ameliorate labour mismatches and enable workers to transition to high-demand sectors; the role of gig and platform workers in a smart city; and the impact of the shift to remote- and hybrid-work and the decoupling of sites of labour demand and supply.

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Executive Summary

A “smart city” uses technology to improve urban planning and processes, but it also needs people to bring it to life. Talented people live and work within a smart city, using urban spaces and amenities in their day-to-day life, engaging with public and private concerns, and bringing their expertise to pressing problems. Some of these people take diverse paths to work in smart city occupations, including interdisciplinary fields like health technology, urban design, and sustainability, as well as technology-focused fields like IT operations and cybersecurity.

This report combines insights from four surveys totalling over 2,400 respondents and conversations with 47 experts who were asked, 1) What types of pathways are there into a "smart city" career? and 2) How can municipalities attract and retain the people tracing these pathways? Dynamics that shape the unique answers to these questions in municipalities (both large and small) across Canada include the following:

Education and Training Leading to Smart Cities Careers

1 **Future smart city workers pursue diverse educational pathways.** Learners may choose to hone their skills in colleges, universities, polytechnics (as well as several or none of the above) and select various specializations within those institutions. For example, surveyed recent graduates interested in smart cities careers pursued education in business administration, management, and accounting; environmental and natural sciences; social sciences; arts; computer science; healthcare; engineering; and urban planning and architecture, along with many others. Most commonly, students selected fields of study based on a combination of job prospects and interest in the topic. In contrast to these varied educational pathways, many recent graduates secured their first professional job predominantly through interpersonal connections and networks.

2 **Smart city hiring decision-makers value degrees, but question whether university curricula can keep pace with industry demands.** While most surveyed smart cities hiring decision-makers sought candidates with university degrees, other participants questioned whether this preference was due to the prevalence of undergraduate education in Canada. Critics of universities argue that they are out of touch with quickly changing skill sets and lack interdisciplinary and competency-based education that is key to smart city work. In terms of a response to industry needs, some noted that universities do not compete well with technical training institutes, colleges, polytechnics, and other post-secondary programs that typically focus their curricula more explicitly on labour market needs and applied learning. To address these potential shortcomings, universities are rapidly improving their distance education offerings; adopting WIL (work integrated learning) programs and foundational competency training (like human skills, critical thinking, advanced literacy and numeracy); and creating specialized smart city-related graduate programs that are purposefully interdisciplinary.

3 **Many smart city occupations are technology occupations, and as such, historically, and today, lack diversity (for gender equity-deserving groups, Black Canadians, and Indigenous peoples in particular).** However, smart city occupations also overlap with other disciplines, such as urban planning, policy, health, and sustainability, which tended to draw more interest from surveyed students identifying as women. Compared to the technology sector, approximately the same proportion of surveyed recent graduates working in smart cities occupations are racialized Canadians or visible minorities. Fewer identified as Indigenous.

4 **Micro-credentials are a growing industry, with the potential to reach underrepresented learners pursuing smart cities careers.** Micro-credentials cater to people who need flexible schedules, short-term training, and affordable education options. For example, career transitioners who may not be able to afford to (or need to) pursue a four-year degree can use micro-credentials to develop applied knowledge and skills specific to a new field. Some secondary research, however, shows that micro-credential learners may still be predominantly male, core working age, and well-educated or already working. To reach underrepresented learners, then, institutions may require robust strategies to support and attract these learners. In addition, for micro-credentials to reach their potential, smart city employer openness to micro-credentials needs to be reflected in applicant assessments during the hiring process.

Municipal Development, Workforce Attraction and Retention

1 **Workforce attraction and retention can challenge smaller municipalities.** Surveyed new graduates in smart cities fields typically expect to work in Toronto (53.3.%), Vancouver (35.3%), and Montreal (34.2%). Smaller municipalities are often overlooked even though they offer quality of life and affordability. Smaller communities that feature high quality post-secondary education institutions could benefit from focused efforts to retain students in community after they graduate (68% of surveyed graduates were looking for work in the same city as the school they attended, though only 56% fully expected to stay in that city.)

2 **Smart city graduates seek out remote and flexible work opportunities.** For example, 57% of surveyed respondents agreed that "the possibility of remote work post-COVID has opened up [their] job search to more cities/regions." That said, not all employers believe that this trend will last forever. Most surveyed hiring decision-makers said that they were primarily seeking local candidates who could come into a physical office.

3 **Immigration is key to municipal economic development.** Although smart city employers are open to hiring immigrants, immigrants still face barriers to smart city employment. Smart cities employers in this study were open to hiring immigrants but less likely to hire those in need of visa sponsorship (only 16% had done so). Beyond visa sponsorship, immigrants to Canada face challenges such as Canadian work experience and Canadian education, both of which were required by about half of surveyed employers.

4 **A smart city must support its talent in more ways than one: employment is only part of the equation.** Affordability, housing and food security, and quality of life are all essential to a smart city. Across Canada, these features have increasingly appeared in public engagement sessions and are vital dimensions to attracting and retaining talent. To develop, attract, and retain, talent, a city must also guarantee that its residents can live well and securely. Strong and diverse educational institutions, collaborations between sectors (including schools, industry, the public, and the public sector), beautiful and open public spaces, and affordable options for living are the foundations upon which a smart city is built.

Introduction

This paper examines the concept of a "smart city" through the lens of the people who live and work in municipalities across Canada. Canada has long sought to promote a knowledge economy, where well-educated workers engage in careers that that generate, process, and use knowledge as a resource.[1] Creating knowledge workers is a two-way street: people need opportunities to pursue education, but also affordable housing, secure and fulfilling job opportunities, and spaces that permit collaboration and innovation. Importantly, it is not only knowledge workers who comprise a "smart city;" people from all sectors and occupations, as well as care providers, youth, and the elderly share in a smart city and should derive benefits from it—if the smart city is living up to its promise.

And what is the promise of a smart city? Canada is facing increasing urbanization,[2] along with new ways of designing communities to reduce greenhouse gas emissions, house more people, and create safe and livable spaces. "Smart City" is one term for a community that uses new technologies to improve urban planning and processes. This report's sister publication, *Moving Towards an Inclusive Smart Economy for Canada (2022)*, investigates what types of jobs and skills need to be filled in municipalities across Canada as technology further integrates with urban planning. In turn, the current report investigates the various pathways into a "smart city" careers and how cities can attract and retain the people pursuing these pathways.

This report focuses on Canada and unpacks the idea of talent supply in a smart city from two directions:

First, it discusses education and training. Pulling from several surveys of recent post-secondary graduates and hiring decision-makers, it asks:

- What fields of study lead to smart cities careers?
- How responsive to industry needs can and should four-year degree programs be, and are there opportunities to improve their outcomes in Canada?
- What roles do shorter programs and micro-credentials play?
- What are the best programs available to people making career transitions?

1 John Houghton and Peter Sheehan, A Primer on the Knowledge Economy, (Melbourne, Australia: Victoria University, 2000) https://vuir.vu.edu.au/59/; Judith Walker and Tara Gibb, An Exploration of Human Capital Assumptions in a Canadian Construction of a Knowledge Economy, (Waterloo, Ontario: Wilfrid Laurier University and the University of Waterloo, 2012)

2 Rufteen Shumanty, Patrick Charbonneau, and Laurent Martel, "Canada's fastest growing and decreasing municipalities from 2016 to 2021," Statistics Canada, February 9, 2022, https://www12.statcan.gc.ca/census-recensement/2021/as-sa/98-200-x/2021001/98-200-x2021001-eng.cfm

Second, it discusses municipal economic development, immigration, and the impact of COVID-19 on our assumptions about labour mobility. Primarily through a case study on Atlantic Canada, this section asks:

- What can smaller municipalities in Canada do to attract and retain knowledge workers?
- What role has occupation-based immigration played in smart cities development in Canada?
- What can we learn from recent data on working from home and new patterns in domestic and international migration?

This report series marks the end of a multi-year research initiative on smart cities-related jobs, skills, training programs, and the social impacts of smart cities in Canada by the Information and Communications Technology Council (ICTC). Accordingly, this report pulls from multiple surveys run throughout the study, focus groups with municipal development personnel and technology training institutions, and semi-structured interviews with researchers and educators who focus on technology education and urban development in Canada.

Building a Smart City From Its People Up: How Citizen Engagement and Talent Supply Are Prerequisites for the Smart City

Smart cities attract highly qualified people and a skilled labour force because of their openness and their eagerness to use technology in effective and innovative ways. They attract creative people who build creative cultures and industries, which in turn foster the development of knowledge ecosystems that bring prosperity to the city.[3] ”

Often, definitions of smart cities are technology driven. For example, ICTC has previously defined a smart city as a municipality that “uses technology to manage resources more efficiently and equitably, and/or pursues long-term planning to that end.”[4]

3 Margarita Angelidou, “Four European Smart City Strategies,” International Journal of Social Science Studies 4, no. 4 (2016): 18–30.

4 Tyler Farmer, Mairead Matthews, and Faun Rice, “Procurement Office or ‘Living Lab?’ Experimenting with Procurement and Partnerships for Smart Cities Technologies in Canada” (Ottawa, ON: Information and Communications Technology Council, February 2021), https://www.ictc-ctic.ca/wp-content/uploads/2021/03/ICTC_Report_SmartCities_ENG.pdf

Others, however, have highlighted human and social capital as essential components of smart cities and argue that the knowledge that fuels a smart city (including public data, its intelligent dissemination and participatory use, and social innovation) implicates citizens as much as a business ecosystem.[5] The idea of "human capital" both reflects the potential for people to build new and lasting value where they are, and, on the flip side, acknowledges that if a city is not doing enough to remain attractive and livable, people can take their labour, training, and creativity, and leave to a place with more opportunities. How cities pursue municipal development, how educational institutions integrate with their cities and citizens, and what role livability and quality of life play all relate to smart cities supply.

In a similar way, smart technology projects can be "bottom up" or "top down." In other words, they can emerge from popular demand and need, where an educated, creative populace looks for ways to improve urban planning, or they can be technology-driven endeavours, such as districts reserved to test new technologies. The two are not mutually exclusive: a business ecosystem that drives a technology project is also comprised of people but can provide a helpful way to think about a smart city's origins and the relationship between the people in a city and how smart cities decision-making happens. Urban planning decisions are of course impacted by "technology push or culture pull"[6]: but so are educational institutions (making decisions around curriculum). Accordingly, a top-down or bottom-up smart city approach can impact both demand-side and supply-side labour market considerations, as will be shown throughout this report.

This study convened municipal workforce development personnel, educators, technologists, and researchers. Overall, participants felt that a smart city's approach—whether technology or human driven—influenced its labour market in several ways. First, some argued that a "top-down" approach helps a city with its status and branding. As Zachary Spicer, Associate Professor at the School of Public Policy and Administration, York University noted: "A lot of technology is procured based on status: we want to be the smartest city, we want to have a new innovation centre, we want to bring in technology." From this perspective, being a tech-driven smart city, being on the global stage and being viewed as a dynamic place to live and work is one way to attract talented people. Conversely, critics noted that a poorly run, top-down project could instead damage a city's reputation for livability, particularly as public awareness of data collection and privacy grow.

5 Margarita Angelidou, "Four European Smart City Strategies," International Journal of Social Science Studies 4, no. 4 (2016): 18–30.; Rama Kummitha and Nathalie Crutzen, "How Do We Understand Smart Cities? An Evolutionary Perspective," Cities 67 (October 25, 2017): 43–52, https://doi.org/10.1016/j.cities.2017.04.010; Seunghwan Myeong, Younhee Kim, and Michael J. Ahn, "Smart City Strategies—Technology Push or Culture Pull? A Case Study Exploration of Gimpo and Namyangju, South Korea," Smart Cities 4, no. 1 (March 2021): 41–53, https://doi.org/10.3390/smartcities4010003

6 Seunghwan Myeong, Younhee Kim, and Michael J. Ahn, "Smart City Strategies—Technology Push or Culture Pull? A Case Study Exploration of Gimpo and Namyangju, South Korea," Smart Cities 4, no. 1 (March 2021): 41–53, https://doi.org/10.3390/smartcities4010003

"A city without people is not a city," one focus group participant said, citing the disappointing results of projects to date that have tried to create a smart city using strictly a top-down approach. Examples of this include the now-cancelled Sidewalk Labs project[7] or Songdo, Korea, a highly planned smart city with (thus far) far fewer residents than originally intended.[8]

Early, upfront, and ongoing consultation and co-design with city residents is one way to shape a smart city that reflects what citizens want.[9] ICTC research on smart cities in Canada has continually emphasized the importance of citizen participation and engagement in decision-making and design: while there is an important balance to be struck between technologists and citizen participation, cities that embrace early, upfront engagement may in the end create more welcoming and sustainable smart city projects than a "build it and they will come" approach.[10] Canada indeed has incorporated this ethos into much of its smart city planning. For example, the Infrastructure Canada Smart Cities Challenge (winners announced in May 2019) mandated that applicants engage in extensive co-design and engagement with citizens.[11] This report also includes several snapshots from ICTC's virtual public engagement sessions (aimed to inform research rather than smart cities design), with the remainder summarized in Appendix A.

In the *ICTC Survey of Recent and Future Graduates in Smart Cities-Related Fields* (2021, n = 601, hereafter *Smart City Graduate Survey*), ICTC asked respondents what a smart city meant to them: about a third (35%) attempted a response while the remainder were unsure. Their responses illustrate that the term "smart city" comes with both positive and negative connotations, and a mix between technology-centred and human-centred definitions. Furthermore, it seems that for some students, their impression of a smart city might impact their decision to work in a related field in the future:

What does the term "Smart City" mean to you?

"Advanced cities with more employment opportunities."

"Smart cities I think refers to locations that are technologically advanced and remote work is available to employees. They are advanced when it comes to resources."

7 "Sidewalk Toronto," Sidewalk Labs.com, accessed July 13, 2022, https://www.sidewalklabs.com/toronto

8 Anna Verena Eireiner, "Promises of Urbanism: New Songdo City and the Power of Infrastructure," Space and Culture, (August 2021), https://doi.org/10.1177/12063312211038716

9 Faun Rice, "A Tale of Two Consultations: Meaningful Engagement for Technology in the Public Sphere," Information and Communications Technology Council, August 6, 2021, https://www.digitalthinktankictc.com/articles/a-tale-of-two-consultations-meaningful-engagement-for-technology-in-the-public-sphere

10 Faun Rice, Maya Watson, and Phil Dawson, "Building Human Rights into Intelligent Community Design A Focus on Canada" (Ottawa, ON: Information and Communications Technology Council (ICTC), April 2022), https://www.digitalthinktankictc.com/policy-briefs/building-human-rights-into-intelligent-community-design; Mairead Matthews, Faun Rice, and Trevor Quan, "Responsible Innovation in Canada and Beyond: Understanding and Improving the Social Impacts of Technology" (Ottawa, ON: Information and Communications Technology Council, January 2021), https://www.ictc-ctic.ca/wp-content/uploads/2021/01/ICTC_Report_SocialImpact_Print.pdf

11 "Smart Cities Challenge," Infrastructure Canada, August 2020, https://www.infrastructure.gc.ca/cities-villes/index-eng.html

"Cities that are adaptable with the use of technology to help make better decisions. Smart cities are also integrated with technology (sensors, cameras) to help improve the livelihoods of its citizens."

"A variety of things: infrastructure and skilled labour force to attract tech companies, upgraded infrastructure for modern efficiencies (e.g., WiFi everywhere, technology helps manage resources such as lighting throughout city, energy efficient public spaces, etc...)."

"Urban area that uses gizmos to collect data."

"Villes ou il y a beaucoup de robots qui font du travail humain" [cities where there are many robots that do human work]

As these recent or soon-to-be graduates intuited, the technology- or culture-driven nature of smart cities also relates to the types of jobs that are created in smart cities. Study participants noted that human-centric smart cities design will create better, more fulfilling jobs, and require workers to bridge humanities, social sciences, and technology.

> *I do believe that a human-centric approach will create more jobs and retain better talent. And so educators, how do we fit into the picture? Well, maybe our job is to help the engineers to understand the humanities, and vice versa, so everybody can work together.* ❞
>
> – Taskforce Member

A smart city is created by the people who live in it just as much as the technology that drives it—indeed, many smart technologies are literally supplied with citizen data—and human capital development is an essential component of a sustainable smart city. This is mirrored in the types of jobs and education that have been identified as "smart cities related" and used for analysis throughout surveys and other research tools in both this report and *Smart Cities Demand*. Smart cities jobs and skills are not limited to technical roles but also encompass policy and planning, sustainability, ethics and diversity, equity, and inclusion, and business analysis.

Let's Talk Smart Cities

Waterloo Region

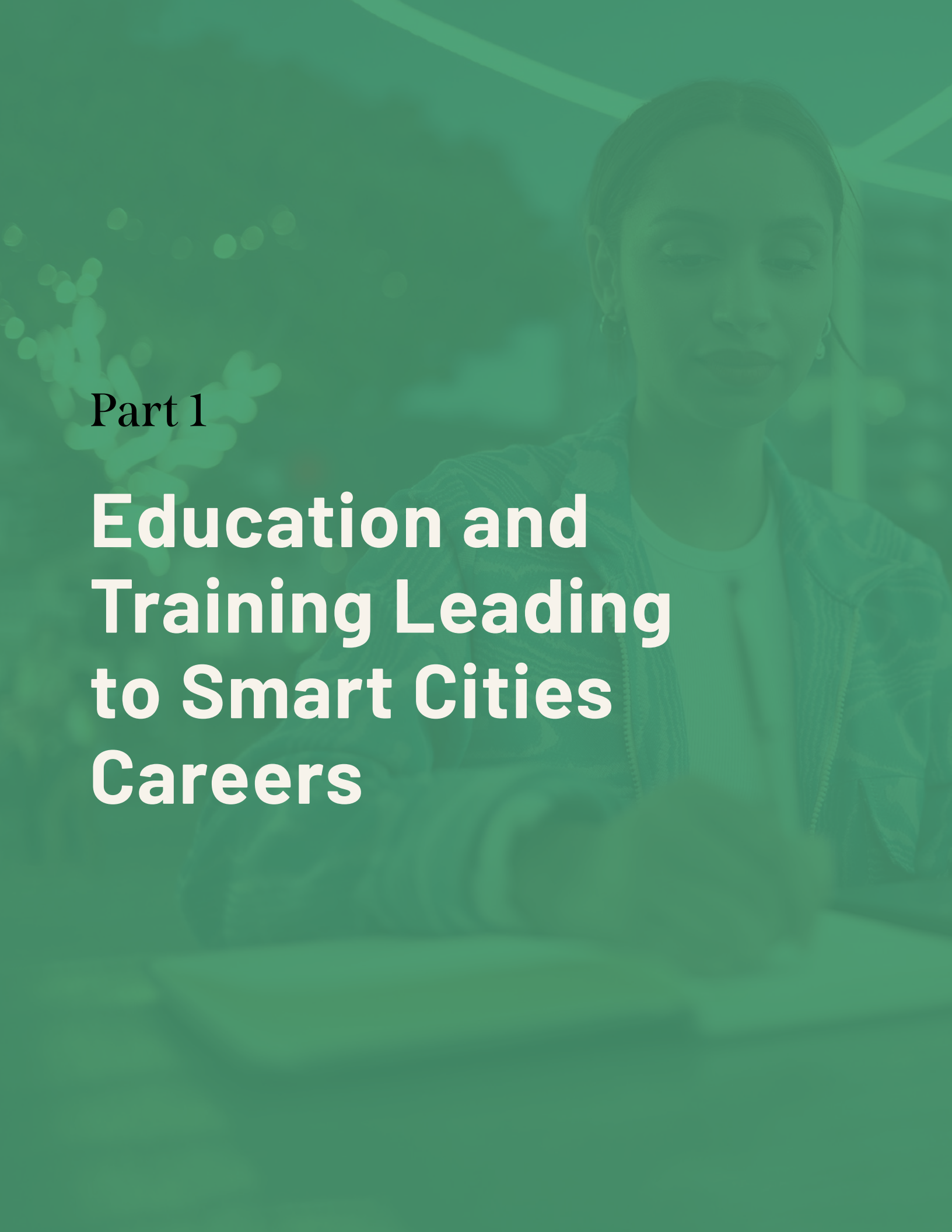
This report highlights findings from remote public engagement events across Canada, in which ICTC researchers partnered with local organizations to ask attendees what they envisioned for a smart city in their region. A smart city's "talent supply" is, in addition to smart cities workers, municipal citizens who shape local priorities.

On Nov 8, 2021, ICTC ran a public engagement session (virtually) with Waterloo residents. Sources for full descriptions of each of these engagement sessions are listed in Appendix A. In the figure below, Waterloo region participants talked about what a smart city meant to them using an interactive digital engagement tool. Their priorities for a "smart Waterloo" included accessible public transportation, but also inclusivity and accessibility, along with prioritizing basic needs of residents rather than flashy projects related to municipal branding.

Smart cities need people to be able to see the future, and that's the problem. It's hard to see the future, especially for people that are impoverished, who are dealing with the here and now every single day... It's very middle class to be talking about smart Waterloo. ❞

– Waterloo Region Engagement Participant

Figure 1: Group commentary on Google Jamboard (digital engagement tool). Waterloo Smart Cities virtual public engagement session, ICTC 2021.



Part 1

Education and Training Leading to Smart Cities Careers

Post-Secondary Training and Smart Cities Careers: The Landscape Today

Throughout ICTC's smart cities research, the following aggregations of careers have been used to describe smart cities occupations. These have been shaped through a combination of quantitative and qualitative research on existing and emerging in-demand jobs involving data collection, digital infrastructure, urban planning, and relevant service delivery.

- Health Technology
- Augmented/Virtual Reality & Gaming
- Smart Mobility
- Artificial Intelligence, Machine Learning, and Human-Computer Interaction
- Business and Policy Analysis
- Agricultural Technology (e.g., vertical farming)
- Urban Design & Sustainability
- Clean Technology
- Hardware Design and Development
- Web or Software Development
- IT Operations
- Cybersecurity
- Data Science
- Cloud Computing & Databases

A person pursuing a smart city-related career may take a variety of pathways: formal education, such as a degree program; accrued work experience; "non-traditional" education, such as a bootcamp or micro-credential; or a mid-career transition. Similarly, many different types of education can support a smart city's workforce while helping to promote civic participation. A lively debate exists about what type of education is the best way for a worker to acquire rapidly changing technical skills, along with broad human skills and the critical thinking, digital literacy, and confidence to engage in municipal affairs.

Educators from post-secondary institutions, including universities and colleges, as well as micro-credential and bootcamp issuers, participated in this study through interviews and an advisory taskforce. Some participants contend that a four-year degree program is no longer a viable way to teach rapidly changing technology-related skills; while others suggest that shorter-term training does not produce well-rounded, human-skilled candidates.

This study also surveyed hiring decision-makers, finding that the majority still look for candidates with degrees. In the *ICTC Survey of Smart City Employers' Perceptions of Career Transitions and Credentials* (2021, n = 404, hereafter *Smart City Employer Survey*), respondents (hiring decision-makers in smart cities-related fields) were asked to identify the typical level of education they sought in candidates. Most respondents looked for candidates with university educations, either an undergraduate degree (48%), a master's degree (27%), or a PhD (10%).[12]

Overall, many respondents also looked for technical institute education (33%), a college program (26%), or a high school education (11%), while 4% looked for a "non-traditional (e.g., certification or bootcamp)" education.

While interpreting this data, it is important to remember that Canadians in general, and particularly young Canadians, have a higher level of education on average than their peers in other OECD countries.[13] Accordingly, people responsible for hiring could simply expect that the average applicant has a college or university education and adjust their responses accordingly. This may or may not mean that post-secondary education is always required to do a job well.

In addition, employers frequently desire or expect workers to pursue life-long learning and competency-based upskilling. Perspectives differ on whether post-secondary education provides an important baseline to which further credentials can be added. This topic is unpacked throughout Part I. Nevertheless, many colleges and universities in Canada are working to improve their programs' interdisciplinarity and industry responsiveness, while other types of educational institutions are looking to fill what they see as a gap in quick and relevant competency-based education.

In what follows, Part I discusses four year-degree programs relevant to smart cities-related work, and how universities and colleges are working to improve their interdisciplinary programming and build work-integrated learning into their offerings. It then turns to the role of two-year and shorter vocational programs. Finally, it examines the world of competency-based learning, micro-credentials, and how professionals making career transitions can use them on their path to a new occupation.

12 Hiring managers in AI/ML (37%), data science (21%), and other technical fields (hardware, software, cloud computing; 15-16%) were most likely to be looking for PhDs and most likely to seek "technical institute" educations (e.g., 61% of HR professionals in AI/ML noted that they sought this; the question was "select all that apply").

13 "Young Canadians generally have a higher level of education than their counterparts across OECD countries, with 63% of young Canadians aged 25 to 34 attaining a college or university education compared with the OECD average of 45%. This is mainly due to a higher proportion of young Canadians attaining a college education—24% compared with the OECD average of 8%." Statistics Canada, "Study: Youth and education in Canada," The Daily, Oct 4 2021, https://www150.statcan.gc.ca/n1/daily-quotidien/211004/dq211004c-eng.htm

Universities and Colleges:
Degree-Based Pathways into Smart Cities Work

A student wishing to work in a smart-city related career can pursue many pathways in Canadian universities and colleges, including STEM (science, technology, engineering, math) training, humanities and social sciences, or more specialized programs. Colleges and universities in Canada both offer four-year degree programs. While both may offer shorter-term technical or vocational training, this section focuses primarily on longer-term degrees.

Four-Year Degrees Leading to Smart Cities-Related Careers

A career in smart cities could involve a number of core technical competencies (e.g., data science) required to support smart cities projects, or jobs that are more interdisciplinary in nature (e.g., a role in smart mobility, city planning and digital infrastructure, sustainability, or ethics and inclusion).[14] In the surveys used throughout this study, hiring managers, students, and smart cities workers were included through job-related filtering questions, and the occupation categories used throughout this report reflect aggregations of their responses. In *Smart City Demand*—the sister report to this study focused on key demand-side issues of smart city development in Canada—these same aggregate categories are used where possible (e.g., to simplify webscraped job title data). These aggregations, however, do not necessarily map cleanly to National Occupation Classification (NOC) codes or Classification of Instructional Program (CIP) codes. The technical paper that accompanies this report, forecasting labour supply and demand across key smart cities in Canada, relies on data sets from Statistics Canada (and other sources) that are structured along these classification systems. Readers interested in further details on how ICTC research defines and classifies smart city occupations should consult the forecasting report.

Traditional four-year programs that lead to smart cities work may include many single-discipline programs. In the *Smart City Graduate Survey* (2021), respondents were selected based on their interest in smart cities-related jobs (see Figure 2) and then asked what type of degree programs they were pursuing or had recently pursued. Figure 2 ranks occupations in descending order of respondents with university educations. In particular, respondents in or hoping to enter roles in Cloud Computing and Databases, Data Science, Cybersecurity, Development, and IT operations had some university. The sample of respondents in the *Smart City Graduate Survey* tends toward university students: accordingly, more telling than the amount of post-secondary respondents is the comparison between graduate and undergraduate studies by field of work. For example, a large proportion of Cloud Computing and Databases workers and hopefuls had pursued graduate training.

14 Akshay Kotak and Khiran O'Neill, "Work in Progress: Emerging Smart City Occupations" (Ottawa: Information and Communications Technology Council, August 2021), https://www.digitalthinktankictc.com/reports/work-in-progress

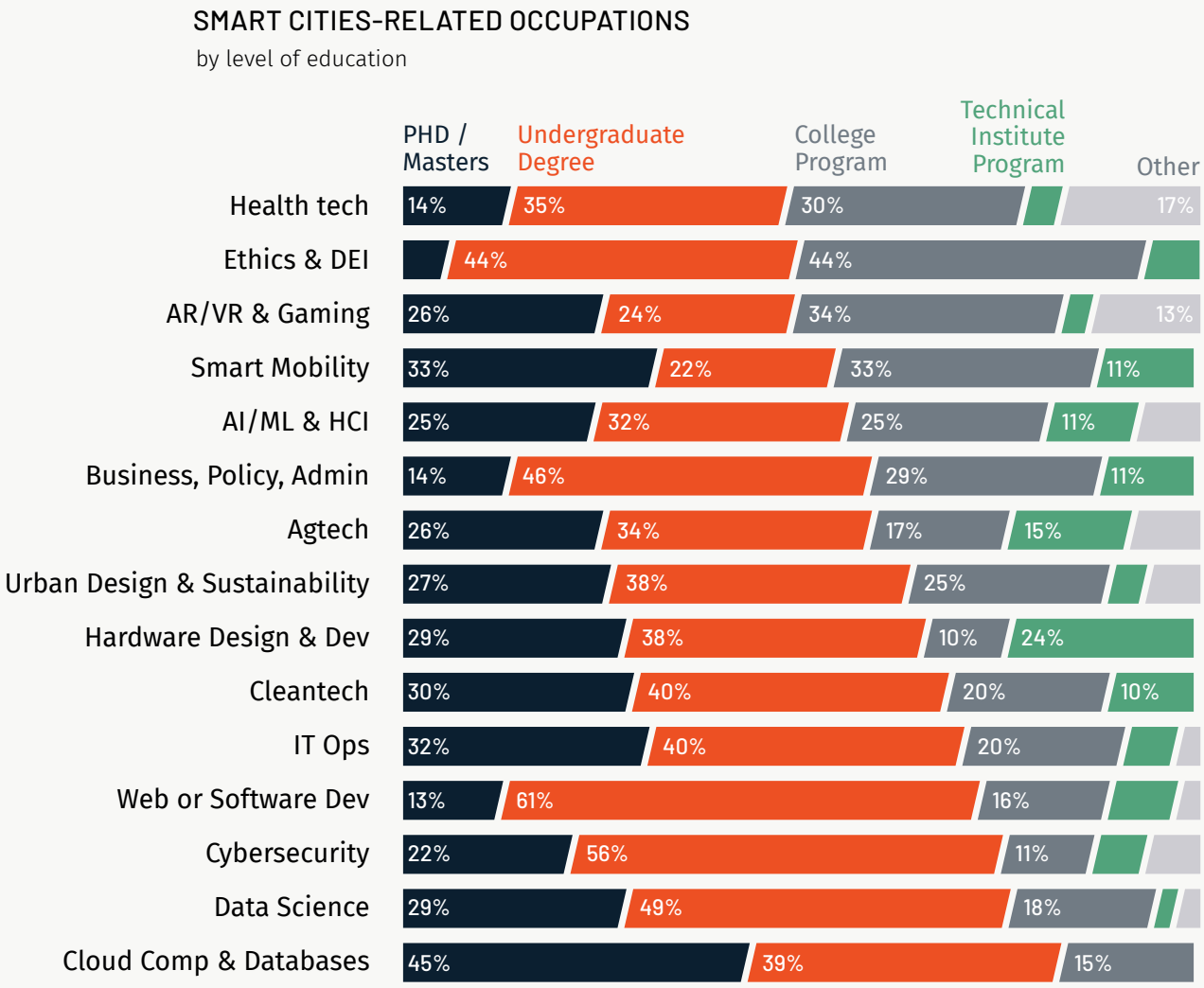


Figure 2: Questions visualized are "What is the highest level of education you have achieved" by "Which of the following fields / careers are you most interested in pursuing." Occupations are ranked in ascending order of highest percentage (%) of respondents with some university education. (AI/ML & HCI: Artificial Intelligence and Machine Learning & Human-Computer Interaction; DEI: Diversity, Equity and Inclusion; AR/VR: Augmented or Virtual Reality; IT: Information Technology.) ICTC Survey of Recent and Future Graduates in Smart Cities-Related Fields, 2021.For an interactive version, visit https://www.datawrapper.de/_/RGJLE/

Many different degrees can lead to smart cities work. Survey respondents were asked what fields of study they had completed or were pursuing. The following list should be taken as an array of fields of interest to future smart cities workers: as mentioned earlier, the *Smart City Graduate Survey* filtered respondents based on their interest in smart cities occupations, and some fields of study showed greater response rates than others (e.g., health technology). Among the most common domains of focus were the following (in descending order):

1. Business Administration, Management, or Accounting
2. Environmental, Biological, Natural, or General Sciences
3. Arts or Social Sciences
4. Computer Science or Information Technology
5. Healthcare
6. Engineering
7. Urban Planning and Architecture
8. Other programs such as Mathematics, Statistics, and Modern Languages

Students combined job prospects and personal interest when selecting a field of study. In a follow up question, respondents were asked why they had chosen their educational paths. Students were evenly split between those choosing fields of study based on the job they wanted and those who were "passionate about the topic."[15]

For students who had graduated and started work (n = 300), interpersonal connections were the most common way into their roles: 21% knew someone in a similar role and 11% had received a word-of-mouth referral. For 18% of respondents, the role had been promoted in their post-secondary program. Many respondents found work through online job boards (Indeed: 11%; LinkedIn: 6%; other: 2%) while 9% landed their role through due to a co-op or practicum.

Four-year degrees are still in demand with hiring decision-makers, and surveyed recent graduates of four-year programs have successfully found smart cities work. However, there is also an ongoing conversation in Canada about whether traditional post-secondary education institutions are serving students as well as they could. Four-year degrees may be out of touch with the types of skills needed by industry and face new competition in an era of distance education.

15 The question was select all that apply. Responses: "what led you to the specific degree program(s) you chose?" : 56%, "it was related to the job I wanted," 56%, "I was passionate about the topic," 27%, "it is what I always planned to do," 11%, "It is what my family encouraged me to do," 7%, " I fell into it by accident." ICTC Smart Cities Graduate Survey, 2021, n = 601.

In a four-year program, the competencies that are taught in year one are probably obsolete by the time you graduate. ❞ – Interviewee

My business partner cannot find people with skills in pen testing. We've been searching for years and really have difficulty with that skill, even among students coming out of college. There is a big supply problem. ❞ – Taskforce Member

Study participants who were detractors of post-secondary degrees also noted that they saw a troubling trend toward explicitly for-profit models in post-secondary institutions, where value for students might be undermined due to a university's bottom line. This conversation has been complicated by distance learning and the COVID-19 pandemic, where many have pointed out that universities are suddenly faced with more urgent competition from open distance-learning organizations (e.g., massive open online courses, or MOOCs).[16] Post-secondary institutions have needed to adapt to online education delivery in light of established, and sometimes less costly, competition. To compete, universities will need to continue to learn how to offer high-quality digital learning, as more students may now actively seek out remote education.[17] Some post-secondary education providers have begun to consider distance learning as a strategic part of their offerings:

Something that I don't think we push on enough is that post-secondary institutions have been remarkably resilient and not really changed. There's not a lot of space for self-directed, accelerated learning. There are more part time programs than before because more people are working or have families, but a standard bar is still three or four years. Really? Can we not move faster or better? I don't think the future is just micro-credentials, but I do think people have an appetite to articulate the skills they have. To round out some of these thoughts, we offer a small graduate program of about 20 people. We're solving for an experiential component by having practitioners in the classroom and bringing traditional sources to life through a case study approach. Our exercises in the classroom translate immediately to the working world. And, our first year has had to be digital first. It's an active conversation of whether that's a competitive advantage for the program, because people are from all over Canada and they can stay where they are instead of uprooting themselves for a year. We're trying to figure out what the future looks like for us. ❞

– Vasiliki Bednar, Executive Director, Master of Public Policy in Digital Society, McMaster University

16 John Daniel, "Running Distance Education at Scale: Open Universities, Open Schools, and MOOCs," in Handbook of Open, Distance and Digital Education, pp. 1-18, Singapore: Springer Singapore, 2022.

17 Kabir Mabruk, Brad Seward, and Elizabeth Dhuey, Higher Education in Canada During COVID-19: Current challenges and future directions, (Toronto, ON: FutureSkills Research Lab, 2021), https://futureskillscanada.com

Study participants also expressed that universities often take a long time to approve and review revisions to curricula. Others see the rapid structural changes that post-secondary institutions made since 2020 as a sign that other changes of an ambitious scale could be made. This could include structural changes to speed up curricular revisions, better incentives for professors and educators to make changes to curricula, and an increased role for the private sector.

Colleges and universities have been doing this in different sectors for years and decades; it's not that it's not there. They offer 10,000 different programs that respond to the labour market within their communities, and program advisory committees. I'd also argue that colleges can only train in skills they can hire. With new skills, there's not too many people [to act as professors], and those people are in demand. ❞ – Taskforce Member

However, others argue that a four-year degree is not intended to teach "narrow" job-ready skills that could quickly become irrelevant. Greater industry integration in post-secondary institutions came with mixed reviews from study participants. Critics point out the dangers of designing university programs to fulfill narrow labour market needs.[18] For example, some study participants commented that the purpose of a four-year program is to create well-rounded, self-driven professionals who can choose a diversity of career paths. Labour market demand in technology can call upon new skills quickly, making it difficult for any program to guarantee a student the technical skills of the hour. Such respondents advocated for a balanced approach where university programs stay relevant and responsive without undermining foundational skills with longer-term value and utility, such as knowledge economy skills like processing, organizing, and managing information; advanced literacy and numeracy; and critical thinking.[19]

What happens when industry isn't going to hire you and you have a degree that is very highly spun for that industry? This prospective student can end up actually dependent, potentially in trouble. So whatever the industry-related curriculum is, is it big enough to allow students to swing out of that particular industry? Should they not want to do it, or something happens in their lives, what if they decide to do something else? I think that our four-year institutions are specifically meant to be as broad as possible, such that you can take a data science degree and apply it in 15 different fields. ❞ – Taskforce Member

18 As an illustration of the concerns some voice about narrow vocational programs, some research has found that broader educations tend to produce more favourable labour market positions, suggesting that narrow programs teaching specific skills and competencies may best be additive rather than exclusive of broader education. For a comparative look at the topic of the value of post-secondary education, including Canada, see OECD (2017), In-Depth Analysis of the Labour Market Relevance and Outcomes of Higher Education Systems: Analytical Framework and Country Practices Report, Enhancing Higher Education System Performance, OECD, Paris. For an additional international perspective that explicitly compares types of training, see Johan Coenen, Hans Heijke, and Christoph Meng, "The Labour Market Position of Narrow versus Broad Vocational Education Programmes," Empirical Research in Vocational Education and Training 7, no. 1 (August 26, 2015): 9, https://doi.org/10.1186/s40461-015-0020-x

19 Anthony William Bates, Teaching in a Digital Age – Second Edition, "Chapter 1: Fundamental Change in Education," 2019, https://pressbooks.bccampus.ca/teachinginadigitalagev2/chapter/section-1-4-should-post-secondary-education-be-tied-directly-to-the-labour-market//

While four-year programs seek to teach foundational, transferable skills, some evidence suggests that they still need to make changes in order to do this well. Research from the OECD has shown that Canadian post-secondary graduates' relative skills in literacy, numeracy, and problem solving could still be significantly improved in areas such as "performing multi-step operations to integrate, interpret, or synthesize information from complex and lengthy texts."[20] This finding was echoed by the Conference Board of Canada in an investigation of skills development and labour market needs, which concluded that the "literacy, numeracy, and problem-solving skills of Canadian adults are less impressive than one might expect for a country with a high level of post-secondary participation and attainment."[21] This is echoed from within post-secondary institutions: for example, Canadian professors who teach writing as a professional competency have noted an endemic lack of support from their institutions, and a structure that sidelines skills falling outside of recognized disciplines.[22] If critical reading, writing, numeracy, and problem solving are the types of broad, foundational skills that post-secondary institutions are best suited to teach, continued assessment of these trends through student assessments like the OECD's Survey of Adult Skills (PIAAC) will be helpful in benchmarking Canada's achievement against the world,[23] as will employer-side research.

Smart cities-related fields are interdisciplinary in nature: they require people who can balance human social systems and urban living patterns with technical competencies. Four-year degrees have long been an assumed pre-requisite for many people working in Canada's knowledge economy: however, this discussion has touched on new shocks to traditional post-secondary education and whether it is effectively teaching foundational, broad skills,[24] or taking its cues from industry needs. Further, post-secondary institutions can offer external modular "additives" to training: this includes micro-credentials and supplementary education from other institutions (covered later in this section) and work-integrated learning (WIL).

Work-Integrated Learning

WIL "combines traditional post-secondary education with exposure to real-world work experience, often with the goal of better preparing graduates for entry into the workforce and smoothing the transition from student to employee (or becoming self-employed)."[25]

20 In Canada, close to 30% of post-secondary graduates are not at this level of literacy at the time of this research. OECD, In-Depth Analysis of the Labour Market Relevance and Outcomes of Higher Education Systems: Analytical Framework and Country Practices Report, Enhancing Higher Education System Performance, (Paris: OECD, 2017), pp. 60- 61.

21 Dan Munro, Cameron MacLaine, and James Stuckley, Skills—Where Are We Today? The State of Skills and PSE in Canada, Ottawa: The Conference Board of Canada, 2014.

22 Heidi Darroch, Micaela Maftei, and Sara Humphreys, "Writing instruction, academic labour, and professional development," Discourse and Writing/ Rédactologie 29 (2019): 133-136.

23 In the most recent PIAAC data at the time of writing, adults with post-secondary education in Canada again performed slightly below the OECD average in mean literacy, numeracy, and problem-solving scores. Importantly, this data should be interpreted in light of its inclusion of internationally educated adults in Canada. See: "Survey of Adult Skills (PIAAC): Full Selection of Indicators," OECD, 2019, https://gpseducation.oecd.org/IndicatorExplorer

24 A significant literature exists on how to address the problem of a dearth of foundational skills in academic contexts. See for example, Paul J. Grayson, "Generic Skills, Academic Achievement, and Means of Improving the Former," GiLE Journal of Skills Development 1, no. 2 (2021): 7-28; Nicholas Dion & Vicky Maldonado, "We need to assess student literacy skills," University Affairs, April 12, 2013, https://www.universityaffairs.ca/opinion/in-my-opinion/we-need-to-assess-student-literacy-skills/; Lisa Tsui, "Fostering critical thinking through effective pedagogy: Evidence from four institutional case studies," The Journal of Higher Education 73, no. 6 (2003): pp.740-763, http://dx.doi.org/10.1353/jhe.2002.0056; Statistics Canada, "Overqualification, skills and job satisfaction," September 14, 2016, https://www150.statcan.gc.ca/n1/pub/75-006-x/2016001/article/14655-eng.htm

25 Steve Martin and Brandon Rouleau, "An exploration of work, learning, and work-integrated learning in Canada using the longitudinal and international study of adults," Centre for Income and Socioeconomic Well-Being Statistics, Statistics Canada, May 25, 2020, https://www150.statcan.gc.ca/n1/en/catalogue/89-648-X2020001

WIL can include co-operative programs, internships, fieldwork, and work placements.[26] Across the board, educators who participated in this study saw co-ops WIL programs as valuable offerings for students to gain a diversity of real-world experiences while pursuing degree programs.

It's popular for a reason because it helps you learn skills, competencies, and it lets you put them into practice through what the educational theorists would call legitimate peripheral participation. That is to say, whatever I'm practising under your guidance and tutelage, my participation is legitimized by access to an expert, and participatory because I'm actually doing something. I think it's very important. ❞

– Interviewee

Educators commented that beyond teaching important technical skills and expertise, WIL programs integrated important human skills into STEM training, including collaboration and self-driven learning. WIL programs also allow for interdisciplinary collaboration and training: for example, one respondent working in post-secondary education had created a purposefully interdisciplinary program where WIL students from different degree programs participated in projects that solve specific problems for WIL-sponsoring organizations.

Student evaluations of WIL suggest that it can be helpful for finding work: 9% of recent graduates working in smart cities fields and surveyed in this study had found their current role through a WIL placement (in other words, the same employer hired the student upon completing the co-op and degree program).[27] Statistics Canada found that from 2012–2016, about half of post-secondary graduates who had worked during their degrees had found this experience useful for finding their first job. This proportion grew to 71.3% for graduates who had held a job related to their field of study during post-secondary.[28] Secondary literature on employer perceptions of co-op programs typically reports positive employer assessments of student progress and learning outcomes.[29] A further systematic evaluation of WIL outcomes by degree type across Canada would add to the literature on this topic.

26 Ibid.

27 ICTC Survey of Recent and Future Graduates in Smart Cities-Related Fields (2021; n=300, sub-sample of recent graduates now working).

28 Steve Martin and Brandon Rouleau, "An exploration of work, learning, and work-integrated learning in Canada using the longitudinal and international study of adults." Centre for Income and Socioeconomic Well-Being Statistics, Statistics Canada, May 25, 2020, https://www150.statcan.gc.ca/n1/en/catalogue/89-648-X2020001

29 For example, literature on WIL for engineers supports the view that students develop workplace skills (e.g., communication and teamwork) through such programs. See: Susan Hang, Eric Guildbeau, and Whitney Goble, "Assessing Engineering Internship Efficacy: Industry's Perception of Student Performance," International Journal of Engineering Education 22, no. 2 (2006): pp. 257-263; Morteza Sadat-Hossieny and Mauricio Torres, "How Co-op in Engineering Technology Proves to Strengthen Student Learning and Fulfill Student Learning Outcomes," (paper presented at 2016 ASEE Annual Conference & Exposition, New Orleans, Louisiana, June 2016).

By and large, employers engaged in this study also agree that WIL training is helpful in building mature, workplace-ready candidates. In the *ICTC Survey of Employer Perceptions of Human or Soft Skills* (2021, n = 404, hereafter *Human Skills Survey*), ICTC presented 400 hiring managers with a list of skills and asked them where candidates could best learn them. While the answer was "select all that apply," (see table below) a tellingly high proportion of employers felt that many skills were best learned in a previous job. While post-secondary education was also seen as teaching human skills, a combination of work experience and post-secondary training may go further in convincing hiring managers that a candidate will be a mature fit.

CANDIDATES CAN BEST LEARN ____ SKILL THROUGH...

Select all that apply

	Post-secondary	High school	A previous job	A certificate program	Personal or family life	Volunteering	After I hire them
Communication	55%	55%	53%	47%	47%	40%	36%
Attention to detail	44%	47%	48%	40%	38%	27%	36%
Planning	50%	39%	53%*	41%	33%	32%	40%
Design thinking	46%	26%	44%	40%	18%	18%	33%
Troubleshooting	42%	33%	51%	43%	32%	26%	42%
Decision-making	48%	40%	53%	43%	40%	31%	42%
Leadership Skills	47%	39%	53%	39%	40%	37%	42%
Empathy	33%	37%	33%	28%	54%	36%	27%
Time Management	51%	47%	54%	47%	37%	29%	40%
Adaptability	41%	42%	53%	38%	44%	35%	35%
Collaboration	48%	51%	52%	44%	40%	39%	40%
Conflict management	41%	35%	50%	41%	44%	29%	40%

*Significantly higher for technology sector respondents (68%)

Table 1: Employer perceptions of where candidates can best learn human skills.
Source: ICTC Survey of Employer Perceptions of Human or Soft Skills, 2021. For an interactive version, visit https://www.datawrapper.de/_/3lfke/

WIL programs fill an important experience gap for fields that require significant exposure to a workplace for a candidate to be successful, which includes fields related to smart cities. In the *Smart City Employer Survey*, ICTC asked whether recruits were typically early career (less than five years of experience), mid career (five to 15 years) or late career (15+). Overall, the majority of respondents typically hired mid-career professionals (64%), while 53% also hired early-career personnel, and 18% hired late-career personnel (the question was non-exclusive).

Several fields show significant experience-related trends.[30] The figure below shows respondent perceptions of the seniority and experience, in descending order of careers into which late-career personnel are most likely to be hired.

In addition, this data does not ask about *preference* but *availability*. For example, it is likely that more hiring managers would have selected "late career" if more experienced hires were "typically" available. Accordingly, the table below reflects a mix of supply and demand, and may be more illustrative of the most typical pathway into a particular field than preferred hiring trends. While in every field, it is possible for early career professionals to get a foot in the door, many hiring decision-makers typically hire experienced personnel for smart cities-related roles. For a new graduate, it is important to gain experience through entry-level positions and workforce-integrated learning.

ARE THE EMPLOYEES YOU TYPICALLY HIRE...

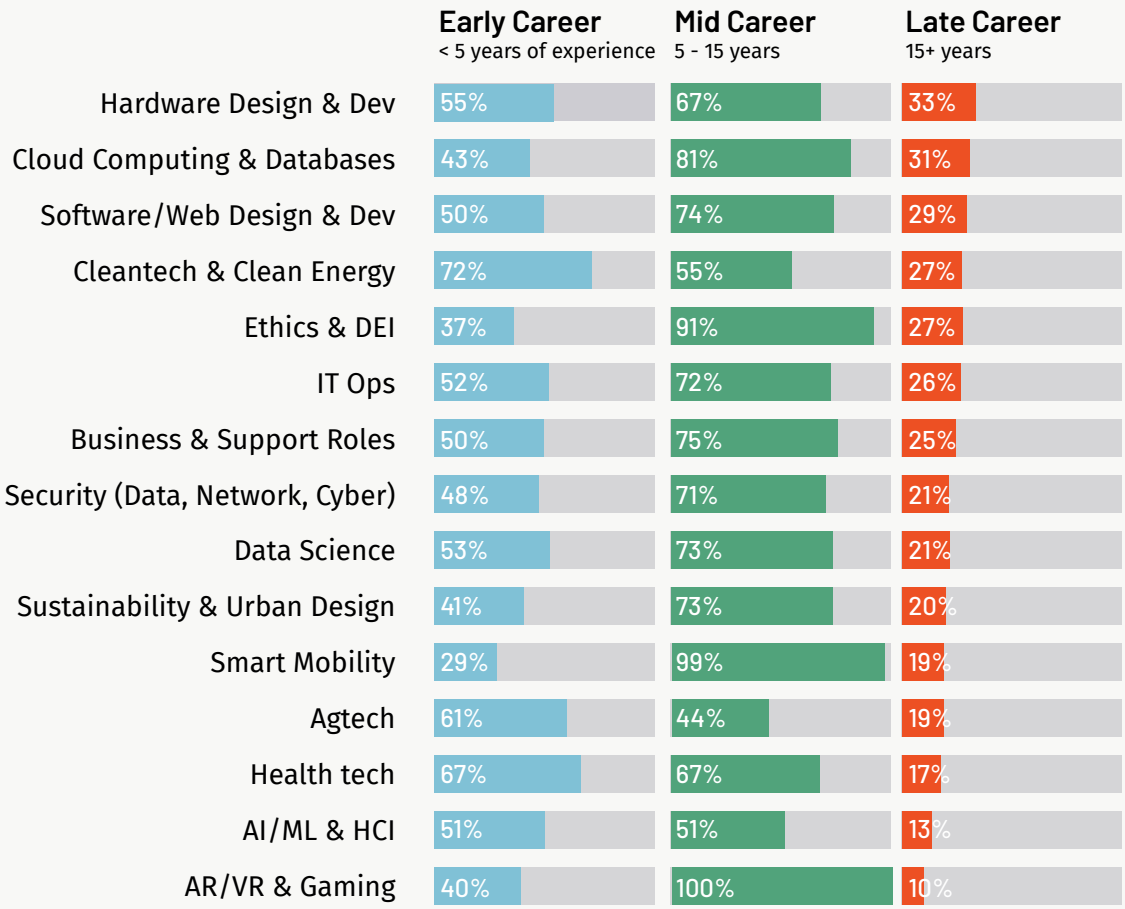


Figure 3: Percentage (%) of early-, mid-, and late-career workers that are typically hired in select smart city fields. ICTC Survey of Employer Perceptions of Career Transitions and Credentials, 2021. For an interactive version, visit: https://www.datawrapper.de/_/I5p4T/

30 An important caveat to the occupation categories in the Smart City Employer Survey is that hiring decision-makers could be hiring for more than one field. For example, the same hiring manager could recruit cloud computing personnel and software/web design personnel. Accordingly, whether the preference for early-, mid-, or late-career personnel comes more from the respondent or the field cannot be fully disaggregated.

Limitations of WIL

WIL programs can have shortcomings when operationalized restrictively or uncritically. First, WIL is not always easily accessed by all employers and students. Training WIL students often requires additional employer resources (even when programs are funded). Accordingly, small and medium sized enterprises (SMEs) may have a harder time hiring and supporting co-op students because of the amount of time it takes to manage and train entry-level workers. Co-ops do not always support workforce diversity: some WIL funding is tied to citizenship, and international students are not eligible. Nearly all WIL funding is tied to enrolment in post-secondary education, which can pose a significant barrier for many Indigenous young people.[31] Furthermore, post-secondary students who are visible minorities are not accessing relevant job opportunities at the same rate as their non-visible minority peers (from 2014–2016, 37% of visible minority post-secondary students, compared with 48.1% of non-visible minority students, held a job related to their field of study during their post-secondary training).[32]

WIL Digital is an ICTC-administered program focused on placing students with technology sector employers. It offers a higher wage subsidy for employers hiring students from underrepresented groups (75% vs. 50%). In 2020-21 it had 5,961 participants, and 2021-2022 it had 8,426 applicants. Based on self-identification data, it had the following participation from:

	2020–2021	2021–2022
Women	**13.0%**	**15.8%**
Newcomers	**2.7%**	**3.3%**
Visible minorities	**8.6%**	**29.0%**
People with disabilities	**2.4%**	**4.5%**

31 Indigenous Leadership in Technology, First Nations Technology Council, Information and Communications Technology Council, and Reciprocal Consulting, Forthcoming.

32 In the relevant Statistics Canada study, visible minority students were defined by the Employment Equity Act definition of the time, "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour. The visible minority population consists mainly of the following groups: South Asian, Chinese, Black, Filipino, Latin American, Arab, Southeast Asian, West Asian, Korean and Japanese." Steve Martin and Brandon Rouleau, "An exploration of work, learning, and work-integrated learning in Canada using the Longitudinal and International Study of Adults," Centre for Income and Socioeconomic Well-Being Statistics, Statistics Canada, May 25, 2020.

Unpaid internships in federally regulated industries are now illegal in Canada, but people who qualify as "student interns" may still be unpaid (e.g., when WIL experience goes toward academic credit).[33] Furthermore, provincial regulations of unpaid internships vary.[34] Statistics Canada considers WIL to include volunteer work and other unpaid work experience. When WIL is unpaid, it can create accessibility issues and limit opportunities to students with adequate financial support. From 2012–2016, 16.8% of Canadian post-secondary education students in formal WIL programs received no payment for their work,[35] though this estimate has not yet been updated to reflect the changes in federal regulations. Finally, some research has questioned whether WIL culture does a good job of reinforcing best practices in ethical technology and responsible design: a case study looking at the University of Waterloo's program finds that engineering and technology students typically do not have the opportunity to apply ethics training to practical work experience within co-ops (e.g., because they compete to intern at large, international technology companies and end up in roles disconnected from design choices). The authors describe this as a systematic disconnect between ethics curriculum guided by Canadian Engineering Association Board standards and co-op culture, proposing that universities integrate responsible design curricula across more classes and pursue "employer buy-in with respect to reinforcing principles of ethical design."[36]

Educational Institutions Can Connect to Their Cities in More Than One Way

Embedded, experiential learning need not be limited to the private sector. Many universities and colleges also offer programs that connect students and researchers to local communities, and vice versa. Study participants also advocated for greater civic participation from universities: options might include students receiving volunteer work experience placements with charities, not-for-profits, or public sector institutions. Volunteer experiences face the same challenge of limiting access to certain students, but charitable organizations and not-for-profits may also be less able to compensate trainees.

33 "Federal labour standards for interns and student interns," Government of Canada, July 9, 2022, https://www.canada.ca/en/services/jobs/workplace/federal-labour-standards/interns.html#h2.3

34 Peter Bowal, Carter Czaikowski, and Josh Zablocki, "The Law of Unpaid Internships in Canada," LawNow: relating law to life in Canada, May 1, 2022, https://www.lawnow.org/the-law-of-unpaid-internships-in-canada/

35 Steve Martin and Brandon Rouleau, "An exploration of work, learning, and work-integrated learning in Canada using the Longitudinal and International Study of Adults," Centre for Income and Socioeconomic Well-Being Statistics, Statistics Canada, May 25, 2020, https://www150.statcan.gc.ca/n1/en/catalogue/89-648-X2020001

36 Conor Truax, Alexi Orchard, and Heather A. Love, "The Influence of Curriculum and Internship Culture on Developing Ethical Technologists: A Case Study of the University of Waterloo," in IEEE International Symposium on Technology and Society (ISTAS) (2021): pp. 1–8, https://doi.org/10.1109/ISTAS52410.2021.9629124

Universities and colleges may create urban research labs, public resources, and other types of programs that interact with a municipality's citizens as well as prospective and current students. Literature on the role of human capital in smart cities argues that "educational institutions have an active role within the smart city ecosystem, as they are expected to become hubs of innovation in education, collaborative research in edge sectors and multifaceted social interaction."[37]

Training for Human Skills: Work-integrated Learning and Beyond

Employers value "soft" or human skills, including critical thinking, communication, and creativity. As illustrated in Table 1, many hiring managers believe that the best place to learn these skills is through previous work experience. That said, the most important thing to employers may simply be that candidates arrive on the job with certain soft skills in place. In the *Human Skills Survey*, employers gave skills a score based on how essential they are prior to a job start date.

> When thinking about soft skills, which skills do you think are required before a candidate starts their role vs. those skills that can be learned on the job? (Summary = % of employers who selected skill as "required")

PERCENTAGE OF HIRING MANAGERS THAT REQUIRE SELECT HUMAN SKILLS BEFORE CANDIDATES BEGIN THEIR ROLE

Human Skill	% of Hiring Decision-Makers Who Require it Prior to Start Date
Reading	74%
Communication	72%
Empathy	71%
Attention to detail	69%
Teamwork	69%
Adaptability	68%
Critical thinking	63%
Collaboration	63%
Self-management	61%

Critical skills (applicants should have to enter workforce)

37 Margarita Angelidou, "Four European Smart City Strategies," International Journal of Social Science Studies 4, no. 4 (2016): 18–30.

Human Skill	% of Hiring Decision-Makers Who Require it Prior to Start Date	
Time management	58%	**Important skills** (applicants may develop on the job and prior to the job)
Creativity and innovation	56%	
Problem solving	53%	
Personal development (life-long learning)	51%	
Decision-making	50%	
Planning	46%	
Leadership skills	44%	
Troubleshooting	43%	
Conflict management	41%	
Strategy	40%	**Advanced skills** (applicants will develop with continued work experience)
Systems thinking	40%	
Design thinking	36%	
Ability to manage a team	35%	
Project management	33%	

Table 2: Percentage of hiring decision-makers who require select human skills prior to start date. ICTC Survey of Employer Perceptions of Human or Soft Skills, 2021.

This chart shows that there are critical foundational skills—reading, communication, empathy, attention to detail, teamwork, adaptability, critical thinking, collaboration, and self-management at the top of the list—employers want candidates to arrive with. Post-secondary education is a key area where students can build these skills, and many education organizations are working to include better human skills training in their programs. This can benefit students finding their feet in the workplace for the first time, newcomers and internationally educated professionals learning about Canadian professional culture, and anyone who wants to expand their human skills personally and professionally.

While participants differed on the best way to incorporate human skills into educational programming, most agreed that it needed an interactive component (active learning from the student) and intentional time from the instructor. Educators across the study named a variety of different tactics:

Teaching soft skills is among the hardest thing to bake into a class. It's a heck of a lot easier for me to stand up and speak for an hour, which I too frequently did when I was a faculty member, rather than have students engaged in regular conversation. ❞ – Taskforce Member

You can't really get a badge on LinkedIn for your creativity. I think a key point is case studies, a style of learning to promote and support more critical thinking because it is interpretive—where you have to supplement your learning with many resources including non-traditional ones. ❞ – Interviewee

We try to teach people that yes, you have to show up for the job, you have to meet your deadlines, you have to work with your team and collaborate and take initiative. ❞ – Taskforce Member

We do role playing: what to do in different situations. We utilize as much experiential learning as possible. So we put them in groups where they create their own scenarios. ❞ – Taskforce Member

Others simply work with their students to help them understand how important it is to be aware of human skills and actively pursue growth in their eventual workplaces. By building awareness of the value of collaboration and critical thinking, educators can alert their pupils to areas of personal development they should monitor and foster in their early careers. Some educators felt this was important because their technical students undervalued human skills:

I love the term human skills. I think we sometimes downplay those and call them soft skills, which I like to refer to as power skills, because they are so important in the workplace. We start really early with our participants to help them understand how valuable those skills are when they get into the workplace. It's a big endeavour. ❞ – Taskforce Member

Importantly, some research participants viewed human skills as a major reason why four-year degrees were still needed. For example, an industry member and employer commented that technology skills change rapidly, and they can teach people to use whatever software programs they need.

However, the foundation of human skills, including information management, synthesis, adaptation, and rapid learning, was best taught by a liberal arts program. As one taskforce member noted: "We need those human skills, or we like to call them 'resilience skills,' and we're looking at the comeback of the liberal arts for quick learning, problem solving, and communications."

Specialized Graduate Degree Programs for Smart Cities-Related Careers

Critics of university degrees point out that such institutions are built around the idea of siloed disciplines, in contrast to smart cities, which are quite interdisciplinary, involving urban planning, engineering, computer science, ethics, policy, business, and many social sciences. Educators unanimously wanted their humanities and social sciences students to have data literacy and their STEM students to have better soft skills.

It's really hard because you run up against disciplinary norms and all kinds of rules. We need to think about the digitization of society, which requires interdisciplinary thinking, but that's really hard to operationalize. ❞

– Taskforce Member

Study participants from inside universities discussed a number of pilot projects to improve interdisciplinary thinking in their institutions, such as cross-departmental work-integrated-learning cohorts that can solve problems for a co-op employers. While institutional inertia was a barrier for some, many noted that their universities were recognizing the importance of accelerating interdisciplinary learning for their undergraduate students.

Furthermore, many organizations offer graduate programs that combine disciplines. Specialized programs support an important niche in smart cities education by sitting at the intersection of traditional disciplines such as public policy, urban planning, and technology.

A student wishing to pursue a leadership or high-level planning and policy role in a smart city could pursue programs such as the following:

- A Master of Engineering Leadership (MEL) in Urban Systems at the University of British Columbia (Vancouver, BC)[38]
- A Master of Digital Innovation at Dalhousie University (Halifax, Nova Scotia)[39]
- A Master of Public Policy in Digital Society at McMaster University (Hamilton, Ontario)[40]

38 "Master of Engineering Leadership in Urban Systems," University of British Columbia, https://apscpp.ubc.ca/programs/mel/urban-systems/, accessed May 5, 2022, https://apscpp.ubc.ca/programs/mel/urban-systems/

39 "Master of Digital Innovation," Dalhousie University, accessed May 5, 2022, https://www.dal.ca/academics/programs/graduate/digital-innovation/curriculum.html.

40 "Master of Public Policy," McMaster University, accessed May 5, 2022, https://socialsciences.mcmaster.ca/master-of-public-policy/

Masters' programs could inform their curricula through consultation with industry and demand-side data. Furthermore, many of these programs explicitly contain coursework on ethical guidelines and principles addressing digital technology in the public realm (for example, Dalhousie's program includes a class called Law, Policy, and Ethics in Emerging Technologies):

> Emerging technologies—such as digital media, the "internet of things", artificial intelligence (AI), and financial tech—are playing an increasingly central role in how individuals live and interact with each other; how businesses innovate and create new opportunities; and how governments function and serve their populations. But the unrestrained development and use of these technologies can raise complex legal, policy, and ethical challenges. This course offers students an introduction to foundational legal, policy, and ethical issues raised by emerging technologies in a variety of contexts, with special consideration for digital innovation and commerce. On completion, students will be able to better identify, understand, and critically assess these issues and also more effectively manage and resolve them in the course of the professional pursuits.[41]

Future research will be needed to trace the trajectories of students emerging from such programs because each of them is relatively new. However, study participants lauded the principles espoused by each of these programs: most notably, timeliness, agility, and interdisciplinarity.

Diversifying Smart Cities Fields: From Education to Work

Many smart city occupations are technology occupations. As such, they belong to a sector that, historically, and today, lacks diversity in particular areas (for gender equity-deserving groups and Indigenous peoples in particular). However, smart city occupations also overlap with other disciplines, such as urban planning, policy, health, and sustainability.

To understand the diversity of smart cities workers and students, we can examine core occupations in the technology sector as a baseline, before turning to findings from smart cities-specific fields.

41 "Program Outline - Law, Policy And Ethics In Emerging Technologies," Dalhousie University, accessed May 5, 2022, https://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx

The Tech Sector Baseline: A Snapshot of Diversity in Tech in Canada

The Canadian census offers data on the proportion of racialized Canadians, Indigenous peoples, and women across core occupations in the technology sector. While the 2021 Census is complete, labour force data will not be published until the end of 2022. Accordingly, this paper uses a snapshot from the 2016 census as a baseline. First, compared to their proportion of the Canadian workforce (based on a national average across all occupations), racialized Canadians or visible minorities occupy relatively high percentages of technology sector roles. Figure 4 shows the percentage of racialized Canadians in key technology sector occupations compared with the percentage of the overall population.

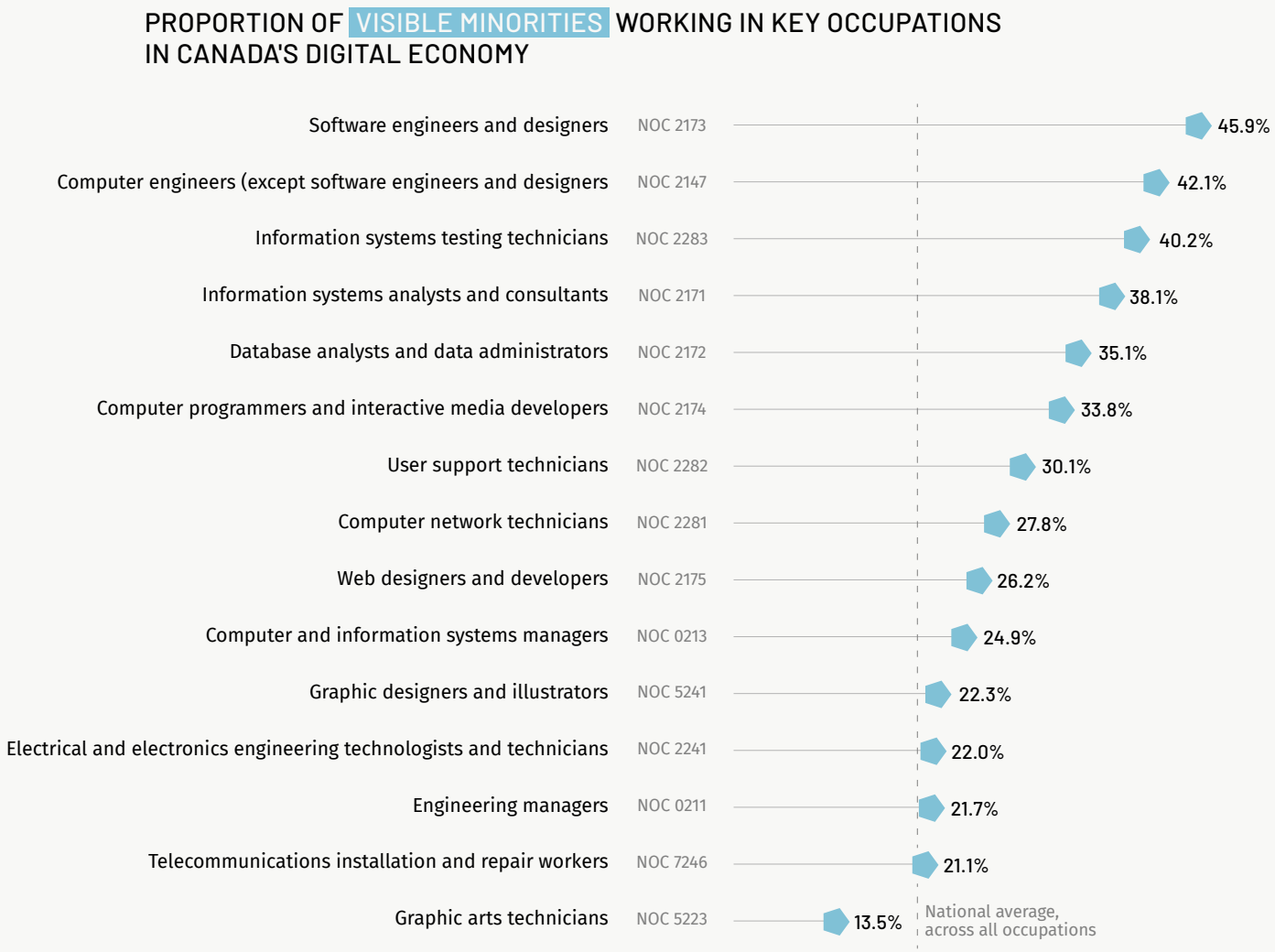


Figure 4: Proportion of racialized Canadians or visible minorities in tech roles in Canada compared to non-racialized Canadians or visible minorities. Statistics Canada Census, 2016. For an online version, visit https://www.datawrapper.de/_/VF00P/

Notably though, this trend is reversed when focusing only on Black Canadians. While Black Canadians make up 3.1% of the aggregate Canadian workforce, in most digital occupations the proportion of Black workers is significantly lower.

PROPORTION OF BLACK CANADIANS WORKING IN KEY OCCUPATIONS IN CANADA'S DIGITAL ECONOMY

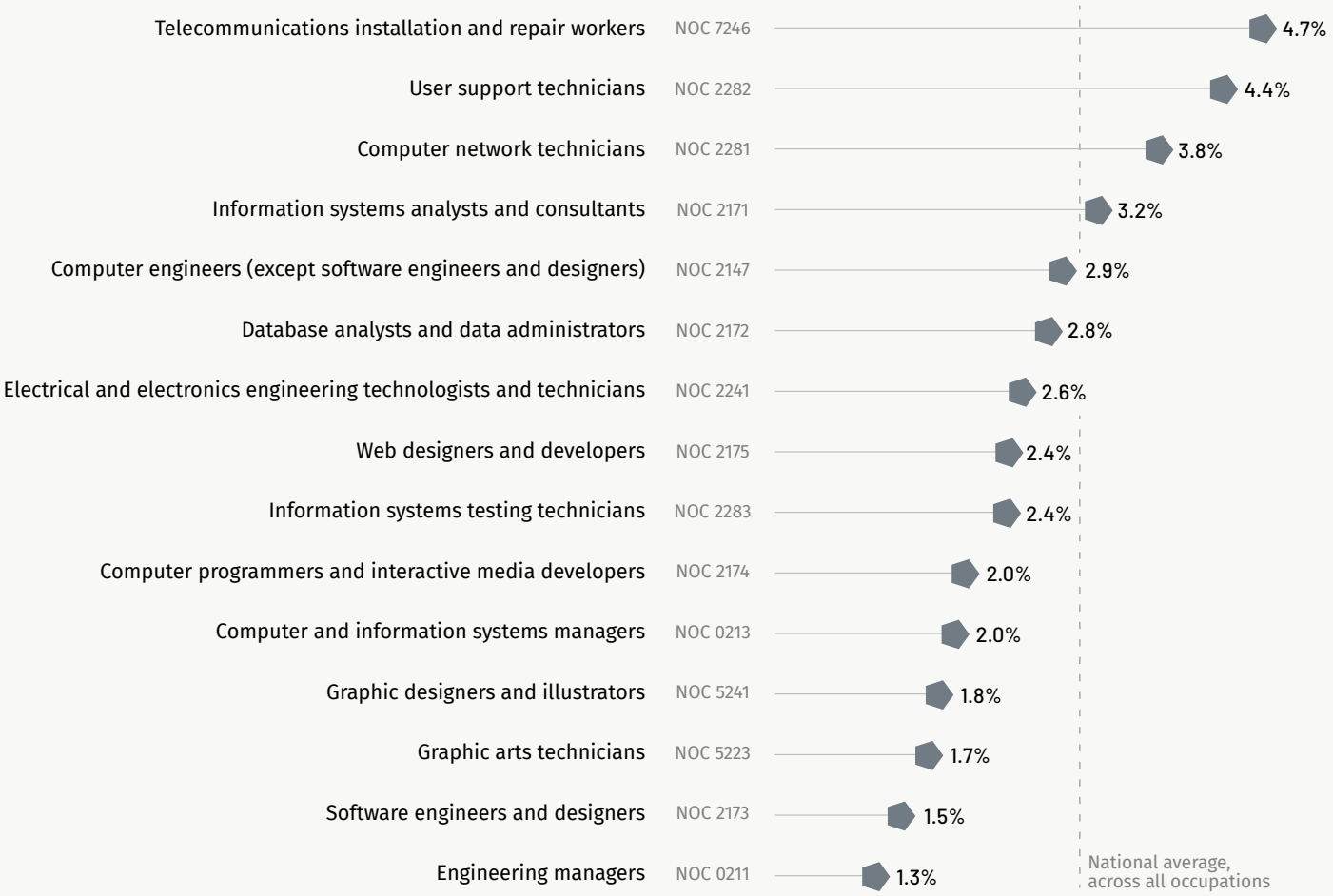


Figure 5: Proportion of racialized Canadians or visible minorities in tech roles in Canada compared to non-racialized Canadians or visible minorities. Statistics Canada Census, 2016. For an online version, visit https://www.datawrapper.de/_/2Fvcy/

Similarly, only about 2.2% of technology professionals in Canada are Indigenous, despite Indigenous peoples comprising about 5% of the country's population.[42] Broken down by core occupations, it is possible to see trends in senior and leadership roles, with more Indigenous people working in technician positions than in managerial roles.

PROPORTION OF WORKERS IN KEY OCCUPATIONS IN CANADA'S DIGITAL ECONOMY WHO IDENTIFY AS INDIGENOUS PEOPLE LIVING IN CANADA

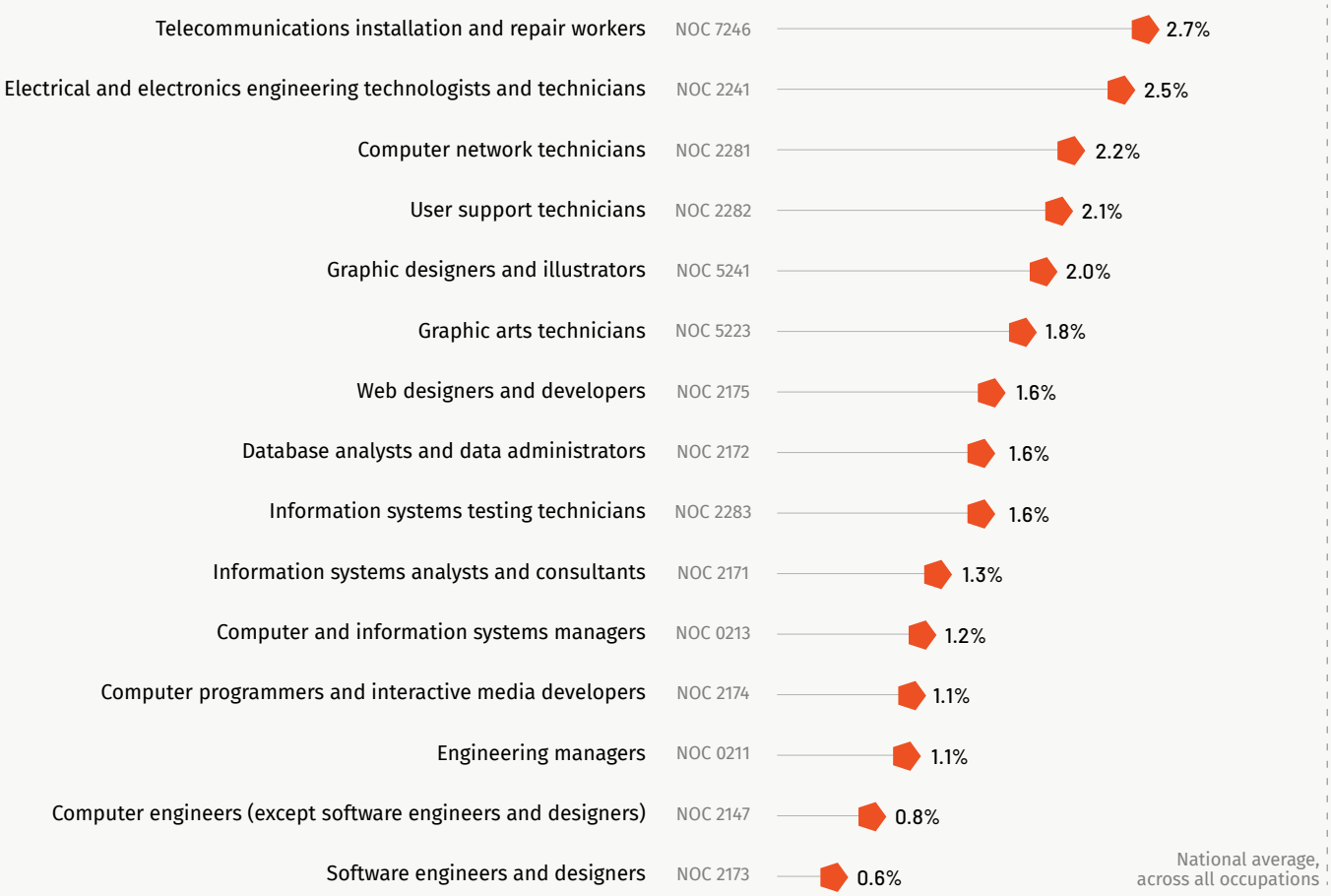


Figure 6: Proportion of Indigenous people living in Canada in key tech roles in Canada compared to non-Indigenous people living in Canada. Statistics Canada Census, 2016. For an online version, visit https://www.datawrapper.de/_/QkOQO/

42 "Indigenous Leadership in Technology," First Nations Technology Council, Information and Communications Technology Council, and Reciprocal Consulting, forthcoming.

Data on gender nonconforming (GNC) workers in technology is typically self-reported and limited to studies of specific fields and regions, but estimates from some firms have suggested that GNC tech workers comprise about 1% of the tech workforce in many large U.S. companies.[43] Better data exists for women in technology, as seen in the 2016 census (see Figure 7) and the Canadian Labour Force Survey (in 2021, women made up 47% of the total workforce but only 28% of all technical roles in the Canadian economy).[44] With regard to intersections of gender and race, estimates suggest that BIPOC (Black, Indigenous, and people of colour) women tend to represent much smaller percentages of tech workers than white women in Canada.[45]

PROPORTION OF WOMEN WORKING IN KEY OCCUPATIONS IN CANADA'S DIGITAL ECONOMY

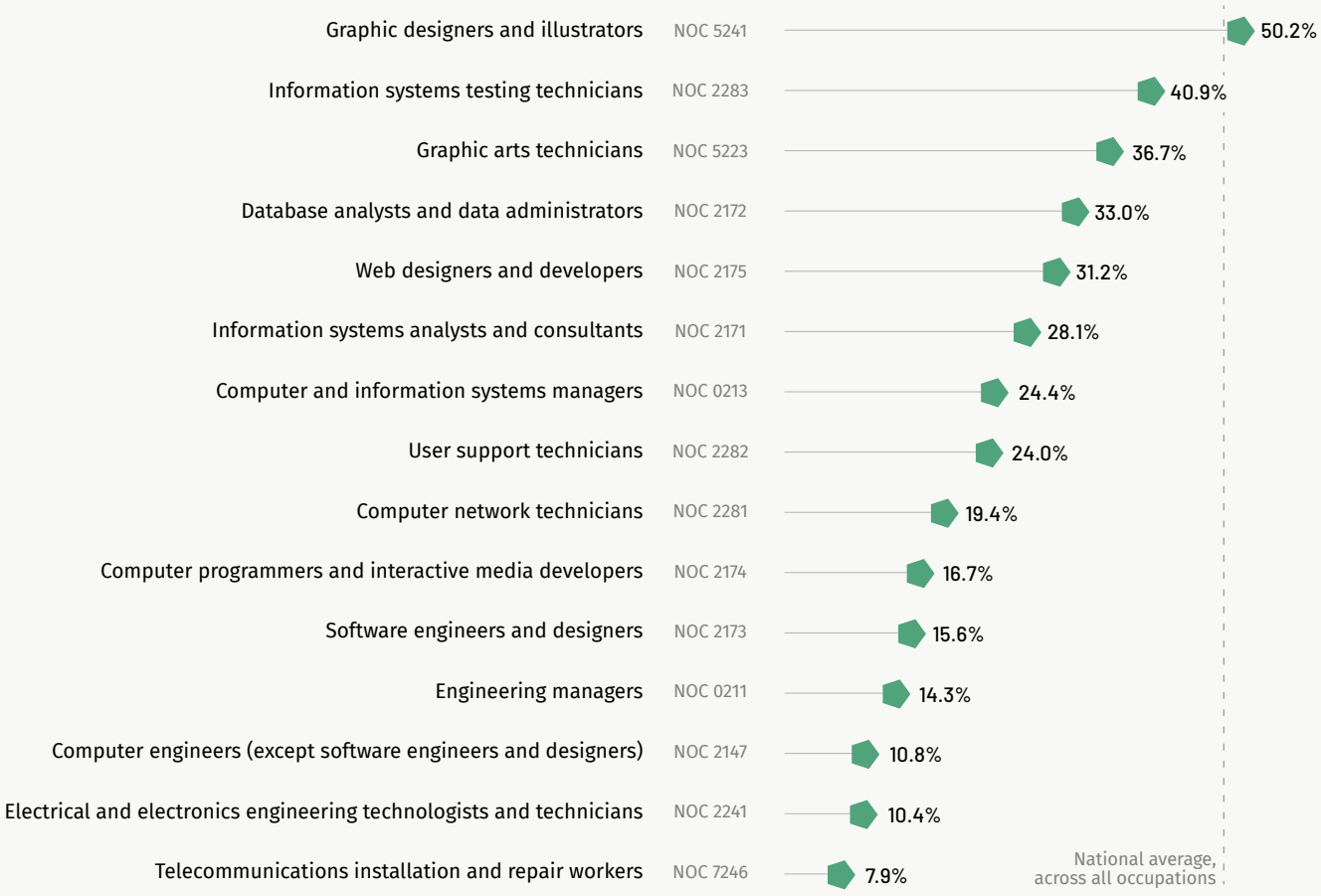


Figure 7: Proportion of women in key tech roles in Canada compared to non-women. Statistics Canada Census, 2016. For an online version visit: https://www.datawrapper.de/_/182Rv/

43 Gender nonconforming (GNC) is defined as "a person whose life experience includes existing as another gender, in more than one gender, or being assigned the wrong gender at birth." Maryna Ivus and Maya Watson, "Gender Equity in Canada's Tech Ecosystem Attracting, Retaining, and Supporting Entry- and Mid- Level Talent" (Ottawa, ON: Information and Communications Technology Council (ICTC), May 31), pp. 15-17. https://www.digitalthinktankictc.com/reports/gender-equity-in-canadas-tech-ecosystem.

44 Ibid., p. 21.

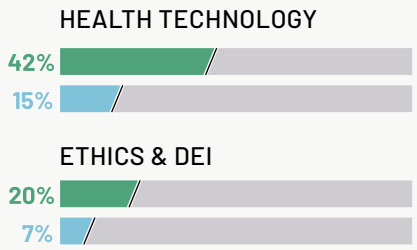
45 Viet Vu et al. "Who Are Canada's Tech Workers?", Brookfield Institute (2019), https://brookfieldinstitute.ca/wp-content/uploads/FINAL-Tech-Workers-ONLINE.pdf

Diversity in Smart Cities Disciplines: Students and Recent Graduates

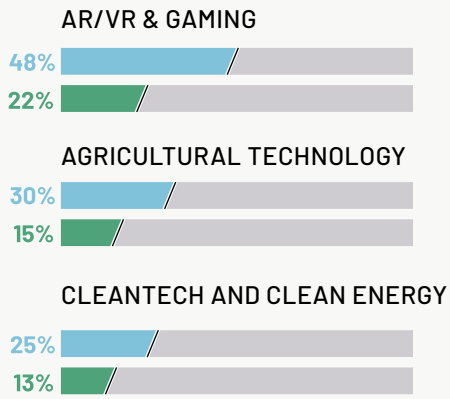
Soon-to-be graduates (*Smart City Graduate Survey*, student subsample, n = 300) pursuing smart cities work showed some differences in the fields they were interested in based on demographics.

When asked to name the "top 3" smart cities fields of interest,

Women were significantly more likely to report interest in:

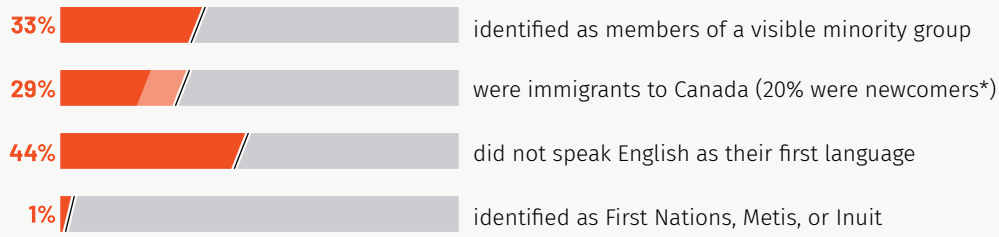


Men were significantly more likely to report interest in:



These trends were borne out in the subsample of recent graduates currently working, where women were also more likely to be working in sustainability and urban design, while men were also more likely to be working in IT operations. Across the whole survey, 4% of respondents identified as non-binary or opted to self-describe their gender identity: however, this sample size is not large enough to examine interest in different smart cities fields.

Overall, for recent graduates currently working in smart cities fields,



* in Canada for less than five years

Compared to the technology sector baseline, the *Smart Cities Graduate Survey* found that about the same proportion of recent graduates who work in smart cities occupations are racialized Canadians or visible minorities. Fewer identified as Indigenous.

Strategies to Improve Diversity in Smart Cities Fields

The results of the *Smart Cities Graduate Survey* suggest that students from different demographic groups vary in their interest in different fields. For example, women and men who are about to graduate from university show different degrees of interest in health technology and agricultural technology. This type of trend is broadly recognized: for example, Statistics Canada finds that among Canadian high school graduates, "women are 29.8% less likely than men to enrol in a post-secondary STEM program shortly after graduation."[46] Gendered socialization begins very early in life and can be difficult to identify, let alone transform: for example, one longitudinal study in the U.S. found that all kindergarteners had similar average math test scores when they first began school, but by the end of Grade 5, a gender gap had emerged in favour of boys[47]; in a different study, this gap did not exist for Canadian students at age 15.[48] Nevertheless, the gender gap in STEM in Canada is primarily attributable to the gap of enrolment in math-intensive fields (computer science, engineering, mathematics, physics, chemistry, and combinations of the above, vs. biological sciences, general sciences, integrated sciences, and healthcare).[49] Much of this gap remains unexplained in Canada, although some hypothesize that role models (e.g., mothers' careers, teacher gender) are key to understanding young women's career pathways.[50]

Much more information is available about how to create an inclusive environment for candidates who have already received their education and are entering the workforce. A recent ICTC report takes a deep dive into the ways in which technology employers can recruit, retain, and advance gender-diverse applicants.[51] It provides recommendations on employer signals, branding, and language; finding candidates; interviewing candidates; setting salaries; creating supportive leadership; fostering positive organizational culture; and creating strong accommodations and benefits.

It is also important to measure (voluntarily disclosed) disaggregated data in the workplace, if it is collected confidentially and responsibly by HR and used to monitor pay equity and advancement across equity-deserving groups.

46 Ping Ching Winnie Chan, Tomasz Handler, and Marc Frenette, "Gender differences in STEM enrolment and graduation: what are the roles of academic performance and preparation?" Statistics Canada, November 24, 2021, https://www150.statcan.gc.ca/n1/pub/36-28-0001/2021011/article/00004-eng.htm

47 Roland Fryer, Jr., and Steven Levitt, "An empirical analysis of the gender gap in mathematics," American Economic Journal: Applied Economics 2, no. 2 (2010): 210–240.

48 Kathryn O'Grady et al., "Measuring Up: Canadian Results of the OECD PISA 2018 Study," (Toronto, ON: The Council of Ministers of Education of Canada, 2019).

49 Ping Ching Winnie Chan, Tomasz Handler, and Marc Frenette, "Gender differences in STEM enrolment and graduation: what are the roles of academic performance and preparation?" Statistics Canada, November 24, 2021, https://www150.statcan.gc.ca/n1/pub/36-28-0001/2021011/article/00004-eng.htm

50 Ibid.

51 Maryna Ivus and Maya Watson, "Gender Equity in Canada's Tech Ecosystem Attracting, Retaining, and Supporting Entry- and Mid- Level Talent" (Ottawa, ON: Information and Communications Technology Council (ICTC), May 31), pp. 15-17. https://www.digitalthinktankictc.com/reports/gender-equity-in-canadas-tech-ecosystem

In the *ICTC Survey of Employer Perceptions of Diversity, Equity, and Inclusion* (2020, n = 1000, a survey of employers in technology and professional services industries, hereafter Employer DEI Survey), ICTC found that micro and small enterprises (1-49 employees) were less likely to collect demographic data than medium and larger businesses. Smaller companies may be less likely to have organizational HR teams who can collect voluntary data confidentially. However, numerous large organizations in the technology and professional services sector are moving toward measuring demographic equity and inequity in the workplace.

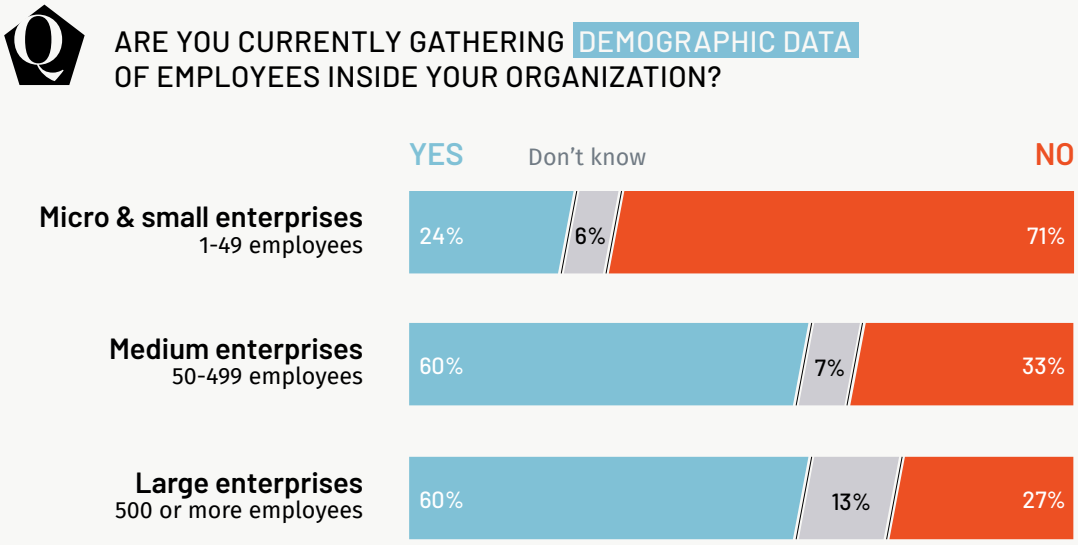


Figure 8: Percentage (%) of surveyed employers that collect demographic data of employees by size. ICTC Survey of Employers: Perspectives on Diversity, Equity, and Inclusion, 2020. For an online version visit: https://www.datawrapper.de/_/4gawa/

In an open-ended question, the same employers were asked what they believed the biggest barriers were to hiring more people from equity-deserving groups. Figure 9 aggregates open-ended employer responses. The number one response—that applicants lack the necessary skills, qualifications, and experience—could reflect a combination of employer-side biases and systemic disadvantages that begin with education.

WHAT DO YOU BELIEVE ARE THE BIGGEST BARRIERS TO HIRING EMPLOYEES FROM AN UNDERSERVED GROUP (INCLUDING PEOPLE WHO IDENTIFY AS BIPOC, WOMEN, NEW CANADIANS, OR PERSONS WITH A DISABILITY) IN YOUR ORGANIZATION?

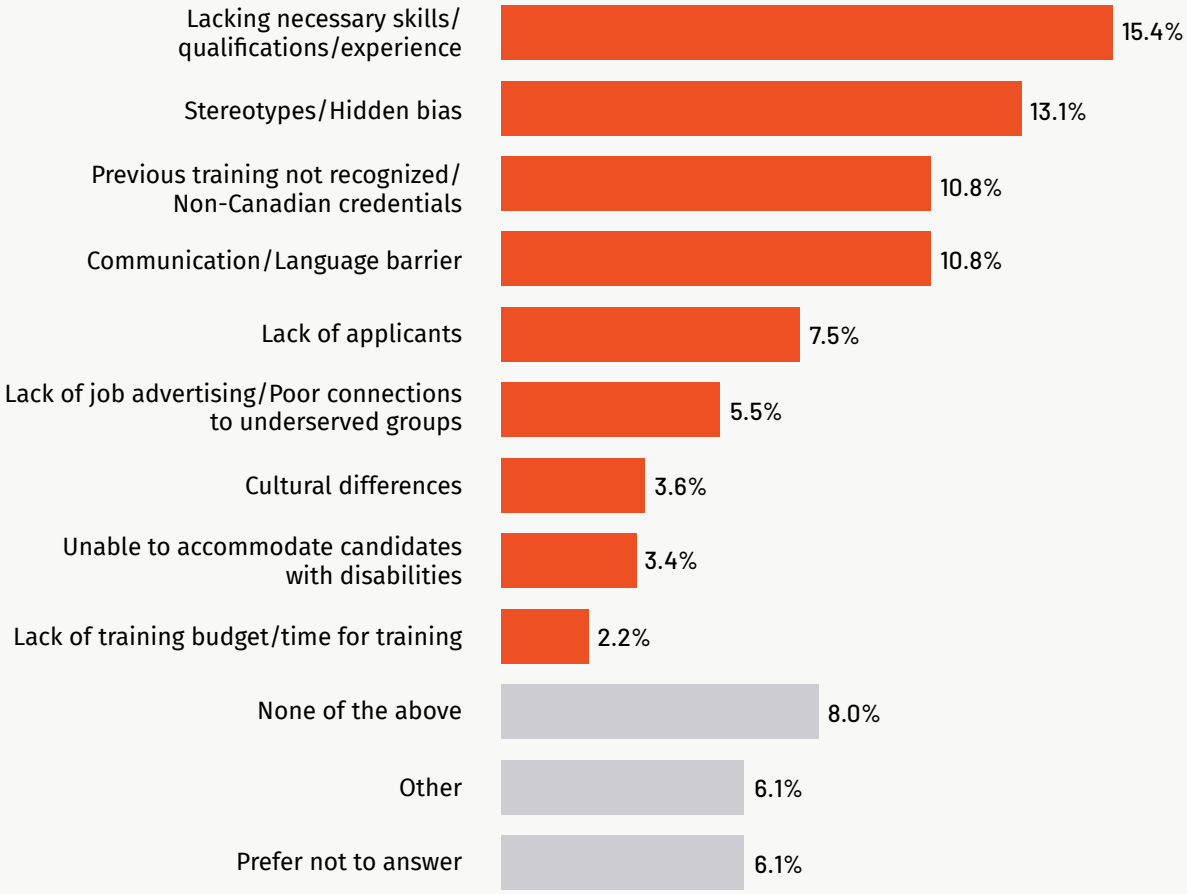


Figure 9: Percentage of survey respondents who selected the visualized options as the biggest barriers to hiring employees from underserved groups. ICTC Survey of Employers: Perspectives on Diversity, Equity, and Inclusion, 2020. For an online version, visit https://www.datawrapper.de/_/LI06q/

Furthermore, in Figure 10, employers were asked what would help motivate them to hire more equity-deserving employees. Again, employers said that more candidates with the right skills would be the number one variable to improve equitable hiring for their organizations. Writ large, these two figures emphasize that resolving underrepresentation in technology must begin by improving underrepresentation in education and attending to workplace culture.

WHICH OF THE FOLLOWING WOULD MOTIVATE YOUR ORGANIZATION TO BECOME MORE INCLUSIVE IN ITS HIRING PRACTICES?

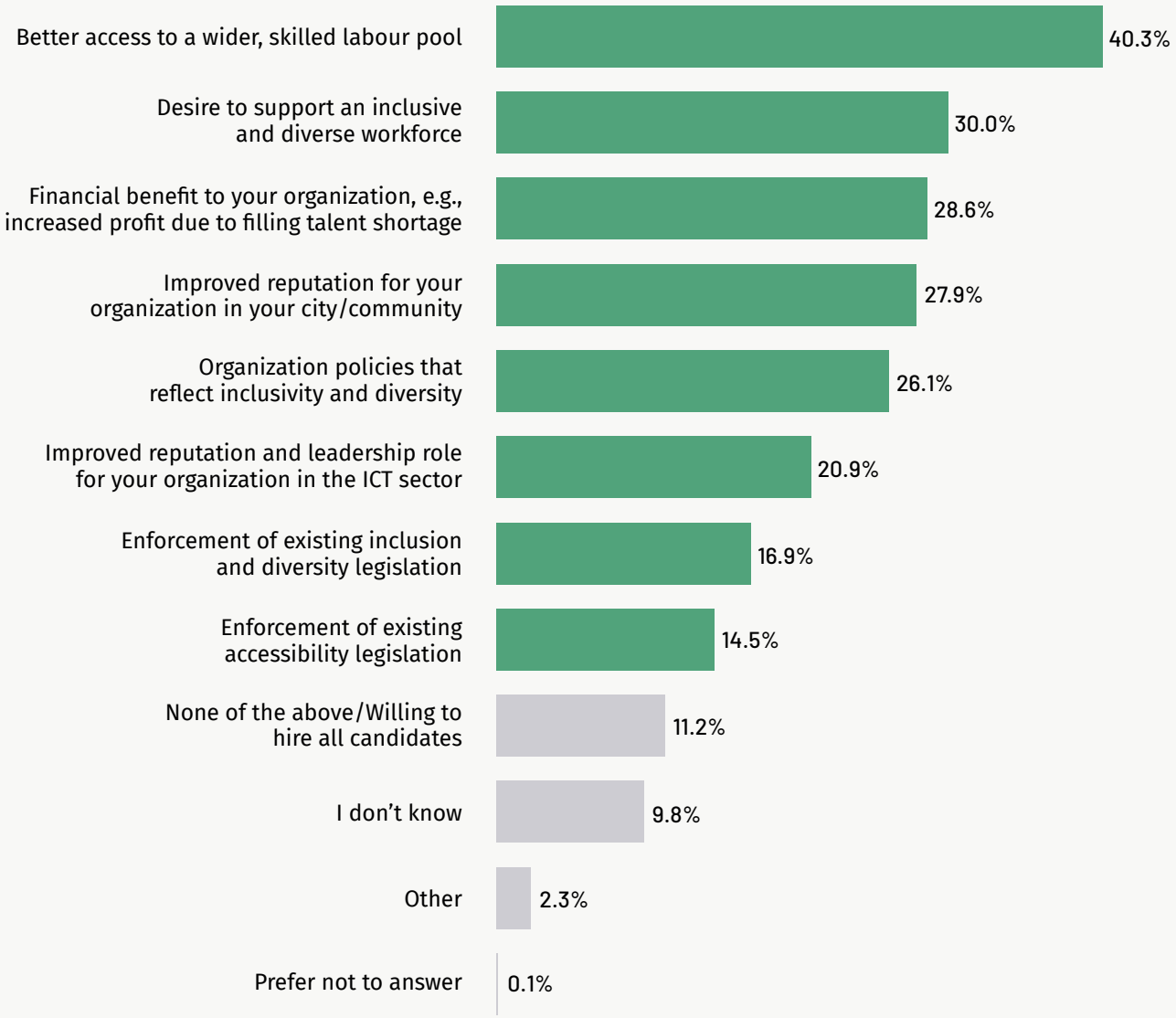


Figure 10: Percentage of survey respondents who selected the visualized options as key motivators for their organization to be more inclusive in their hiring practices. ICTC Survey of Employers: Perspectives on Diversity, Equity, and Inclusion, 2020. For an online version, visit https://www.datawrapper.de/_/BD9C6/

Technical Training Institutes, Colleges, and Two-Year Programs

For smart cities-bound students who want labour demand focused programming, other post-secondary education options include colleges and technical training institutes such as polytechnics.[52] In contrast to universities, colleges and polytechnics are explicitly focused on labour market demand.[53] According to a *Policy Options* article by the President of Seneca College and the CEO of Humber College Institute of Technology and Applied Learning, the key difference between colleges and polytechnics compared to universities is "the combination of career-focused theory with the opportunity for work-integrated learning, applied research, and connections to industry."[54] As one taskforce member put it, "Colleges respond to the labour market, what industry wants." Indeed, part of the reason critics argue against adopting a narrow vocational training focus in universities, is that niche is already filled.

While there are differences between colleges and polytechnics,[55] the distinctions between post-secondary institutions are shifting.[56] For the most part, in Canada the difference between colleges and polytechnics is grounded in focus, institutional partnerships, and reputation—not regulations.[57] As noted in a report on governing PSE (post-secondary education) and skills in Canada, "while colleges, institutes, and polytechnics all offer similar credentials, programs at polytechnics tend to be of a more intensive nature."[58] To make things more confusing, educational institutions that brand themselves as colleges are sometimes actually polytechnics, such as Sheridan College.[59] Other institutions, including Manitoba's Red River College, have recently rebranded by adding polytechnic to their name.[60] Moreover, in Alberta, Ontario, and British Columbia, many colleges and polytechnics offer four-year degrees, making these institutions similar to universities as well.[61]

52 Trevor Quan, "Smart City Priority Areas and Labour Readiness of Canadian Cities," (Ottawa, ON: Information and Communications Technology Council, August 2019), https://www.ictc-ctic.ca/wp-content/uploads/2019/08/ICTC_Smart-City-Priority-Areas_Brief_ENG-8.19.19.pdf

53 Janie Ginsberg, "University or College? Polytechnics Fall Somewhere in Between.," Macleans.Ca (blog), February 24, 2016, https://www.macleans.ca/education/university-or-college-polytechnics-fall-somewhere-in-between/

54 David Agnew and, Chris Whitaker, "Canada's Polytechnics Deserve to Be Recognized," Policy Options, 31, 2019, https://policyoptions.irpp.org/magazines/october-2019/canadas-polytechnics-deserve-to-be-recognized/

55 Alison Howard and Jessica Edge, "Policies, Laws, and Regulations: Governing Post-Secondary Education and Skills in Canada," (Ottawa, ON: The Conference Board of Canada, 2014), http://static.pseupdate.mior.ca.s3.amazonaws.com/media/links/6611-spse_governing_pse-rpt_pub4307.pdf

56 "Canada's Three Types of Colleges: CEGEP's, Polytechnics & The Rest," Post-Secondary BC, accessed July 14, 2022, https://www.postsecondarybc.ca/knowledgebase/canadas-three-types-of-colleges-cegeps-polytechnics-the-rest/

57 Alberta is one noted exception to this generalization: Government of Alberta, "Universities, Colleges & Technical Institutes," Study In Alberta, accessed July 14, 2022, http://study.alberta.ca/plan-your-studies/universities-colleges-technical-institutes/ ; Michael L. Skolnik et al., "Exploring the Potential Contribution of College Bachelor Degree Programs in Ontario to Reducing Social Inequality," Policy Reviews in Higher Education 2, no. 2 (July 3, 2018): 176–97, https://doi.org/10.1080/23322969.2018.1455532

58 For example, the British Columbia Institute of Technology (BCIT) offers bachelor's degrees in technology management and launched a Master of Engineering in Smart Grid Systems and Technologies in October 2021; whereas smaller colleges such as Selkirk, located in Castlegar, BC offer diplomas, certificates, robust streaming programs to universities, but do not grant undergraduate degrees; Alison Howard and Jessica Edge, "Policies, Laws, and Regulations: Governing Post-Secondary Education and Skills in Canada," (Ottawa, ON: The Conference Board of Canada, 2014), http://static.pseupdate.mior.ca.s3.amazonaws.com/media/links/6611-spse_governing_pse-rpt_pub4307.pdf

59 It is important to note that Sheridan College's full name is the Sheridan College Institute of Technology and Advanced Learning; however, on Google they currently appear as "Sheridan College" without the "Institute of Technology and Advanced Learning." One article highlighted this confusion between college names and designations in Ontario: Janie Ginsberg, "University or College? Polytechnics Fall Somewhere in Between.," Macleans.Ca (blog), February 24, 2016, https://www.macleans.ca/education/university-or-college-polytechnics-fall-somewhere-in-between/

60 "The Evolving Role of Polytechnic Institutions: Uniting Agility and Quality," Polytechnics Canada (blog), January 10, 2022, https://polytechnicscanada.ca/news-events/news-articles/the-evolving-role-of-polytechnic-institutions-uniting-agility-and-quality-2/

61 It is important to note in Ontario colleges and polytechnics are capped at 20% of their program activity being degrees. Brent Davis, "Ontario colleges will be able to offer three-year degree programs for the first time," Toronto Star, April 11, 2022, https://www.thestar.com/tr/news/waterloo-region/2022/04/11/ontario-colleges-will-be-able-to-offer-three-year-degree-programs-for-the-first-time.html

Changing definitions and certification offerings in colleges may impact the populations that can access the necessary education and retraining opportunities for smart city work. Because colleges are often located in rural areas, often without access to local universities, and were designed to serve adult learners, colleges can attract underrepresented learners. According to a Statistics Canada report, "youth who grew up living out of commuting distance from a university are generally less likely to attend university and more likely to attend college."[62] In addition, research shows that compared to university students, racialized, low-income students, and students with disabilities are overrepresented at colleges.[63] Research is inconclusive, but by offering four-year bachelor degrees at colleges (and three-year degrees in Ontario as of April 2022),[64] there may be a chance to boost enrolment for these underrepresented learners and help more diverse learners find work in smart city jobs.[65]

In addition, because colleges and technical institutes are already focused on delivering more industry-relevant training in a shorter time than typical university programs, they are well positioned to take advantage of the need for smart city skills.[66] For example, in partnership with the Future Skills Centre (FSC) Atlantic Colleges Atlantique (ACA) has a project that will address skill gaps and labour shortages in key sectors, including Information and Communications Technology.[67] This program will help address labour issues that arise from rapid technological change by creating micro-credentials such as the College of the North Atlantic's "Communicating in the Digital Era."[68] With a robust infrastructure for industry partnerships and community consultation already in place, Canada's colleges are well positioned to meet the rising demand for smart city workers across Canada. As some universities adapt to distance education offerings, new competitors, and a desire to offer more workplace-ready, interdisciplinary, and human skills training, their offerings may overlap increasingly with colleges. Alternatively, a focus on foundational skills within disciplines may continue to distinguish their programming.

62 Marc Frenette, "Obtaining a Bachelor's Degree from Community College: Earnings Outlook and Prospects for Graduate Studies," Statistics Canada, Sept 9, 2019, https://www150.statcan.gc.ca/n1/en/pub/11f0019m/11f0019m2019016-eng.pdf?st=ac6W4jQQ

63 "Lifelong Learning in Ontario: Improved Options for Mid-Career, Underserved Learners," Higher Education Quality Council of Ontario, accessed July 13, 2022, https://heqco.ca/pub/lifelong-learning-in-ontario-improved-options-for-mid-career-underserved-learners/

64 Kevin Nielsen, "Ontario Colleges Expected to Offer New 3-Year, 4-Year Degree Programs This Fall: Province," Global News, April 11, 2022, https://globalnews.ca/news/8752485/ontario-colleges-bachelor-degrees/

65 Marc Frenette, "Obtaining a Bachelor's Degree from Community College: Earnings Outlook and Prospects for Graduate Studies," Statistics Canada, Sept 9, 2019, https://www150.statcan.gc.ca/n1/en/pub/11f0019m/11f0019m2019016-eng.pdf?st=ac6W4jQQ

66 "COVID-19," Deloitte Center for Higher Education Excellence, https://www2.deloitte.com/us/en/pages/public-sector/articles/covid-19-higher-education-scenario-planning.html

67 "College Transformation Des Colleges," Atlantic Colleges Atlantique, accessed July 15, 2022, https://atlanticcollegesatlantique.ca/college-transformation-des-colleges/

68 "College of the North Atlantic – Information and Communications Technology," Atlantic Colleges Atlantique, accessed July 15, 2022, http://atlanticcollegesatlantique.ca/college-of-the-north-atlantic-information-and-communications-technology/

Future of Work Snapshot

Are Platform Workers Smart City Workers?

(And When is a Smart City Relying on Personal Data Supply?)

Many gig economy jobs occur in the "platform economy": that is, where a platform like a smartphone app matches customers and service-providers and manages financial transactions. Gig economy workers also often supply their own equipment (e.g., an Uber driver brings their own vehicle). Gig economy jobs are often considered to be part of a "smart city" for a few reasons: they typically use technology to offer convenient services, like last-mile mobility, for citizens. However, gig economy work stands apart from the other types of smart cities occupations we have discussed so far. Unlike these, it rarely comes with benefits, expectations of education, and stable compensation. On the contrary, the gig economy is often home to precarious workers, such as newcomers.[69] Wage stagnation in the gig economy, particularly during times of inflation, is a challenge because gig economy workers may not have formal mechanisms through which to organize and negotiate.[70] Furthermore, gig economy work has typically lacked a social safety net—recently, the Canadian Government has committed to redesigning Employment Insurance (EI) to accommodate gig economy workers, but gig workers were more consistently denied related supports, such as the Canada Emergency Response Benefit (CERB) during the pandemic than other types of workers.[71]

69 Trevor Quan et al., "Emergent Employment: Canadian Findings on the Future of Work," (Ottawa: Information and Communications Technology Council, August 2021), https://www.digitalthinktankictc.com/reports/emergent-employment

70 Though labour organization in the platform economy has recently begun to occur: for a global example, see: Rita Qadri and Noopur Raval, "Mutual Aid Stations," Logic Magazine 13, (May 17, 2021), https://logicmag.io/distribution/mutual-aid-stations/

71 Khiran O'Neill and Trevor Quan, "Helping to Build a Better EI Program," Digital Think Tank by ICTC, https://medium.com/digitalthinktankictc/helping-to-build-a-better-ei-program-3c9a4c9b5e54

Accordingly, gig work in the smart city raises several ethical questions for municipalities, other levels of government, and employers. Some of the questions raised by survey participants included the following:

- **What policy changes can help improve fairness for gig economy workers?** For example, in Canada and the U.S., gig economy workers have begun to ask for "employee status," allowing them to receive consistent compensation and benefits.[72]
- **How can governments provide improved clarity on how existing benefits and subsidies interact with gig economy income?** For example, interviewees across several ICTC studies have voiced uncertainty about how freelance or gig income will impact their EI, CERB, subsidized housing, and other programs.
- **Are platform economy services always "smart"?** For example, ride-hailing has been found to increase emissions and idling in some downtown cores, decrease use of public transportation, and decrease active transport. Cities have control over regulations such as curb management and congestion pricing—and literature is emerging on the outcomes of such policies applied to ride-hailing vehicles.[73]
- **When a smart city is supplied by platform economy data, and in what ways can it give back to the people supplying that data?** This question is not limited to the gig economy. Several study participants raised the idea that everyone in a smart city is donating personal data through platform apps to companies and municipalities that run programs to track transit usage (sources that often intersect in public-private partnerships).[74] As ICTC interviewee Katie Wells, Fritz Fellow at the Communication, Culture, and Technology Program and Beeck Center for Social Impact and Innovation at Georgetown University put it, "So much of the data that we collect and produce is from workers that aren't paid or users that aren't compensated." They emphasized that companies, and cities receiving personal data in this way needed to find a way to give back to their cities and gig workers through helpful infrastructure, programs, actual compensation, and data minimization when collection was not necessary.

72 Ibid.

73 Yiyuan Pu, "Understanding the Impacts of Ride-hailing Vehicles on Congestion and the City of Vancouver's Climate Emergency Response," Greenest City Scholars Program at the University of British Columbia, August 2020, https://sustain.ubc.ca/sites/default/files/2020-47_Understanding%20Impacts%20of%20Ride-hailing_Vehicles_Pu.pdf

74 Tyler Farmer, Mairead Matthews, and Faun Rice, "Procurement Office or 'Living Lab?' Experimenting with Procurement and Partnerships for Smart Cities Technologies in Canada" (Ottawa, ON: Information and Communications Technology Council, February 2021), https://www.ictc-ctic.ca/wp-content/uploads/2021/03/ICTC_Report_SmartCities_ENG.pdf

Many platform economy and gig economy workers either report high job satisfaction or have been able to use their gig work to transition to other roles. Literature on this topic has emphasized that structural issues in platform work is balanced with worker agency. In other words, despite certain drawbacks, gig work can provide valuable freedom to someone such as a newcomer.[75]

There is something to be said about this kind of [gig] work being a steppingstone to a better labour market integration. Yes, [most gig work] is not particularly lucrative. It has a high risk that is absorbed by the worker. For example, you may be driving for hours on Uber and realize you only made money for your fuel or even less than that. But sometimes it can be lucrative, and there is a level of autonomy, and it is amenable to combine it with other work and study. People, such as newcomers, use this work in very creative ways with a strong sense of agency in pursuing a certain plan. ❞ – Taskforce Member

In other ICTC studies, gig workers have made conscious choices about the trade-off between flexibility and income security.[76] In the *Smart City Graduates Survey*, respondents reported being able to use platform economy skills on their resume to branch off into new work.

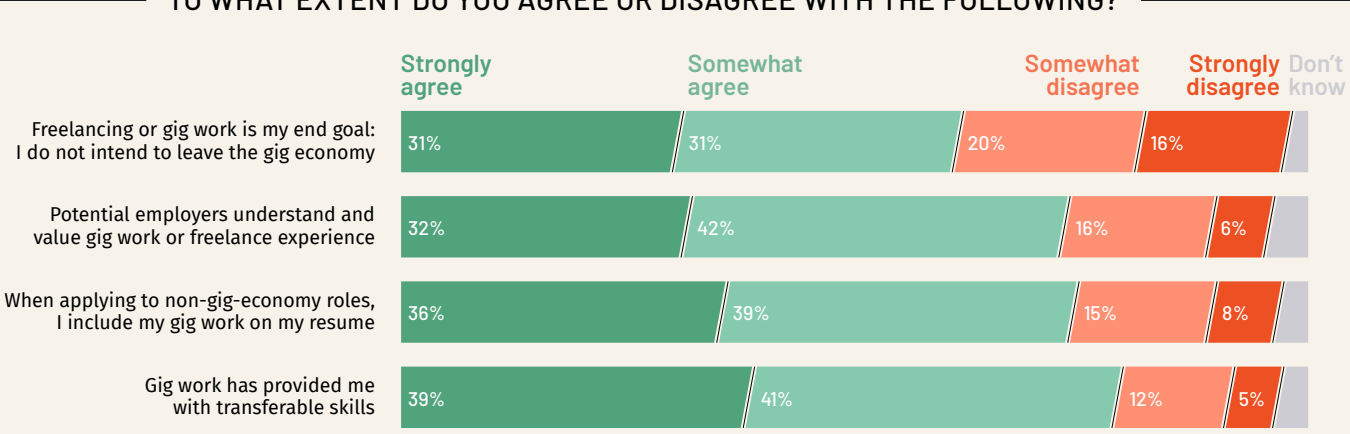


Figure 11: Percentage of survey respondents who agree or disagree with select gig work questions. ICTC Smart City Graduates Survey on employer perceptions of gig work, 2021. For an interactive version, visit https://www.datawrapper.de/_/gZWwD/

The subsequent section on micro-credentials takes a deeper dive into different pathways to career transitions, and "non-traditional" pathways into smart cities work.

75 Anna Triandafyllidou and Laura Lam, "An Unlikely Stepping Stone? Exploring How Platform Work Shapes Newcomer Migrant Integration," Journal of Transient Migration, forthcoming.

76 Trevor Quan et al., "Emergent Employment: Canadian Findings on the Future of Work," (Ottawa: Information and Communications Technology Council, August 2021), https://www.digitalthinktankictc.com/reports/emergent-employment

Micro-Credentials: "Non-Traditional" Pathways into Smart City Work

In addition to traditional four-year degrees, graduate programs, and technical training institutes, individuals wishing to work in a smart-city related career can also pursue alternative education pathways, including micro-credentials. Sources of micro-credentials include bootcamps, online continuing education courses, and massive open online courses (MOOCs) that can help candidates upskill and reskill to develop the specific competencies needed to thrive in smart city jobs.

What is a Micro-Credential?

Micro-credentials are often defined in contrast to traditional forms of education. As an international leader in micro-credential standards, the New Zealand government defines micro-credentials as "[certifying an] achievement of a coherent set of skills and knowledge" whose focus is smaller than certifications typically offered at post-secondary institutions.[77] Similarly, eCampus Ontario, a provincially-funded organization that develops and tests e-education tools, defines micro-credentials as "a certification of assessed learning associated with a specific and relevant skill or competency...[which] enables rapid retraining and augments traditional education through pathways into regular post-secondary programming."[78] Generally, micro-credentials include some form of industry consultation, are shorter in duration and more limited in knowledge and skills learned than traditional three- to four-year post-secondary education programs.

EXAMPLES OF MICRO-CREDENTIALS FOR SMART CITY STUDENTS

Figure 12: Examples of micro-credentials in terms of type, purpose, length, delivery, and cost. University of British Columbia, Google, Lighthouse Labs, 2022.

Blockchain Innovation and Implementation

Vancouver, BC

Type: Micro-Course

Length: 55 hours

Purpose: To equip students "with the [non-technical] skills and tools to identify, assess, and lead blockchain initiatives."

Type: Online

Cost: $2,520

77 "Micro-credentials," New Zealand Qualifications Authority, accessed June 5, 2022, https://www.nzqa.govt.nz/providers-partners/approval-accreditation-and-registration/micro-credentials/#heading2-0

78 "Micro credentials," ecampus Ontario, accessed June 5, 2022, https://micro.ecampusontario.ca/home-2/

Professional UX Design

International

Type: Certificate

Length: 6 months / flexible

Purpose: To teach students "the foundations of UX design, including empathising with users, building wireframes and prototypes, and conducting research to test... designs."

Type: Online

Cost: $39/month, subscription on Coursera

Web Development Bootcamp/Flex Program

Canada

Type: Coding Bootcamp

Length: 12 weeks FT / 30 weeks flexible

Purpose: To help students "understand coding logic using popular languages and frameworks like Javascript & Ruby on Rails, while learning how to think like a programmer by building software from the ground up.."

Type: Online

Cost: $14,000

Why Pursue a Micro-Credential?

Internationally, research shows that micro-credentials are being developed and adopted at a rapid rate, with high-income countries such as New Zealand, Australia, and the United States leading the charge.[79] In Canada, the pandemic has prompted post-secondary institutions to incorporate "skills-specific, practical micro-credential accreditations like never before, latticing these micro-credentials into existing programs."[80] According to the Canadian Digital Learning Research Association's (CDLRA) national survey *Online and Digital Learning*, almost half of surveyed Canadian post-secondary institutions were developing or producing micro-credentials in 2019.[81] CDLRA's 2021 report supports this growth trend, with 68% of surveyed Canadian public post-secondary institution noting they will likely offer more "alternative credentials" in January 2022.[82] Adding to this growing production from post-secondary institutions, industry and not-for-profits are also developing their own micro-credentials.

Despite this, research on the value of micro-credentials is emerging, often with conflicting results. According to a recent large-scale U.S. survey of employers across sectors by the Society of Human Resource Management (SHRM), over 80% of surveyed executives, supervisors, and HR professionals agree that alternative credentials bring value to the workplace.

79 Nkosikhona T. Msweli, Hossana Twinomurinzi, and Mymoena Ismail (was Sharif), "The International Case for Micro-Credentials for Life-Wide And Life-Long Learning: A Systematic Literature Review," Interdisciplinary Journal of Information, Knowledge, and Management 17 (May 1, 2022): 151–90 Shizuka Kato, Victoria Galán-Muros, and Thomas Weko, "The Emergence of Alternative Credentials," OECD Working Paper no. 216, 2020. https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=EDU/WKP(2020)4&docLanguage=En.

80 "Skills for the Post-Pandemic World," Public Policy Forum, accessed July 12, 2022, https://ppforum.ca/project/skills-for-the-post-pandemic-world/

81 Nicole Johnson, "National Survey of Online and Digital Learning 2019 National Report," (Canadian Digital Learning Research Association, 2020), http://www.cdlra-acrfl.ca/wp-content/uploads/2020/07/2019_national_en.pdf

82 "2021 National Report: Lessons from the COVID-19 pandemic," (Canadian Digital Learning Research Association, 2021), http://www.cdlra-acrfl.ca/wp-content/uploads/2022/05/2021_national_report_en.pdf

This value, however, is often not measured in candidate assessment processes: micro-credentials were ranked below other criteria by "all employer groups when forced to choose among a larger list of criteria considered important for making hiring decisions."[83] In addition, SHRM found that only 32% of automated screening systems used in the hiring processes of surveyed organizations recognize micro-credentials.[84]

On the other hand, a smaller survey of 200 employers across sectors from the Higher Education Quality Council of Ontario (HEQCO) found that 60% of respondents agreed that micro-credentials would "increase their confidence in a prospective employee's skills."[85] The study did not track candidate success rates linked to micro-credential possession. In sum, evidence points to a conflict between employers theoretically supporting micro-credentials but not always valuing micro-credentials in practice. This may, however, simply be a case of organizational processes and external standards struggling to keep up with changing educational paradigms.[86]

Despite uncertain employer reception, many students and workers still pursue micro-credentials. Motivations vary, but several studies note that perceived recognition from employers, affordability, and flexibility are important dimensions of micro-credentials to potential students.[87] In line with these findings and the results of ICTC's surveys of smart city employers, this section outlines two key reasons smart city workers in Canada may turn to micro-credentials for their upskilling and reskilling needs: perceived employer value and inclusivity.

Meeting Employer Demands

As the needs of smart city employers continue to change in concert with technological developments, micro-credentials may help students and workers quickly adapt to industry needs.[88] Research increasingly shows that workers will likely need to upskill and reskill throughout their career "to adjust to technological disruption and to take advantage of new opportunities available in the labour market."[89]

83 Nicole Johnson, "SHRM Report: Survey Finds a Rise of Alternative Credentials in Hiring," (SHRM, April 20, 2022), https://www.shrm.org/about-shrm/press-room/press-releases/pages/shrm-report-survey-finds-a-rise-of-alternative-credentials-in-hiring-.aspx

84 Ibid.

85 Jackie Pichette, Sarah Brumwell, Jessica Rizk and Steven Han, "Making Sense of Microcredentials," (ON: Higher Education Quality Council of Ontario, May 2021), https://heqco.ca/pub/making-sense-of-microcredentials/

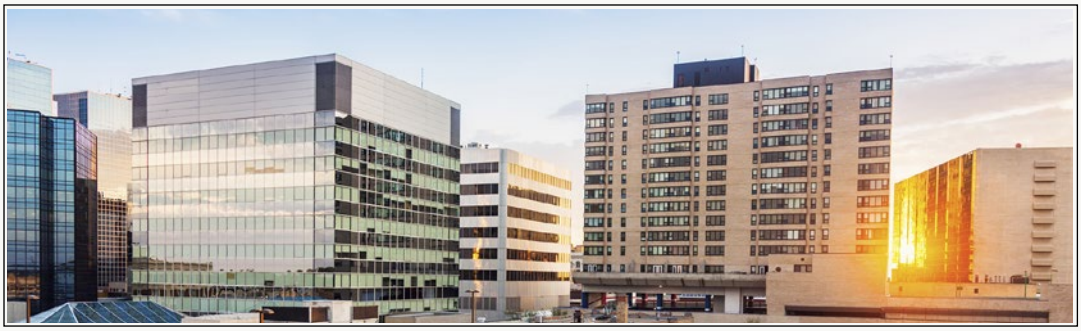
86 "Employers Claim to Value Alternative Credentials. Do Their Practices Match Their Promises?" EdSurge News (April 20, 2022), https://www.edsurge.com/news/2022-04-20-employers-claim-to-value-alternative-credentials-do-their-practices-match-their-promises

87 Jackie Pichette, Sarah Brumwell, Jessica Rizk and Steven Han, "Making Sense of Microcredentials," (ON: Higher Education Quality Council of Ontario, May 2021), https://heqco.ca/pub/making-sense-of-microcredentials/

88 Emma Gooch, Mary Chaktsiris, Kevin Jae, Lena Patterson, Salima Suleman, Michael Crawford Urban, Wendy Cukier, Robert Luke, "The Future is Micro Digital Learning and Micro-credentials for Education, Retraining and Lifelong Learning," (ON: Future Skills Center, eCampus Ontario, Ted Rogers School of Management, Magnet, March 20222), https://fsc-ccf.ca/wp-content/uploads/2022/03/TheFutureisMicro-Report-ENG.pdf

89 Emma Gooch, Mary Chaktsiris, Kevin Jae, Lena Patterson, Salima Suleman, Michael Crawford Urban, Wendy Cukier, Robert Luke, "The Future is Micro Digital Learning and Micro-credentials for Education, Retraining and Lifelong Learning," (ON: Future Skills Center, eCampus Ontario, Ted Rogers School of Management, Magnet, March 20222), https://fsc-ccf.ca/wp-content/uploads/2022/03/TheFutureisMicro-Report-ENG.pdf; Shizuka Kato, Victoria Galán-Muros, and Thomas Weko, "The Emergence of Alternative Credentials," (Organisation for Economic Co-operation and Development (OECD), March 2020), https://read.oecd-ilibrary.org/education/the-emergence-of-alternative-credentials_b741f39e-en#page5

Because industry consultation is often a key feature of micro-credential development,[90] the format is well suited to respond to skill shortages and industry needs in smart cities. As one ICTC interviewee put it, "Smart cities require people to keep going back to learning—that's where micro-credentials fit in." For example, Saskatchewan Polytechnic partnered with Microsoft and the International Minerals Innovation Institute (IMII) in 2021 to develop "Surge Micro-credentials," quick-duration trainings that aims to fill skill gaps in high-demand industries. Courses developed in partnership with Microsoft include Azure AI Engineer, Power Platform App Maker, and MS365 Security Administrator.



Let's Talk Smart Cities

City of Regina

On September 8, 2021, the Information and Communications Technology Council (ICTC) partnered with SaskTel to host the fourth in a series of engagement events focused on capturing what smart cities mean for communities across Canada. The event's participants represented telecommunications companies, post-secondary institutions, industry associations, municipalities, and companies (including both technology and energy monitoring fields), and came from diverse professional backgrounds: research officers, managers, enterprise architects, security analysts, and software developers.

Group priorities for the City of Regina included accessible digital infrastructure, citizen engagement, and attention to the impact of remote work on the downtown core. The feedback also highlighted opportunities to use data collecting technologies to mitigate natural disasters and support mental health and social opportunities.

90 Emma Gooch, Mary Chaktsiris, Kevin Jae, Lena Patterson, Salima Suleman, Michael Crawford Urban, Wendy Cukier, Robert Luke, "The Future is Micro Digital Learning and Micro-credentials for Education, Retraining and Lifelong Learning," (ON: Future Skills Center, eCampus Ontario, Ted Rogers School of Management, Magnet, March 20222), https://fsc-ccf.ca/wp-content/uploads/2022/03/TheFutureisMicro-Report-ENG.pdf

SMART REGINA ENGAGEMENT SESSION

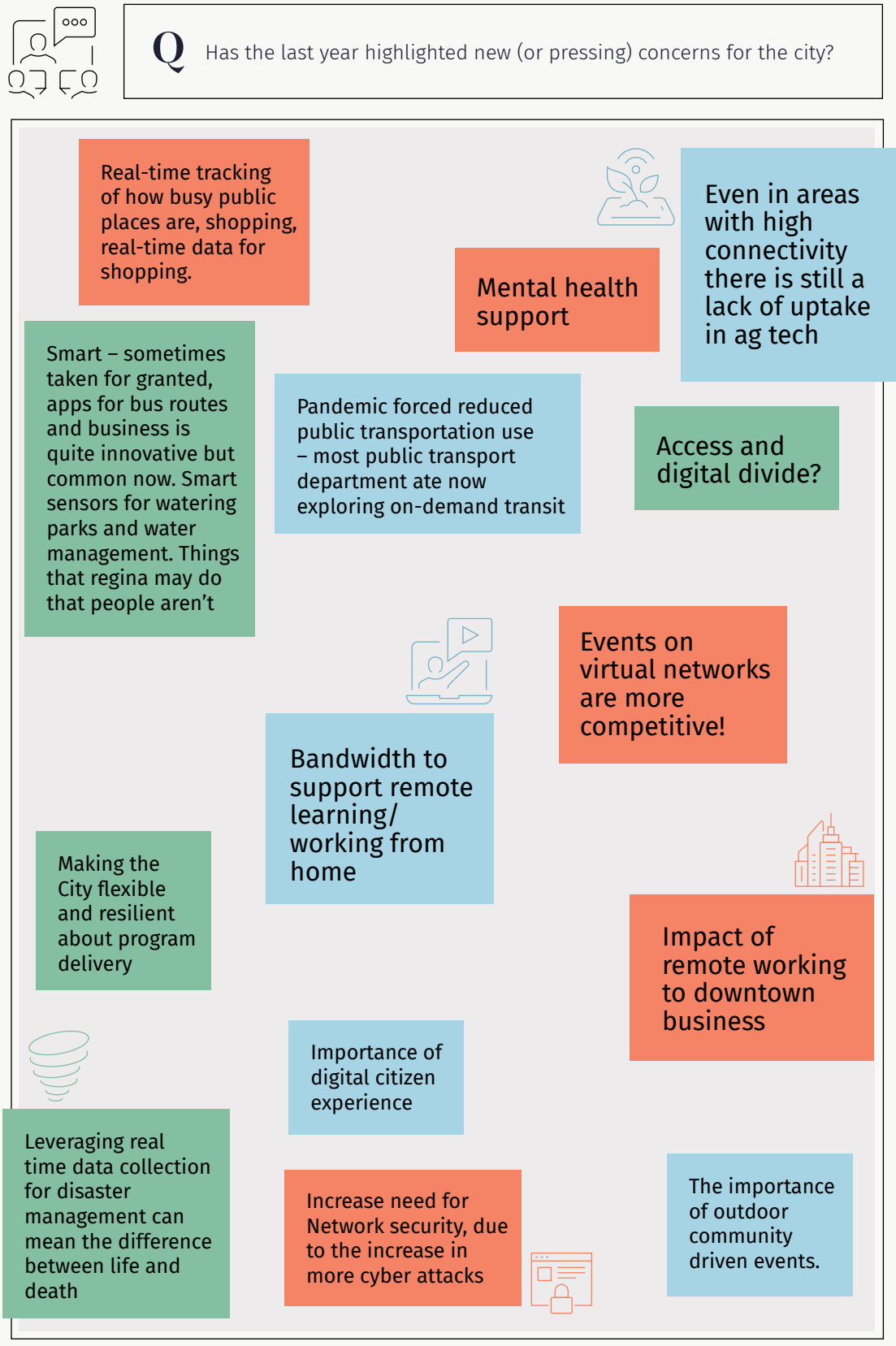


Figure 13: Group commentary on Google Jamboard (digital engagement tool). Regina Smart Cities virtual public engagement session, ICTC 2021

Several experts interviewed for this study agreed micro-credentials are instrumental in responding to constantly changing industry needs in smart cities:

With micro-credentials, you can respond quickly to industry needs and get people trained up quickly as well. ❞ – Taskforce Member

Micro-credentials are a way to orient the post-secondary environment against the immediate labour needs of society. ❞ – Interviewee

While secondary literature, as discussed above, has suggested that employers are still adapting to the idea of micro-credentials, their perceived value may vary depending on field and awareness. Many smart city employers in Canada value micro-credentials as a tool for employees to continue learning and upskilling. In the *Employer DEI Survey*, hiring decision-makers for smart cities-related workers were asked to evaluate whether their organization encourages employees to seek out education even after they are hired. These decision-makers came from the following industries (listed by representation): Technology, Financial Services, Engineering, Technical and Professional Services. Eighty-six percent of respondents said their employees are encouraged to continue upskilling. Of that majority, more than half "strongly agreed" that life-long learning is important to smart city employees (see Figure 14 for more detail). Specifically, 66% of surveyed employers noted that micro-credentials are an important part of a candidate's experience (20% "strongly agreed") and 56% of employers expect their candidates to participate in micro-education including, bootcamps and certified online credentials.

Smart City employers support continuing education and micro-credentials

WHEN IT COMES TO HIRING AND RECRUITING NEW TALENT, TO WHAT EXTENT DO YOU AGREE OR DISAGREE WITH THE FOLLOWING?

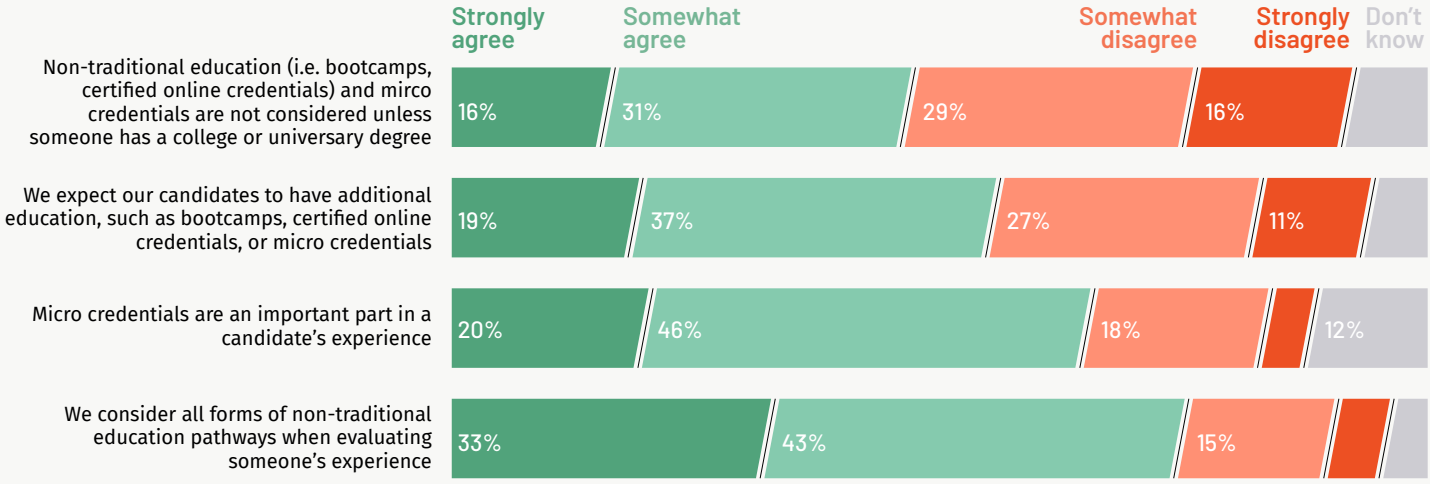


Figure 14: Portion (%) of ICTC survey respondents that value continuing education and micro-credentials. ICTC Survey of Employer Perceptions of Diversity, Equity, and Inclusion, 2021.

Although smart city employers value micro-credentials, micro-credentials typically cannot replace traditional three- and four-year post-secondary education programs. A recent review of micro-credentials in Canada by FSC (Future Skills Centre) found that micro-credentials "are complementary to existing structures of education, augmenting the value of existing educational credentials, as well as offering a path into education and toward credentials for people who do not have any formal education."[91] Research from the FSC, eCampus Ontario, and the Ted Rogers Diversity Institute, similarly outlines the role of micro-credentials as "add-ons" to traditional education programming rather than "stand-alone" options.[92]

91 Mary Chaktsiris, Karen McCallum, Robert Luke, Wendy Cukier, Lena Patterson, Nirvana Garreffa, Emma Gooch, "Is the Future Micro? Unbundling learning for flexibility & access," (Future Skills Centre, Diversity Institute, eCampus Ontario, March 2021), https://fsc-ccf.ca/research/is-the-future-micro-unbundling-learning-for-flexibility-access

92 Emma Gooch, Mary Chaktsiris, Kevin Jae, Lena Patterson, Salima Suleman, Michael Crawford Urban, Wendy Cukier, Robert Luke, "The Future is Micro Digital Learning and Micro-credentials for Education, Retraining and Lifelong Learning," (ON: Future Skills Center, eCampus Ontario, Ted Rogers School of Management, Magnet, March 20222), https://fsc-ccf.ca/wp-content/uploads/2022/03/TheFutureisMicro-Report-ENG.pdf

Interestingly, the HR professionals hiring for smart city roles surveyed by ICTC were divided on whether micro-credentials can count as stand-alone education options. While 47% of the *Employer DEI Survey* respondents said they don't consider non-traditional education (e.g., micro-credentials) and bootcamps unless the candidate has a college or university degree, 45% of respondents do consider them as stand-alone credentials. In other words, just under 50% of surveyed smart city hiring decision-makers would consider a candidate whose only type of education was micro-credentials. These results may point to smart city employers in Canada being more amenable than the average employer to micro-credentials as a stand-alone education option. As one interviewed expert put it, "The world is moving to competency-based learning, rather than necessarily [traditional] education. One of the best developers I know doesn't have a development degree."

On the other hand, when asked what form of education they typically seek in candidates, most surveyed hiring decision-makers in the *Smart City Employer Survey* reported searching for candidates with university or college education. Only 4% looked for a "non-traditional" (e.g., certification or bootcamp) education. Considered together, this survey data may show that surveyed smart city employers are open to hiring people with just micro-credentials, but these applicants are not necessarily first to mind when hiring managers think of successful candidates. In part, this could be due to the novelty of micro-credentials combined with the lack of standardization—the real value of micro-credentials is still emerging (see the Malleable Micro-Future(s) of education for more detail).[93]

Examining the Inclusive Option

Micro-credentials can represent an inclusive upskilling and reskilling option for smart city students.[94] This alternative form of education has the potential to be "flexible and cater to the needs of learners who are unable to engage in longer, traditional programs due to financial, employment-related, or personal barriers."[95] Specifically, affordability, short timelines, and flexibility (in delivery and pace), are central in opening the door for new and returning students.

93 Ibid.

94 Margarita Angelidou, "Four European Smart City Strategies," International Journal of Social Science Studies 4, no. 4 (2016): 18–30.

95 Emma Gooch, Mary Chaktsiris, Kevin Jae, Lena Patterson, Salima Suleman, Michael Crawford Urban, Wendy Cukier, Robert Luke, "The Future is Micro Digital Learning and Micro-credentials for Education, Retraining and Lifelong Learning," (ON: Future Skills Center, eCampus Ontario, Ted Rogers School of Management, Magnet, March 20222), https://fsc-ccf.ca/wp-content/uploads/2022/03/TheFutureisMicro-Report-ENG.pdf

Affordable: Micro-credentials are often more affordable than traditional three- and four-year programs. For example, an undergraduate degree in computer science at the University of Toronto costs approximately $6,000 CAD per semester for four years (~$48,000 CAD total). In contrast, the University of Toronto's School of Continuing Studies (SCS) offers a 15-hour "Python for Automation" micro-credential that costs $550 CAD.[96] SCS also offers a part-time, 24-week Coding Boot Camp that costs approximately $11,245 CAD total. In addition to lower-cost courses offered by post-secondary institutions and industry organizations, MOOCs offered on platforms such as Coursera and edX are often free (although there may be associated costs for additional features).

For the most part, micro-credentials cannot offer the same depth or breadth of knowledge as undergraduate degrees. Micro-credentials are, however, an affordable continuing education option for candidates that already have some form of traditional education (e.g., degree, diploma).

Short timelines: On average, micro-credentials take under a year to complete.[97] That said, timelines vary. Since students can choose the pace at which they complete their course load. Stackable micro-credentials such as UOttawa's micro-programs[98] can take longer than a year to complete. Even so, most micro-credentials take less time than traditional three- and four-year programs.

Shorter timelines can make upskilling more attainable for people who can't afford to take extended periods of time off work. For example, HEQCO's report on life-long learning suggests that short, competency-based programs such as micro-credentials will be instrumental in removing barriers to life-long learning for mid-career workers.[99] As one ICTC taskforce member noted:

It's cost prohibitive for somebody to go back to school once they've been in the working world. They have bills to pay; they have families to support. It's very difficult to go back and say, 'You know what? I'm just going to go back to school because I don't have the skills, and I want to go and reskill.' ❞

96 "3967 - Python for Automation," University of Toronto School of Continuing Studies, accessed June 27, 2022, https://learn.utoronto.ca/programs-courses/courses/3967-python-automation

97 Liza Agrba, "Microcredentials: A Mini Guide to the Micro College Course Market," Macleans.Ca (blog), October 5, 2021, https://www.macleans.ca/education/microcredentials-a-mini-guide-to-the-micro-college-course-market/

98 "UOttawa," Microprograms, accessed July 13, 2022, https://www2.uottawa.ca/study/graduate-studies/microprograms

99 Jackie Pichette, Rosanna Tamburri, Jess McKeown, Kaitlyn A. W. Blair, and Emily Mackay, "Lifelong Learning in Ontario: Improved Options for Mid-Career, Underserved Learners," (ON: Higher Education Quality Council of Ontario, August 2019), https://heqco.ca/pub/lifelong-learning-in-ontario-improved-options-for-mid-career-underserved-learners/

Flexible, remote, and self-paced: Many micro-credentials offer flexible learning formats to suit student needs. These formats include live virtual, pre-recorded virtual, and hybrid (virtual and in-person) lectures as well as flexible due-dates for assignments and online exams facilitated by virtual proctoring. In theory, these flexible timelines could help make education more accessible for students who cannot commit to the traditional full-time, in-person delivery model.[100] These flexible and virtual delivery models can also make educational programming more accessible to individuals living in remote locations with a quality internet connection. One ICTC interviewee noted that lack of access to brick-and-mortar education institutions can make it challenging to deliver training to communities in remote areas. They suggest that "to train people better for work in smart cities, online learning is key (for example through Coursera)."

On the other hand, critics point out that online delivery can exclude learners without access to high-quality, affordable broadband internet. For example, a recent report from FSC cautions that "unequal access to the internet risks reproducing and exacerbating existing inequalities around education, skills training and development, and employment."[101] Research on micro-credential opportunities in Alberta similarly outlines that a lack of reliable internet connection for remote Indigenous communities may decrease access and adoption of micro-credentials that are delivered online.[102] Several interviewees emphasized lack of connection as a potential barrier to online learning, including digitally delivered micro-credentials:

Canada's digital infrastructure isn't quite sophisticated enough to allow a student who resides in the North to participate in some sort of intense remote learning in a classroom based out of Algonquin, or a virtual lab, etc. So, there are impacts on the supply of talent. ❞

– Interviewee

100 Andrée Loucks, "Skills for the Post-Pandemic World," Public Policy Forum, accessed July 12, 2022, https://ppforum.ca/project/skills-for-the-post-pandemic-world/

101 Ibid.

102 "Labour Education Applied Research North (LEARN): Micro-Credentialing in Northern Alberta," (London, ON: Academia Group, March 2021), https://nadc.ca/media/17900/learn-micro-credentials-final-mar-5-21.pdf

Despite potential for greater inclusion, existing research shows no clear consensus about how inclusive micro-credentials are in practice. One international study found that candidates are often "relatively well-educated, male, and within the core working age group (25-54)."[103] Another similarly determined that micro-credential students are typically "Caucasian or Asian, already employed, and between 30 and 44 years old."[104] HEQCO's survey of Ontarians also found that awareness of the term "micro-credential" was higher among younger, working-age Canadians, those with greater household incomes, and those with a university education."[105] On the other hand, some micro-credentials successfully attract underrepresented learners or learners that come from alternative education pathways. For example, more than half of Google's IT Support Professional Certificate graduates do not have an undergraduate degree.[106] In other words, although these programs aim to help underrepresented learners, it is unclear whether micro-credentials actually achieve that goal.

While micro-credentials have the potential to be more inclusive than traditional education, research suggests that greater inclusion will be more likely to succeed if coupled with targeted support. As FSC recommends, the growth of micro-credentials "will need to be matched by a commensurate growth in initiatives that ensure that those most in need of the flexibility offered by online learning—often those with the least ability to access it—are not left on the sidelines."[107] One local example of inclusive micro-credentials planning is Humber College and FSC's free, stackable micro-credential program to develop digital skills focused on supporting newcomers, youth, and racialized people.[108]

103 Shizuka Kato, Victoria Galán-Muros, and Thomas Weko, "The Emergence of Alternative Credentials," (Organisation for Economic Co-operation and Development (OECD), March 2020), https://read.oecd-ilibrary.org/education/the-emergence-of-alternative-credentials_b741f39e-en#page5

104 Mary Chaktsiris, Karen McCallum, Robert Luke, Wendy Cukier, Lena Patterson, Nirvana Garreffa, Emma Gooch, "Is the Future Micro? Unbundling learning for flexibility & access," (Future Skills Centre, Diversity Institute, eCampus Ontario, March 2021), https://fsc-ccf.ca/research/is-the-future-micro-unbundling-learning-for-flexibility-access

105 Jackie Pichette, Sarah Brumwell, Jessica Rizk and Steven Han, "Making Sense of Microcredentials," (ON: Higher Education Quality Council of Ontario, May 2021), https://heqco.ca/pub/making-sense-of-microcredentials/

106 Caren A. Arbeit et al., "Alternative and Independent: The Universe of Technology-Related "bootcamps"" (RTI Press, February 19, 2019), https://doi.org/10.3768/rtipress.2019.rr.0033.1902

107 Andrée Loucks, "Skills for the Post-Pandemic World," Public Policy Forum, accessed July 12, 2022, https://ppforum.ca/project/skills-for-the-post-pandemic-world/

108 "Digital Fluency For The Workforce," Humber College, accessed July 13, 2022, https://humber.ca/community/training-programs/digital-fluency-for-the-workforce.html

Future of Work Snapshot

Supporting Life-long Learning

Micro-credentials are often a more affordable option than four- and three- year degrees and diplomas (both in terms of financial cost and time spent), but learners can perceive them as a risky investment. In part, this perception can be linked to a lack of regulation and standardization and inconclusive research on employer reception.[109] For an adult learner to take a break from work and/or spend money on education for career advancement or transition, they must know that it will pan out for them and their families.

Responsive adult education and reskilling is challenging to achieve, but a number of concrete strategies have been trialled around the world. Many of these policies are centred on the premise that to support a mid-career adult in switching careers, retraining, or upskilling, we need to make the transition less risky, less expensive, and less stressful.[110] In fact, the OECD recently demonstrated that Canada's share of workers who did not participate in training because it was too expensive was above the OECD average in 2018 (18.8% vs. 15.4%; see Figure 15).

109 Jackie Pichette, Sarah Brumwell, Jessica Rizk and Steven Han, "Making Sense of Microcredentials," (ON: Higher Education Quality Council of Ontario, May 2021), https://heqco.ca/pub/making-sense-of-microcredentials/

110 Namir Anani et al., "Economic Resiliency in the Face of Adversity: From Surviving to Prospering" (Ottawa, ON: Information and Communications Technology Council, June 2020), https://www.ictc-ctic.ca/wp-content/uploads/2020/06/Resilient-Economy-Whitepaper-Eng-FINAL.pdf

SHARE OF WORKERS AGED 25-64 WHO DID NOT PARTICIPATE IN TRAINING BECAUSE OF EXPENSE

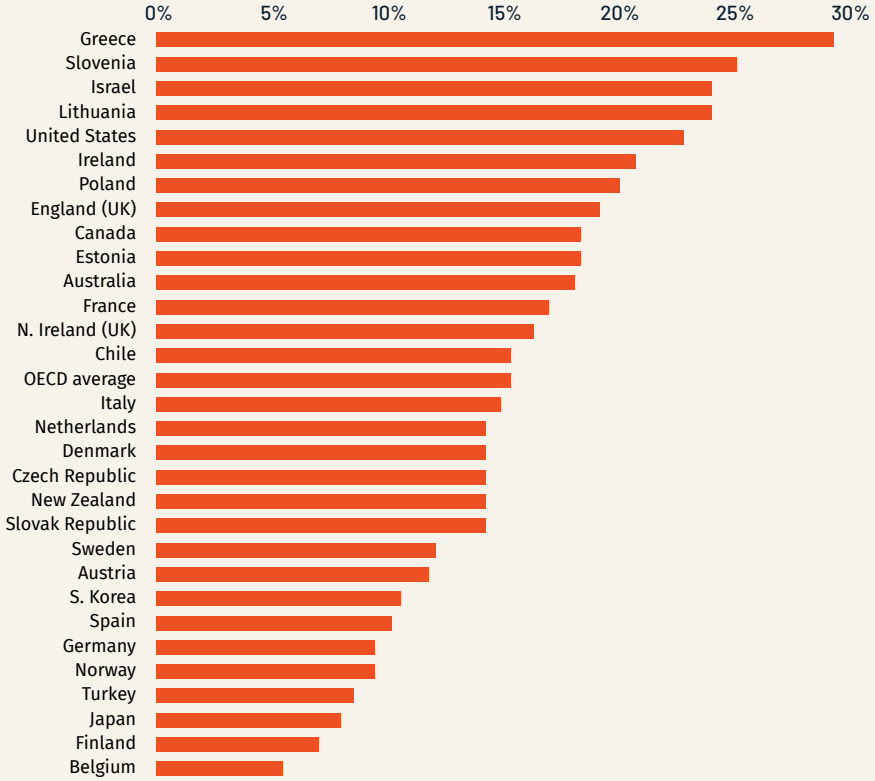


Figure 15: Share of workers (age 25-64) who did not participate in training because it was too expensive. OECD Skills Strategy Flanders, 2019, https://doi.org/10.1787/888933892003

As micro-credentials become increasingly popular as an upskilling option and life-long learning becomes the norm,[111] it is important to ensure that risk, expense, and stress levels for micro-credential students remain low to prevent micro-credentials from becoming a burden to students.[112] There are a number of existing policy proposals that support "innovative hazard," or creative risk-taking in one's career and training over the course of one's life.

Countries around the world have employed different techniques to limit risk, cost, and stress. For example, France piloted "Personal Training Accounts" (Compte Personnel de Formation) in 2015. These accounts are mostly funded by employers, providing "annual, cumulative €500 for education that follows an individual through life until they exercise pension rights."[113]

111 Anthony F. Camilleri, Jochen Ehrenreich, Ildiko Mazar, Marie Ullmann, "Realising the Scope of Open Education Through Credentialisation," (OEPASS Consortium, 2020), https://oepass.eu/wp-content/uploads/sites/22/2020/03/Final-Report-O5_01032020.pdf

112 "OECD Skills Strategy Flanders," (OECD, January 2019), https://www.oecd-ilibrary.org/education/oecd-skills-strategy-flanders_9789264309791-en#:~:text=Flanders%20can%20improve%20skills%20use,and%20firms%3B%20and%204)%20encouraging; "Micro-Credentials: Reshaping Adult Education and Training," (OECD Forum Network, September 10, 2021), http://www.oecd-forum.org/posts/micro-credentials-the-new-frontier-of-adult-education-and-training

113 Sabine Smith-Vital, "Vocational Training in France: Heading Toward a 'Big Bang' Reform?" Morgan Lewis, March 9, 2018, https://www.morganlewis.com/pubs/vocational-training-in-france-heading-toward-a-big-bang-reform

Canada has a similar policy initiative.[114] Other policies intended to support job training include incentives for SMEs to invest in employee skills development—Belgium, for example, offers an "SME Wallet" that covers 30–40% of the costs of a training program[115]—as well as mandatory minimum rights to ongoing education. For example, minimum standards of Paid Education Leave, like parental leave, are being trialled in Europe.[116] Regardless of the forms that ongoing education incentives take, it is essential that they are:

- **Easy to access**—the policy must reach the most vulnerable, possibly by making it a universal standard rather than an application-based program.
- **Shared-cost**—individuals already carry much of the cost of education, and this burden can be spread between individuals, employers, and governments.[117] The bottom line is that people must feel capable of making the financial leap to change their career without putting their livelihood or their family's livelihood at risk.
- **Flexible**—ongoing education must include options: a wide range of high-quality approved funded programs, with timely updates that respond to program offerings by new institutions.[118] Also, programs that are either unaligned with labour demand or not of interest to students are likely to have disappointing outcomes.[119]
- **Well-known and socially acceptable**—many mid-career adults are unlikely to consider and seek retraining opportunities alone, and public awareness campaigns or well-known, trusted, and easily found sources of guidance (e.g., a national database or advise program) can improve participation in ongoing education.[120]

Several policy proposals to support life-long learning were set out in ICTC's 2020 report, *Economic Resiliency in the Face of Adversity*.

114 The Budget 2019 Canada Training Credit adopts a similar approach to France's Personal Training Accounts but for several elements: it is less annually (CAD $250), it can only be applied to 50% of tuition, and it is government-funded rather than employer funded. While a positive step, this policy has several limitations: For example, a student who wished to take a $10,000 programming "bootcamp" would need to wait 25 years to accrue 50% of their tuition, and might not receive guaranteed time off from their employer—accordingly, developing additional and more extensive support for adults in transition, possibly through joint employer funding, may be essential to help this policy make real change; "The Canada Training Benefit," Budget 2019, (Government of Canada, March 19, 2019), https://www.budget.gc.ca/2019/docs/themes/good-jobs-de-bons-emplois-en.html

115 "OECD Skills Strategy Flanders," (OECD, January 2019), https://www.oecd-ilibrary.org/education/oecd-skills-strategy-flanders_9789264309791-en#:~:text=Flanders%20can%20improve%20skills%20use,and%20firms%3B%20and%204)%20encouraging

116 For example, Belgium's program involves at least 32 hours per year, with the cost shared between the government and the employer;"OECD Skills Strategy Flanders," (OECD, January 2019), https://www.oecd-ilibrary.org/education/oecd-skills-strategy-flanders_9789264309791-en#:~:text=Flanders%20can%20improve%20skills%20use,and%20firms%3B%20and%204)%20encouraging

117 See in particular, the quotation: "The crux of these schemes is shared investment by workers, employers, and the state"; Martina Hund-Mejean and Marcela Escobari, "Our employment system has failed low-wage workers. How can we rebuild?", Brookings (blog), April 28, 2020. https://www.brookings.edu/blog/up-front/2020/04/28/our-employment-system-is-failing-low-wage-workers-how-do-we-make-it-more-resilient/

118 Sabine Smith-Vital, "Vocational Training in France: Heading Toward a 'Big Bang' Reform?" Morgan Lewis, March 9, 2018, https://www.morganlewis.com/pubs/vocational-training-in-france-heading-toward-a-big-bang-reform

119 Lola Fadulu, "Why Is the U.S. So Bad at Worker Retraining?", The Atlantic (blog), January 4, 2018. https://www.theatlantic.com/education/archive/2018/01/why-is-the-us-so-bad-at-protecting-workers-from-automation/549185/

120 "Good Jobs for All in a Changing World of Work: The OECD Jobs Strategy," (OECD 2018), https://www.oecd.org/publications/good-jobs-for-all-in-a-changing-world-of-work-9789264308817-en.htm

Upskilling and Reskilling for Different Populations: Recent Graduates and Career Transitioners

Micro-credential-offering institutions, including post-secondaries, typically consider their target audience when developing certificates and programs for life-long learning. In particular, the needs and motivations of recent graduates and mid-career transitioners differ. It is possible that as micro-credentials develop, further attention to student populations, their situations, incentives, and needs, may help promote more inclusive programs with a more diverse student body.

Upskilling: A Closer Look at Recent Graduates

Recent graduates can upskill to keep up with smart city industry demands. According to PricewaterhouseCoopers (PwC), upskilling involves "developing skills required to perform the same role in the future."[121] Two factors that can motivate recent graduates to upskill are 1) to mitigate the lag between industry demand and post-secondary curricula, and 2) to develop applied knowledge and skills specific to a certain field.[122] For example, recent engineering graduates hoping to work in the electric vehicle ecosystem, may want to 1) upskill to meet industry demand for skills related to a new technology that was not covered in their courses, or 2) bolster their general undergraduate training with specific courses related to electric vehicle battery development. Indeed, research on third- and fourth-year university students in the U.S. and from Canadian reports, shows that students typically leverage micro-credentials as "add-ons" to traditional education pathways to make themselves more attractive to employers.[123]

That said, it seems that micro-credentials are not the primary option for recent grads looking to upskill (but they are growing in popularity). In the *ICTC Smart City Graduate Survey* (2021), respondents were recent graduates (five years or less) or soon-to-be graduates seeking employment in smart-city-related jobs. More than two-thirds of new graduate respondents plan to further their education at some point. Almost 90% are open to upskilling if their employer needs them to, and 71% have completed upskilling as part of their current role.

121 Suneet Dua, Carrie Duarte, "How upskilling and citizen-led innovation can change a workforce from the inside out," PwC, June 7, 2020, https://www.pwc.com/us/en/tech-effect/automation/workforce-upskilling-strategy.html

122 Jackie Pichette, Sarah Brumwell, Jessica Rizk and Steven Han, "Making Sense of Microcredentials," (ON: Higher Education Quality Council of Ontario, May 2021), https://heqco.ca/pub/making-sense-of-microcredentials/; Emma Gooch, Mary Chaktsiris, Kevin Jae, Lena Patterson, Salima Suleman, Michael Crawford Urban, Wendy Cukier, Robert Luke, "The Future is Micro Digital Learning and Micro-credentials for Education, Retraining and Lifelong Learning," (ON: Future Skills Center, eCampus Ontario, Ted Rogers School of Management, Magnet, March 20222), https://fsc-ccf.ca/wp-content/uploads/2022/03/TheFutureisMicro-Report-ENG.pdf

123 Mehmet Ali Yilik, "Micro-Credentials, Higher Education and Career Development: Perspectives of University Students," Higher Education Governance and Policy 2, no. 2 (December 31, 2021): 126–39.; Emma Gooch, Mary Chaktsiris, Kevin Jae, Lena Patterson, Salima Suleman, Michael Crawford Urban, Wendy Cukier, Robert Luke, "The Future is Micro Digital Learning and Micro-credentials for Education, Retraining and Lifelong Learning," (ON: Future Skills Center, eCampus Ontario, Ted Rogers School of Management, Magnet, March 20222), https://fsc-ccf.ca/wp-content/uploads/2022/03/TheFutureisMicro-Report-ENG.pdf

Moreover, just under 70% of respondents noted that a degree program was necessary to get the smart city job that they currently hold. When asked how important formal education was in making them a "good" candidate for their current role, 92% of respondents selected education as important. In contrast, 53% of respondents selected micro-credentials. Despite this significant interest in micro-credentials, degree programs are still considered the most important to surveyed graduates working in smart city roles.

While degree and diploma programs are still the most popular choices for the type of education new graduates plan to pursue in the future, 21% of respondents plan to take free online micro-credentials, 16% plan to take micro-credentials or bootcamps, and 12% plan to take post-secondary classes that do not lead to a degree or diploma (these classes are increasingly branded as micro-credits or micro-courses). Interest in micro-credentials is likely influenced by an increased reliance on digital education due to the COVID-19 pandemic: 38% of respondents also noted that because of the pandemic they are looking to expand their skill set with micro-credentials.

Types of Education New Graduates Plan to Persue

WHAT TYPE OF EDUCATION DO YOU PLAN TO PERSUE IN THE FUTURE?

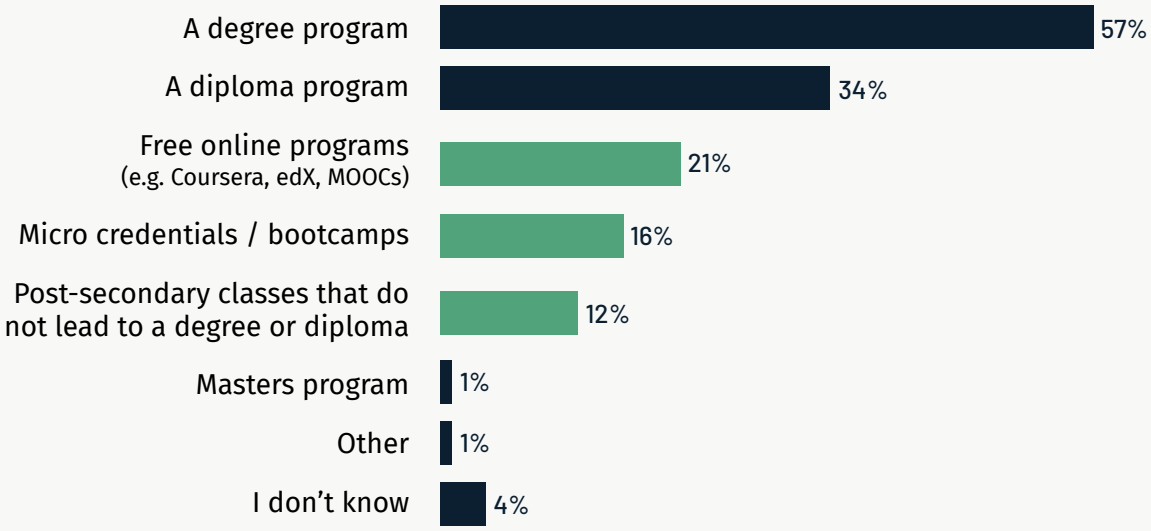


Figure 16: Percentage of survey respondents who selected education options they plan to pursue in the future. ICTC Survey of Recent and Future Graduates in Smart Cities-Related Fields, 2021.

Reskilling and Validating Prior Experience: A Closer Look at Mid-Career Transitioners

Smart cities are about more than a bunch of young people learning how to be good coders. ❞ – Interviewee

Mid-career transitioners also use micro-credentials to move into smart city work, but their motivations may differ from those of recent graduates. Career transitioners are individuals transitioning from one industry or profession into another. To successfully change careers, transitioners can turn to reskilling programs, such as micro-credentials.[124] According to PwC, "reskilling is developing skills needed to perform a new or different role."[125] For example, oil and gas workers in Alberta may use micro-credentials programs, including the Calgary-based EDGE UP program, as targeted training tools to learn the new skills they need to transition into green economy jobs.[126] Higher education institutions across Canada recognize this demand: a recent survey found that more than 90% of post-secondary-run Canadian micro-credential programs "support working adults who wish to change their occupation."[127]

EDGE UP

Micro-Credentials for Energy Sector Career Transitioners

EDGE UP is a retraining program run by Calgary Economic Development in collaboration with ICTC and local post-secondary institutions. The project began by identifying in-demand jobs from across the digital economy and job attrition in Calgary's energy sector. In the first phase of the project, geoscientists, electrical engineers, engineering managers, chemical engineers, and petroleum engineers were mapped to the in-demand roles, outlining skill matches and gaps. Additional roles that are in-demand (e.g., product manager, marketing specialist, etc.) and displaced (e.g., financial analysts, accountants, etc.) were added in the second phase. Labour market data-informed pathways allowed job seekers to better understand their skill overlaps and chart career transition plans.

124 Jackie Pichette, Rosanna Tamburri, Jess McKeown, Kaitlyn A. W. Blair, and Emily Mackay, "Lifelong Learning in Ontario: Improved Options for Mid-Career, Underserved Learners," (ON: Higher Education Quality Council of Ontario, August 2019), https://heqco.ca/pub/lifelong-learning-in-ontario-improved-options-for-mid-career-underserved-learners/; Andrée Loucks, "Skills for the Post-Pandemic World," Public Policy Forum, accessed July 12, 2022, https://ppforum.ca/project/skills-for-the-post-pandemic-world/

125 Suneet Dua, Carrie Duarte, "How upskilling and citizen-led innovation can change a workforce from the inside out," PwC, June 7, 2020, https://www.pwc.com/us/en/tech-effect/automation/workforce-upskilling-strategy.html

126 Misheck Mwaba, "Microcredentials Are Surging in Popularity, but How Should They Be Shaped?," Policy Options, accessed July 12, 2022, https://policyoptions.irpp.org/magazines/micro-credentials-training-education/

127 Jackie Pichette, Sarah Brumwell, Jessica Rizk and Steven Han, "Making Sense of Microcredentials," (ON: Higher Education Quality Council of Ontario, May 2021), https://heqco.ca/pub/making-sense-of-microcredentials/

The EDGE UP pilot program ran from 2019 to 2021 and trained 98 displaced workers for in-demand jobs in the city's digital economy.[128] Phase two, now underway, is training over 300 displaced energy sector workers for in-demand jobs in the city's digital economy. The program's core thesis is to leverage labour market information to identify existing skills, overlaps, and the best possible pathways to competencies in a new career.

In addition to reskilling, micro-credentials can help mid-career transitioners "validate prior experiences and knowledge that learners already possess, and they can help Canadians reskill."[129] Skill validation can be particularly useful for workers who already possess relevant experience. For example, instead of completing a traditional undergraduate degree after leaving the military, mid-career veterans hoping to secure a job in Nova Scotia's ocean tech industry could build the necessary skill sets and knowledge base in less time with a micro-credential (e.g., in Python).[130]

For these and other reasons, research shows that mid-career transitioners seem keen to pursue micro-credentials.[131] Indeed, in ICTC's the *Smart City Employer Survey*, 92% of surveyed hiring decision-makers that hired career transitioners reported that mid-career workers are very or somewhat willing to upskill or complete new training.

Are Smart City Hiring Decision-Makers Open to Hiring Transitioners?

While career transitioners may be motivated to streamline their shift through micro-credentials, successful transitions depend on the willingness of smart city employers to hire transitioners (and to acknowledge micro-credentials). In the *Smart City Employer Survey*, hiring decision-makers recruiting smart cities-related workers were asked to evaluate whether their organization hires candidates from various disciplines, whether they attract career transitioners, and whether they typically hire those career transitioners. Results show that there are many smart cities-related fields that are open to mid-career professionals seeking a new opportunity. Ethics and DEI organizations are reportedly the most interdisciplinary, attractive, and open to career transitioners, closely followed by smart mobility (see Figure 17 for more detail).

128 Alexandra Cutean, "The Digital Talent Imperative: Calgary's Economic Edge," (Ottawa, ON: Information and Communications Technology Council, July 2022)

129 Emma Gooch, Mary Chaktsiris, Kevin Jae, Lena Patterson, Salima Suleman, Michael Crawford Urban, Wendy Cukier, Robert Luke, "The Future is Micro Digital Learning and Micro-credentials for Education, Retraining and Lifelong Learning," (ON: Future Skills Center, eCampus Ontario, Ted Rogers School of Management, Magnet, March 20222), https://fsc-ccf.ca/wp-content/uploads/2022/03/TheFutureisMicro-Report-ENG.pdf

130 Ibid.

131 Melissa McCartney and Holly Rick, The Adult Student/Consumer Model: Micro-Credentials as a Solution for Adult Learners, (IGI Global, 2021), 244–61, https://doi.org/10.4018/978-1-7998-6762-3.ch015

SMART CITY EMPLOYER HIRING TRENDS

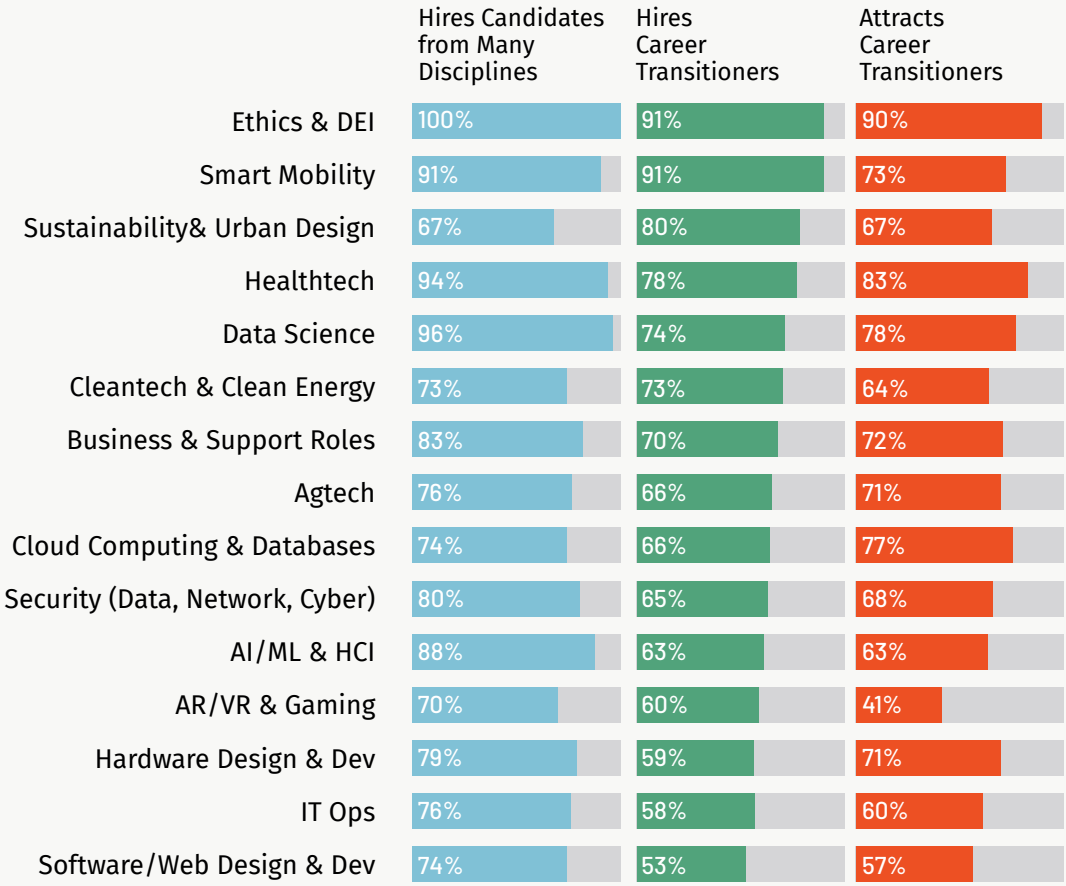


Figure 17: Percentage of employers who participate in select hiring trends. ICTC Survey of Smart City Employer Perceptions of Career Transitioners and Credentials, 2021.

When asked in an open-ended question what specific roles they hired career transitioners for, hiring decision-makers named a wide variety of occupations, including IT, computer science, and technology roles, marketing, business, and management.

To hire career transitioners, the following qualities were most important[132] to employers:

- Good communication skills (96% agree are important)
- Continues to strive for career goals (90%)
- Technical skills relevant to the organization (88%)
- Willing to complete future training/upskilling (88%)

132 Additional qualities, such as leadership experience, loyalty to former companies, progression in one's career, were also listed as important.

These qualities are emblematic of flexibility and life-long learning, suggesting that above all else, people who seek to transition into smart cities-related careers must demonstrate continued flexibility, curiosity, and growth.

In line with this analysis, smart city hiring managers value mid-career transitioners with micro-credentials. In the *Smart City Employer Survey*, 53% of hiring decision-makers said that they "expect [their] candidates to have additional education such as bootcamps, certified online credentials, or micro-credentials." This was particularly true for AI/ML & HCI (human-computer interaction) hiring managers (87% agreed), health tech hiring managers (83% agreed), and ethics and DEI hiring managers (81% agreed). Also, 79% of HR professionals in smart cities-related fields said they encouraged their employees to seek out continuing education after they were hired.

Malleable Micro-Future(s) of Post-Secondary Education

With the growth of micro-credentials, we're going to see a real reshaping of what will happen with credentials in the future...the baccalaureate degrees and diplomas, they'll never disappear, but the pathway to get to them will look very different. ❞

– Dr. Audrey J. Penner, President and CEO, Northern College

Micro-credentials are having a Napster moment: they are disrupting an established industry. We should be asking, where is our Apple or Spotify moment? When will we migrate to the streaming version of education like digital music did? ❞ – Interviewee

I don't think the future is just micro-credentials, but I do think people have an appetite to articulate the skills that they have. ❞

– Interviewee

It is unclear what impact the growing popularity[133] of micro-credentials will have on traditional educational programming. U.S.-based research from Deloitte on the future of education hypothesizes that over the next three to five years, "the perceived value of a degree will likely shift," potentially resulting in "academic portfolios" adapting to support increasing demand for direct vocational outcomes.[134] In line with these findings, a recent Canadian report from the Future Skills Centre suggests that demand for short-term, industry-reactive, and customizable education may shift traditional three- and four-year degrees toward more tailored education formats.[135]

133 "2021 National Report: Lessons from the COVID-19 pandemic," (Canadian Digital Learning Research Association, 2021), http://www.cdlra-acrfl.ca/wp-content/uploads/2022/05/2021_national_report_en.pdf

134 "Higher education remade by COVID-19: Scenarios for resilient leaders 3-5 years," (Deloitte Center for Higher Education Excellence, 2020), https://www2.deloitte.com/us/en/pages/public-sector/articles/covid-19-higher-education-scenario-planning.html

135 Andrée Loucks, "Skills for the Post-Pandemic World," Public Policy Forum, accessed July 12, 2022, https://ppforum.ca/project/skills-for-the-post-pandemic-world/

A report from the Royal Bank of Canada (RBC) suggests that education's "next step requires an inclusive approach to alternative learning—either experiential learning or micro-credentials—that gives students flexibility in how and where they obtain academic credits."[136] At their most extreme, some education experts theorize that future post-secondary education programming may mimic the customizable, self-directed, and stackable properties of micro-credentials, with students picking course-by-course their "a-la-carte" education.[137,138]

All interviewees for this study agreed that the impact of micro-credentials on the future format of post-secondary education is undetermined. Their speculations do, however, tend to emphasize customizability, industry-driven skill demand, and student (or consumer)[139] choice.

In the future, I think we're moving to a more subscription model of education. It is no longer something we do once and then move on to our careers. Rather, we will continue to learn new skills and competencies as our careers and lives progress. ❞ – Interviewee

I see Lego learning as the future of higher education. Every piece fits into another piece, but you can always get a different shape. That's what I think it's going to be for the individual: "I'll have this piece of Lego learning and I'll attach this piece and then I'll need this piece over here." So, what I build for my career profile of credentials is going to look very different than the person next to me, or the neighbour down the street. But it's what I need, and it's totally assembled with the ability to add more to it and to keep going. People may not get a baccalaureate or diploma, instead, they'll have this Lego model of learning. Or maybe they add on a couple more [credentials] to get a degree, a diploma. ❞

– Dr. Audrey J. Penner, President and CEO, Northern College

While it is uncertain what long-term impact micro-credentials will have on traditional education programming in Canada, significant change depends on developing robust national micro-credential standards. FSC notes in a recent report, that "attaching and affirming transferable value to micro-credentials is critical to bolstering their perceived and real value for learners and employers, helping demonstrate the link between learning acquisition and real-world application."[140] Efforts for standardization across Canada are well underway, spearheaded by organizations such as eCampus Ontario, BCcampus, and PowerED from Athabasca University.[141] As one anonymous ICTC interviewee put it, "We have to make all learning valid."

136 Andrew Schrumm, "The Future of Post-Secondary Education: On Campus, Online and On Demand," RBC, June 2020, https://thoughtleadership.rbc.com/the-future-of-post-secondary-education-on-campus-online-and-on-demand/?utm

137 Jimmie Williamson and Matthew Pittinsky, "Making Credentials Matter," Inside Higher Ed, May 23, 2016, https://www.insidehighered.com/views/2016/05/23/understanding-differences-what-credentials-are-being-stacked-and-why-essay

138 Andrew Schrumm, "The Future of Post-Secondary Education: On Campus, Online and On Demand," RBC, June 2020, https://thoughtleadership.rbc.com/the-future-of-post-secondary-education-on-campus-online-and-on-demand/?utm

139 Melissa McCartney and Holly Rick, The Adult Student/Consumer Model: Micro-Credentials as a Solution for Adult Learners, (IGI Global, 2021), 244–61, https://doi.org/10.4018/978-1-7998-6762-3.ch015

140 Emma Gooch, Mary Chaktsiris, Kevin Jae, Lena Patterson, Salima Suleman, Michael Crawford Urban, Wendy Cukier, Robert Luke, "The Future is Micro Digital Learning and Micro-credentials for Education, Retraining and Lifelong Learning," (ON: Future Skills Center, eCampus Ontario, Ted Rogers School of Management, Magnet, March 20222), https://fsc-ccf.ca/wp-content/uploads/2022/03/TheFutureisMicro-Report-ENG.pdf

141 Rory McGreal and Don Olcott, "A Strategic Reset: Micro-Credentials for Higher Education Leaders," Smart Learning Environments 9, no. 1 (February 7, 2022): 9, https://doi.org/10.1186/s40561-022-00190-1

Let's Talk Smart Cities

City of Victoria

On February 17, 2022, the Information and Communications Technology Council (ICTC) partnered with Esri Canada to host ICTC's eighth smart cities community engagement session. The City of Victoria engagement session was attended virtually by Victoria residents, public servants, members of the local tech community, and representatives from community organizations. Key themes from this session include data governance and privacy, better lighting for city streets, enhancing public transportation, and improving public spaces in an era when many people are working from home.

In addition, participants voiced some awareness that Victoria was attracting new workers seeking quality of life during COVID, and that housing affordability and new ways to connect would be important topics for the coming years.

SMART VICTORIA ENGAGEMENT SESSION

Q Have any new opportunities emerged for Victoria over the last year?

Local companies attracting mores talent (based remotely) and able to grow quickly. i.e. CERTN

WFH/ remote work – coworking spaces? A lot of the coworking offices in town have really high demand and not enough spaces

Secondly, connect these newly developing areas better with transportation

I think given WFH, study from home, people are looking for new ways to connect with their community: I've seen lots of local walking, running, workout groups pop up

Employers are changing how they're looking at employment ... more flexibility...it's an employee drives workforce now especially after pandemic!

Attracting more companies who who value the work-life balance of their employees (Victoria offers great lifestyle choices)

With so many new real estates coming up, there is quite a good opportunity for new local businesses/retails to spring up, thus reach out to locals and make entrepreneurs aware of opportunities

But a lot of these groups are now started, found, and congregate on social media – that's has impacts! Not everyone will find them

Potentially increased community engagement (council meetings now being digital allows easier community participation)

Part II of this paper discusses emerging trends in municipal development and workforce attraction and retention in light of COVID-19. In Figure 18, we see that Victoria was one of the few major cities in Canada to experience growing inbound migration during the pandemic. As its residents noted in this engagement session, this type of mobility into cities that are known for work-life balance, proximity to nature, and quality of life also creates a need for careful urban planning and attention to affordability.

Figure 18: Group commentary on Google Jamboard (digital engagement tool). Victoria Smart Cities virtual public engagement session, ICTC 2021.

Part II

Municipal Development, Workforce Attraction and Retention

Workers move to places where jobs are being created. What we see around innovation economies is that tech industries are concentrating in smaller and denser areas in specific markets. This has a lot to do with knowledge flows, because tacit knowledge is flowing in between through informal interactions that happen at bars and restaurants and other third places. That's the economic advantage of cities. ❞

– Austin Zwick, Assistant Teaching Professor, Maxwell School of Citizenship & Public Affairs at Syracuse University

A smart city is much more than just work opportunities and the people who come to fill them. It relies on an engaged population to drive it forward. This includes people who explicitly come to work in smart city roles but extends to a vibrant urban centre, active citizen participation, and networks between public, private, and educational entities that underpin the smart city concept. A city that successfully creates this kind of collaboration produces opportunities for people from different backgrounds to meet and interact productively through events and networks, accessible public spaces, and public resources.[142] Tangible examples of agents forging connections that can improve a smart city ecosystem include a city with public broadband and outdoor event spaces, a university with a public innovation lab (e.g., offering resources like makerspaces), or a company that offers mentorship to students.

In a virtual focus group of economic development professionals across Canada, ICTC asked participants to identify who populated a smart city and what strategies they used to attract and retain such people. The responses are shown in Figure 19 and Figure 20. All of the group feedback can be summarized as follows:

Who populates a smart city? Who works in a smart city?

- Citizens, including diverse demographics (several noted that it was important not to forget vulnerable populations, such as seniors, in the effort to attract knowledge workers)
- Technology companies, incubators and accelerators, entrepreneurs, start-ups, investors
- Not-for-profits and NGOs, post-secondary institutions
- Utilities, governments and policymakers

142 Patrick Cohendet and David Grandadam, "Building Innovation Ecosystems in Cities or Regions: People, Knowledge, Capital, and the Local Commons," (Toronto, ON: Munk School of Global Affairs & Public Policy, 2019) https://munkschool.utoronto.ca/ipl/files/2019/04/Cohendet-Grandadam_BuildingInnovEcosys_slides_01AP2019.pdf

ECONOMIC DEVELOPMENT FOCUS GROUP

Q Who populates a smart city? Who works in a smart city? Why?

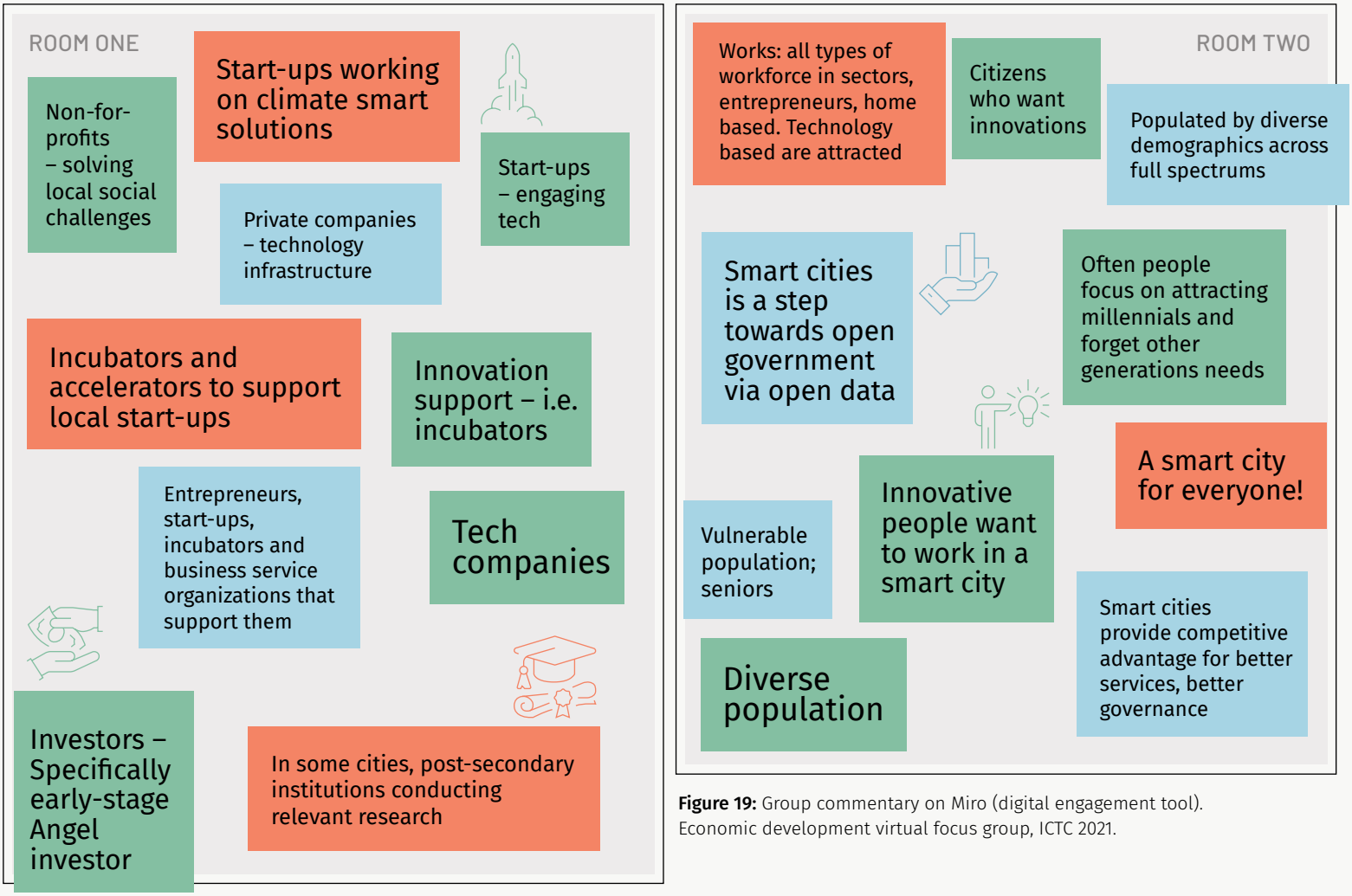


Figure 19: Group commentary on Miro (digital engagement tool). Economic development virtual focus group, ICTC 2021.

What strategies are used to attract and retain these people and organizations?

- Collaboration across the above institutions (e.g., working with post-secondary institutions to align training with demand, "providing opportunities for start-ups and corporations to collaborate and propose innovative smart city solutions")
- Innovation and design challenges, projects that improve services and offer incentives for engaged people and businesses (e.g., open data challenge, accessibility jam, Canada smart city challenge)
- Aligned regulation and policy (e.g., citizen engagement policy, coordination between government office)

- Physical and digital infrastructure, quality of life
- Digital literacy, democratization of digital skills (e.g., “work deliberately with Indigenous groups to ensure coding and robotics skills are accessed by those communities”)
- Municipal advertising and locational branding

ECONOMIC DEVELOPMENT FOCUS GROUP

Q What strategies do you use to attract and retain these people? What works? What doesn’t work? Why?

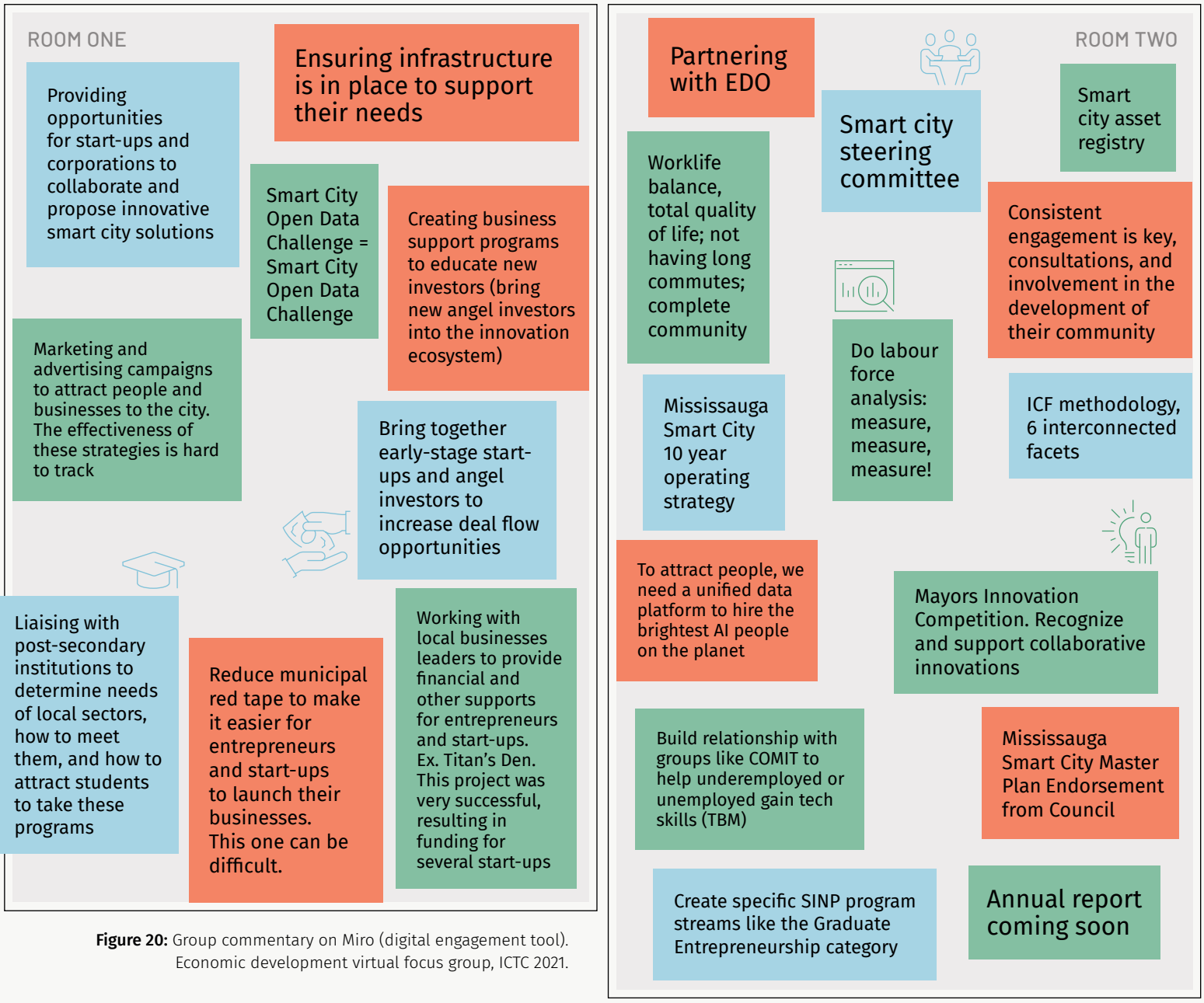


Figure 20: Group commentary on Miro (digital engagement tool). Economic development virtual focus group, ICTC 2021.

When asked to cluster and summarize these ideas for themselves, focus group participants landed on a small number of domains that were essential to municipal development and attraction and retention of people populating a smart city:

- Building community capacity, offering municipal services and digital infrastructure, creating a welcoming and diverse city
- Building a business ecosystem, creating opportunities for collaboration and innovation across a city's technology sector, including specific smart cities-related initiatives and challenges
- Building a strong education system, fostering knowledge workers and the future workforce

The literature on building an innovative ecosystem tends to agree with these themes, suggesting that innovation dynamics in cities rely on people (a talented workforce), capital (financial and material backing), and knowledge (intellectual life and collaboration).[143]

While policy and regulation to foster an innovative smart city ecosystem is beyond the scope of this paper, which focuses instead on talent supply, interviewees in all spheres brought up the importance of having strong local and regional policy to guide smart city implementation. Good innovation policy also creates a safe role for citizens, customers, and workers within a business ecosystem:

Regulations can be an instrument of innovation. They facilitate healthy competition, fair markets, and minimizing customer harm, and then they say, 'Go nuts within that.' With that in mind, it's about really valuing cross-functional teams that can bring a smart city to life. That's why our [policy] students learn to code. They're getting access to a different kind of vocabulary. Cross-functional competencies and policy, I think, become super valuable, necessary, and relevant to a smart city context. ❞ – Interviewee

This topic is covered in greater detail in an ICTC brief on governance in smart cities.[144]

143 Patrick Cohendet and David Grandadam, "Building Innovation Ecosystems in Cities or Regions: People, Knowledge, Capital, and the Local Commons," (Toronto, ON: Munk School of Global Affairs & Public Policy, 2019) https://munkschool.utoronto.ca/ipl/files/2019/04/Cohendet-Grandadam_BuildingInnovEcosys_slides_01AP2019.pdf

144 Mairead Matthews and Khiran O'Neill, "Smart Cities, Smart Government ICTC Policy Roundtable on Smart Government in Canada" (Ottawa, ON: Information and Communications Technology Council (ICTC), July 2021), https://www.digitalthinktankictc.com/policy-briefs/smart-cities-smart-government

Building a Smaller Smart City

The "smart city" concept has some relevance for cities of numerous different sizes: smaller municipalities across Canada are engaging in smart cities-related projects (that is, projects involving data collection and analysis that lead to more efficient urban planning or decision-making) in numerous ways. For example, ICTC's study on procurement of smart technologies in municipalities across Canada showed that smaller cities were using sensors and other data collection tools to improve service delivery, and/or making improvements to public digital infrastructure in order to encourage access to civic participation.[145] Smaller municipalities have been known to make extremely strategic decisions regarding what types of technologies they adopt, having limited budgets, and sometimes building their own solutions.[146]

Municipalities on the smaller side, they're usually a little bit off the beaten path in terms of vendors. There's less capacity. They tend to sort of not to be the recipients of major funding announcements, major grants, stuff like that. They have to look at very different strategies in which to adopt technology. Oftentimes there's inherent limitations for them, such as bandwidth, such as broadband access, and stuff like that, which large cities don't really have to struggle with. It's all to say that it's a very different picture when we look at smaller communities than larger ones. And I think that actually makes them a little bit more savvy players in the smart city space because they have to be very, very selective about the types of technology that they actually adopt. ❞

– Zachary Spicer, Associate Professor, School of Public Policy and Administration, York University

To develop a smart city, procuring and using smart technologies is only half of the equation. Municipalities face the additional challenge of attracting and retaining talent, which can be more challenging for smaller cities.
In the *Smart City Graduate Survey*, students were asked where they were interested in working or applying for jobs. Figure 21 shows that there is a marked preference for large cities—over half of students (53.3%) would be open to working or applying for work in Toronto, for example. Conversely, even provincial and territorial capitals such as Winnipeg, Fredericton, Saskatoon, and Yellowknife are less appealing to graduating students looking for work.

145 Tyler Farmer, Mairead Matthews, and Faun Rice, "Procurement Office or 'Living Lab?' Experimenting with Procurement and Partnerships for Smart Cities Technologies in Canada" (Ottawa, ON: Information and Communications Technology Council, February 2021), https://www.ictc-ctic.ca/wp-content/uploads/2021/03/ICTC_Report_SmartCities_ENG.pdf

146 Faun Rice, "How Scalable is a Canadian Smart City?," Medium, https://medium.com/digitalthinktankictc/how-scalable-is-a-canadian-smart-city-898e7f51a2aa

WHICH OF THE FOLLOWING CITIES ARE YOU INTERESTED IN WORKING / ALREADY APPLYING FOR JOBS IN?

Select all that apply

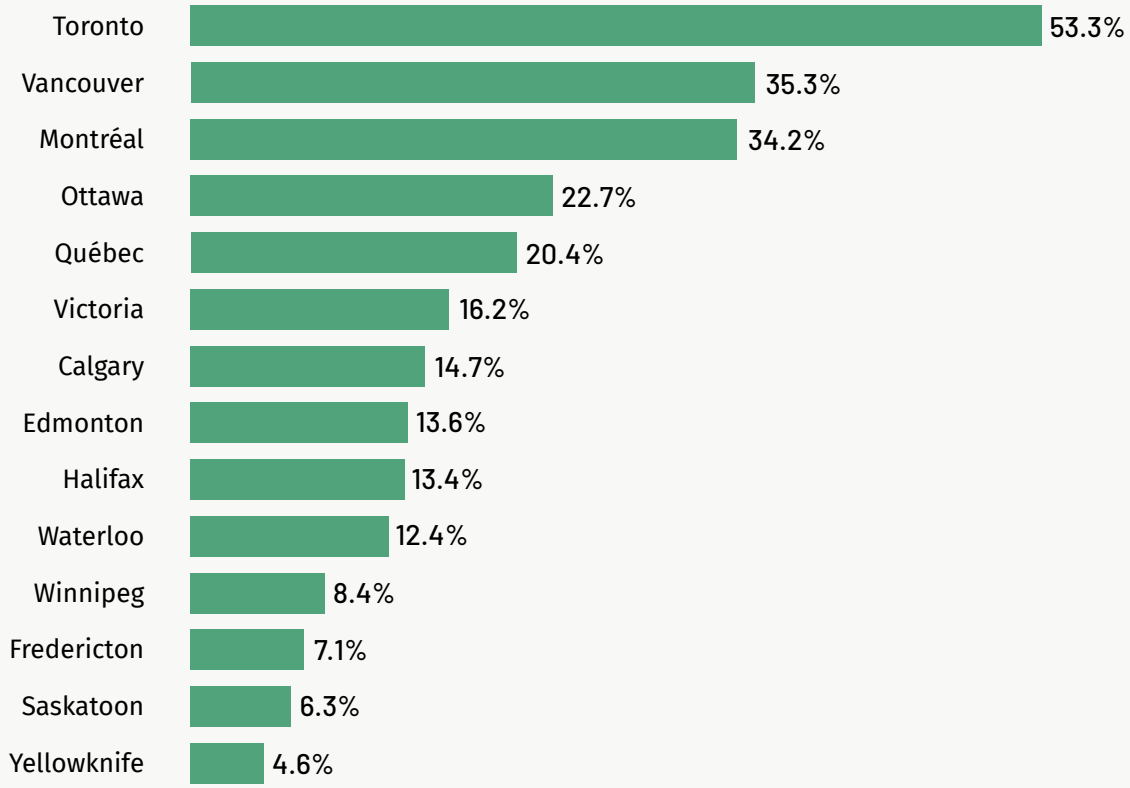


Figure 21: Percentage of survey respondents who are interested in working in select cites. ICTC Survey of Recent and Future Graduates in Smart-Cities Related Fields, 2021. https://www.datawrapper.de/_/KOZO7/

Once attracted, knowledge workers can help drive economic growth and municipal development.[147] The slow process of attracting and retaining new people to help drive further smart city-related projects (and thereby create demand for projects that rely on adequate population, such as public transit) is a causality problem, or "chicken and egg" problem. Smaller cities need an adequate population base to create demand for smart city projects: in turn, this creates jobs for knowledge workers, who in turn feed demand for further urban development. Further, knowledge workers and entrepreneurs may be mobile, with a desire to shift companies or occupations relatively frequently, such that a critical mass of relevant work opportunities is needed to retain them in the long term.[148]

147 See for example the literature on Human Capital Theory as described in Tan Yigitcanlar, Scott Baum, and Stephen Horton, "Attracting and Retaining Knowledge Workers in Knowledge Cities," Journal of Knowledge Management 11 (September 18, 2007), https://doi.org/10.1108/13673270710819762

148 Ibid; see also the discussion on retaining technology start ups in Faun Rice and Mairead Matthews, "Context Matters Strengthening the Impact of Foreign Investment on Domestic Innovation" (Ottawa, ON: Information and Communications Technology Council (ICTC), May 2022), https://www.digitalthinktankictc.com/reports/context-matters

Despite the well-known attractions of large cities—urban amenities, prestigious schools, events, career opportunities—there are downsides to large urban centres, such as a rising cost of living. Remote work opportunities have opened a window for smaller municipalities to advertise affordability and quality of life as a way to attract and retain new talent.[149] Smaller cities trading on quality of life can, to some degree, leverage technology-driven projects, such as strong digital infrastructure (including affordable broadband access), telehealth, and other digital services. These play a role in helping small and remote municipalities attract and retain citizens and workers, both through improvements to quality of life and "locational branding".[150]

New graduates surveyed in this study emphasized the appeal of affordable high-quality living, often close to pre-existing communities. When asked what they were looking for in the city or province they planned to live in after graduation, soon-to-be graduates in smart cities related fields responded with the following number one priorities:

- Affordable cost of living (24%)
  *(students between 15-24 were the most likely to rank this option first)
- Good quality of life, public spaces, and amenities (16%)
  *(students between 15-29 were most likely to rank this option first)
- Personal commitments, family, and friends (11%)[151]

Strengthening educational institutions may also help attract knowledge workers to a city. Building post-secondary educational institutions has been shown to attract and retain knowledge workers in smaller municipalities in the U.S.[152] In the Canadian context, the *Smart City Graduate Survey* asks whether students intend to find work in the same city they are studying in. For soon-to-be graduates, 68% agreed that they were "searching for jobs in the same city as the school [they] attended." This was particularly true for students in Saskatoon (88%), Waterloo (83%), and Edmonton (78%). However, only 56% "expect to stay in the same city [in which they studied."[153]

149 Richard Florida, Karen King, Ross Devol, and David Shideler, "Heartland of Talent: How Heartland Metropolitans Are Changing the Map of Talent in the U.S.," Heartland Forward, Feb 8 2022, accessed July 4, 2022, https://heartlandforward.org/case-study/heartland-of-talent-how-heartland-metropolitans-are-changing-the-map-of-talent-in-the-u-s/

150 Zachary Spicer, Nicole Goodman, and Nathan Olmstead, "The Frontier of Digital Opportunity: Smart City Implementation in Small, Rural and Remote Communities in Canada," Urban Studies, September 4, 2019, 0042098019863666, https://doi.org/10.1177/0042098019863666

151 ICTC Survey of Recent and Future Graduates in Smart Cities-Related Fields, sub-sample of soon-to-be graduates (n=301), 2021.

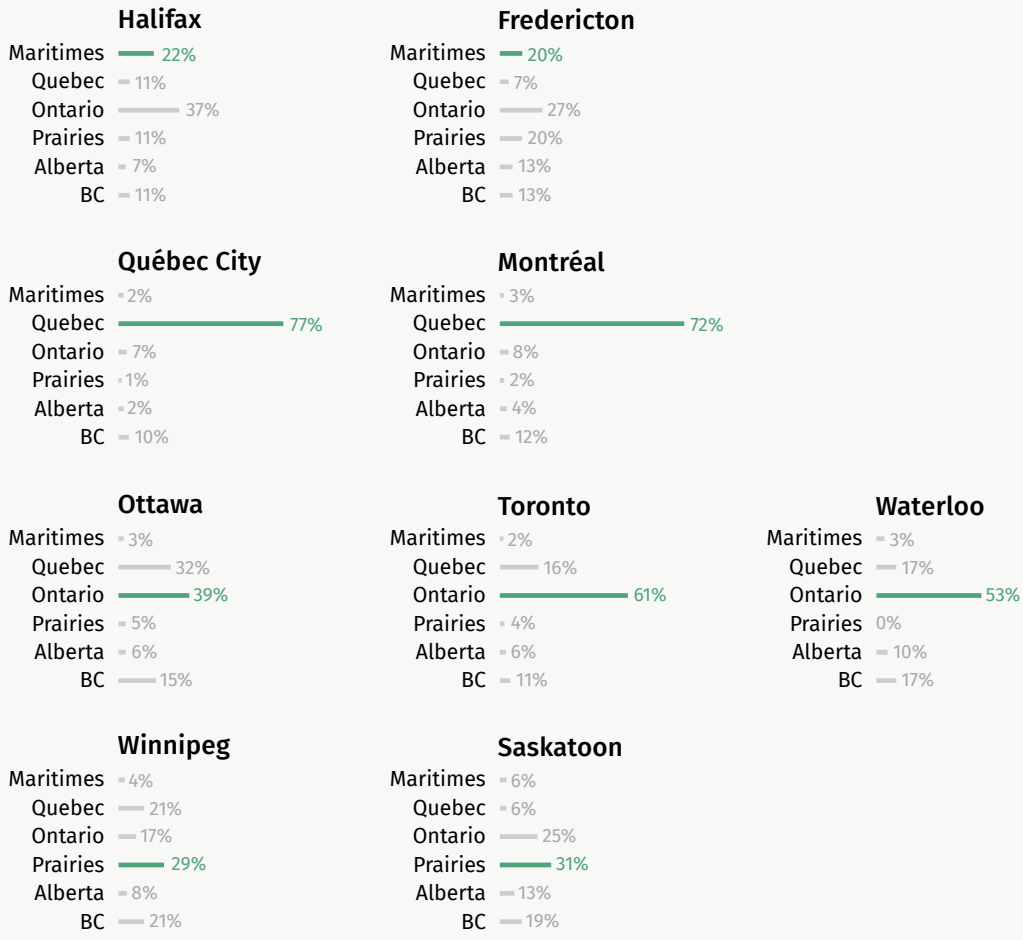
152 John V. Winters, "Why Are Smart Cities Growing? Who Moves and Who Stays," Journal of Regional Science 51, no. 2 (2011): 253–70, https://doi.org/10.1111/j.1467-9787.2010.00693.x

153 Sub-sample of soon-to-be graduates (excludes recent grads/current workers).

We can examine this data in another way: Figure 22 shows students' province of study and interest working in key Canadian cities. Students are mostly interested in cities in their own province: for example, 77% of respondents who said they were interested in working in Quebec City hailed from the province of Quebec. Other cities, such as those in the Atlantic provinces, show a broad distribution of students from other provinces who would be open to applying for work and finding jobs there.

WHICH OF THE FOLLOWING CITIES ARE YOU INTERESTED IN WORKING IN?

Distribution of respondents, by region of current residence



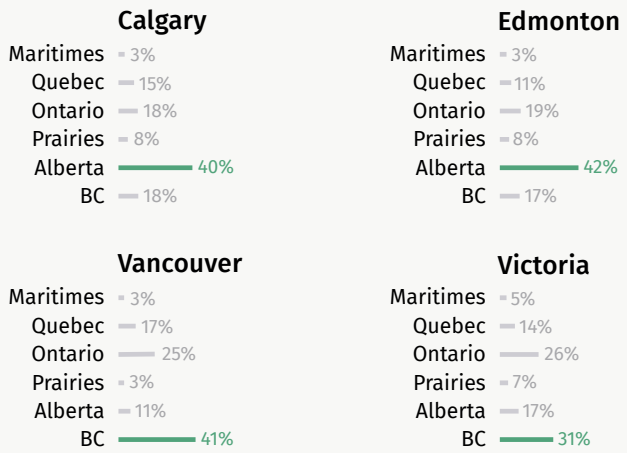


Figure 22: Percentage of survey respondents who are interested in working in select cites, sorted by region of current residence. ICTC Survey of Recent and Future Graduates in Smart Cities-Related Fields, 2021.

In sum, certain cities in Canada are a big draw for knowledge economy workers, while others may struggle to attract and retain recent graduates. Attraction and retention are a bigger challenge for smaller Canadian municipalities: fewer job opportunities, smaller educational institutions, and other variables may contribute to this. Affordability and quality of life are key priorities for smart city workers, however, and smaller municipalities may have an opportunity to offer remote work opportunities and livability instead. Two questions mediate smaller cities' ability to capitalize on this opportunity: first, for how long will remote work last? And second, some smaller cities have successfully used affordability to incentivize immigration (domestic and international) over the last several years, but have they stayed affordable? These two questions are unpacked over the remainder of this section.

Let's Talk Smart Cities

City of Fredericton

On October 14, 2021, the Information and Communications Technology Council (ICTC) partnered with Fredericton organization Ignite, the Fredericton Chamber of Commerce, and the City of Fredericton to host a virtual smart cities community engagement session with residents of Fredericton, NB. In the session, participants were asked about the most immediate challenges Fredericton was facing, as well as most immediate causes for optimism.

Areas of immediate challenge included affordable housing, food insecurity, cybersecurity, lack of inclusivity in municipal decision-making, lack of digitized healthcare services, media literacy issues, and lack of climate urgency and related planning. Causes for optimism included new population growth, working from home, ICT sector growth, and examples of effective renewable energy strategies (see Figure 23)

SMART FREDERICTON ENGAGEMENT SESSION

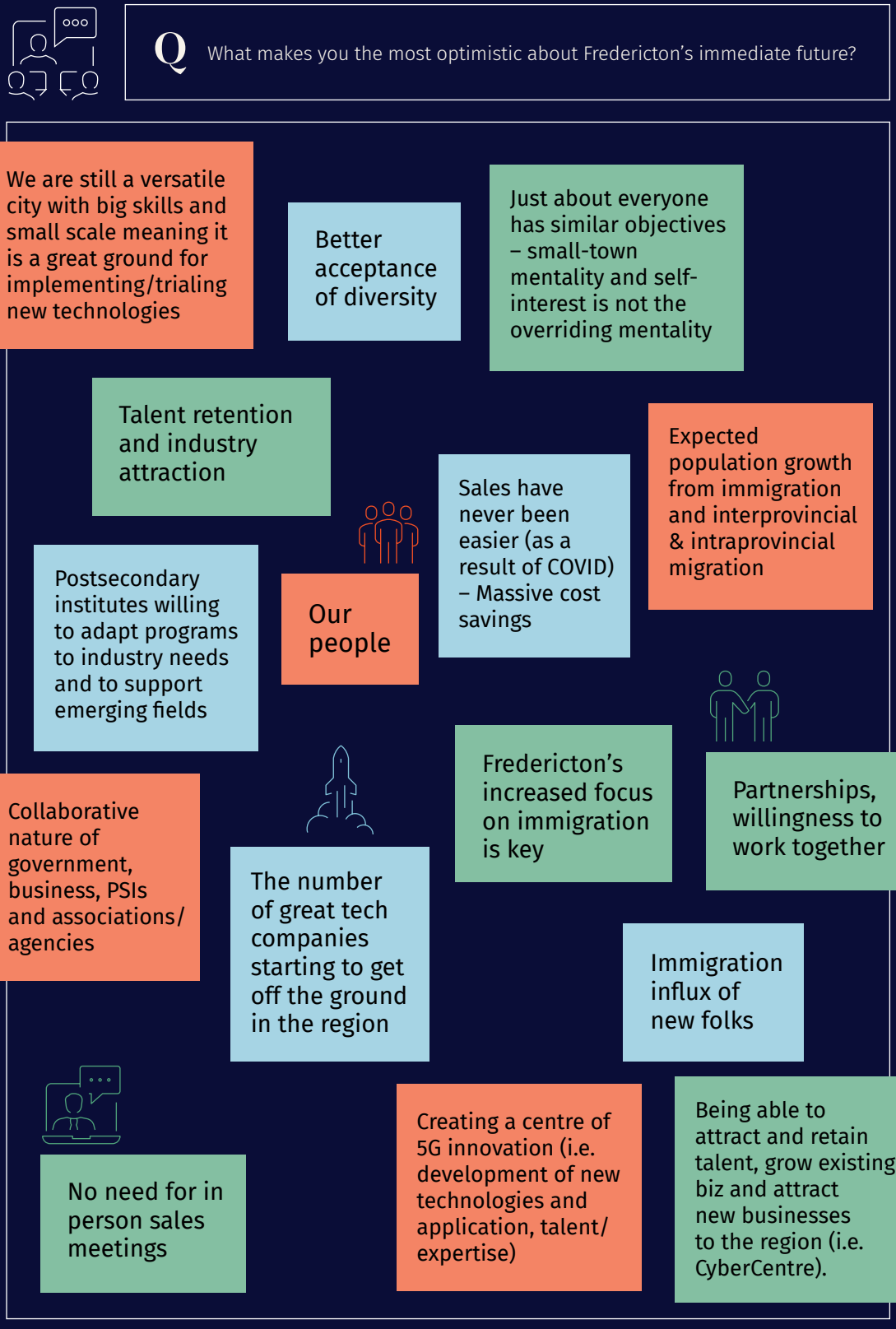


Figure 23: Group commentary on Google Jamboard (digital engagement tool). Fredericton Smart Cities virtual public engagement session, ICTC 2021.

Remote Work and COVID-19: Impact on Municipal Development and Attraction

Data collection for this study occurred from 2019 to 2022, during the COVID-19 pandemic, when many knowledge workers were working remotely. Across the board, participants who contributed to the study voiced some degree of uncertainty about whether remote work would last for long enough to significantly influence living patterns. As discussed earlier, an affordable cost of living is important to new graduates in smart cities fields. Given this, many study participants speculated that smaller municipalities would see an influx of knowledge workers looking for higher quality living spaces for less cost, while downtown cores would be at a disadvantage. In the *Smart City Graduate Survey*, 53% of soon-to-be graduates agreed that they will be "seeking out roles that offer a remote option," and 57% agreed that "the possibility of remote work post-COVID has opened up [their] job search to more cities/regions." Finally, of the full sample (soon-to-be graduates and recent graduates), 47% said they would "like to have the flexibility to choose to be at home or in the office."

That said, not all employers agreed that this trend would last forever: in the *Smart City Employer Survey*, most hiring decision-makers still felt that it was important that workers should at least be able to come into an office at some future date.

Smart Cities Fields Most Likely to Require In-Person Workers

The majority of smart cities hiring decision-makers agreed that they were seeking local candidates who could come into a physical office (75% overall).[154] This figure is higher than other Canadian surveys of employers[155]: it is possible that employers in smart cities fields are more likely to look for candidates who are living in their municipality. For example, smart mobility hiring decision-makers are the most likely to want local candidates who could be present in person, which makes sense for roles that relate to public transit operations in a particular place. Alternatively, this could reflect employer preference but not necessarily their practice (if, for example, employees learn to expect and request remote options[156]).

154 ICTC Survey of Smart City Employer Perceptions of Career Transitions and Credentials, 2021.

155 E.g., Jim Wilson, "3 in 4 employers to keep offering remote work," HR Reporter, June 16, 2021, https://www.hrreporter.com/focus-areas/culture-and-engagement/3-in-4-employers-to-keep-offering-remote-work/357209

156 E.g., Jared Lindzon, "Half of remote workers would quit before returning to the office full-time, survey says," The Globe And Mail, April 15, 2022, https://www.theglobeandmail.com/business/careers/article-50-remote-workers-quitting-office-return/

The smart cities roles below are ranked from most to least likely in their preference for in-person staff, based on hiring decision-makers' responses:

Smart Mobility	91%
IT Operations	83%
Health Technology	83%
Data Science	83%
Ethics & DEI	82%
Software/Web Design & Development	81%
Agricultural Technology	80%
Business & Support Roles	80%
Security	80%
Hardware Design and Development	79%
Cloud Computing & Databases	77%
All Smart City Employers Average	*75%*
Sustainability & Urban Design	67%
CleanTech & Clean Energy	64%
AI/ML & HCI	64%
AR/VR & Gaming	60%

Accordingly, physical location is still a major consideration for many smart cities employers. Overall, 21% of *Smart City Employer Survey* respondents reported that the skill sets they looked for in hiring were not common in their cities, though more (36%) reported that they were hiring for jobs so specialized that there were simply few candidates in general, not limited to their regions. High turnover was also a barrier for about 1 in 3 organizations (29%). Turning this back to the discussion of rurality, municipal size, and ability to attract knowledge workers, remote work is making its presence felt but also displays some inertia, such that many employers are still looking for workers to physically come into their office spaces, at least eventually.

Attracting New Workers and Citizens Through Immigration

While the COVID-19 pandemic significantly decreased immigration to Canada, in previous years immigration has been responsible for the majority of Canada's population growth[157]: furthermore, the country has recently seen a significant resumption of immigration, as well as a backlog of applications due to pandemic-related delays. Immigration plays an essential role in bringing in smart cities workers at different stages of their careers, or as students. In the *Smart City Graduate Survey* (2021), 27% of respondents were immigrants to Canada, and about a quarter of these were newcomers (in other words, 28% of all respondents who were immigrants had arrived in the past five years). Employers also agree that newcomers and immigrants are essential to their businesses. In particular, roles with niche expertise might require international talent: for example, when asked whether their organization seeks international candidates, hiring decision-makers in Smart Mobility (81%), AI/ML and Human-Computer Interaction (74%) and Hardware Design & Development (66%) were most likely to somewhat or strongly agree, suggesting that these fields are likely to require skills or experience that are less easily found in Canada.[158]

When asked further how many *successful* candidates were newcomers, immigrants, or required visa sponsorship, hiring decision-makers in the smart cities field reported hiring many immigrants and newcomers, but less frequently sponsoring newcomer visas (see Figure 24).

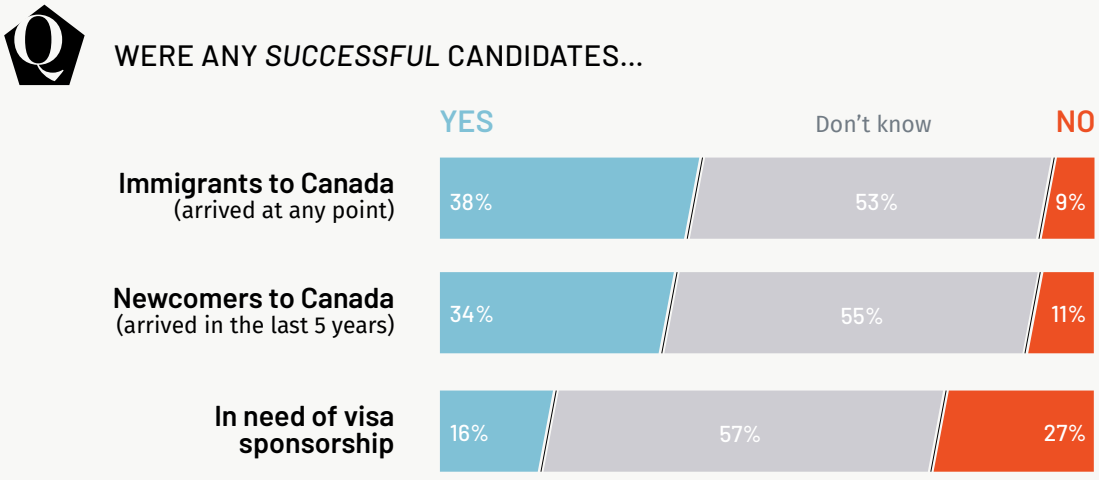


Figure 24: Successful candidates in smart cities organizations based on immigration and visa status. ICTC Survey of Smart City Employer Perceptions of Career Transitions and Credentials, 2021. For an interactive version, visit: https://www.datawrapper.de/_/RbSC5/

157 For example, 85.7% in 2019: Statistics Canada, "Canada's population estimates, fourth quarter 2020," The Daily, 2021, https://www150.statcan.gc.ca/n1/daily-quotidien/210318/dq210318c-eng.htm

158 ICTC Survey of Smart City Employer Perceptions of Career Transitions and Credentials, 2021.

Even after visa sponsorship, immigrants face many challenges in entering the Canadian workforce. Over half of employers surveyed (54%) in this study required candidates to have at least some education in Canada to be considered for their jobs.[159] In a survey conducted for a previous study on diversity, equity, and inclusion in the knowledge economy, just under half (47%) of employers surveyed agreed that they required Canadian work experience to consider applicants.[160] In short, technology sector and knowledge economy newcomers without Canadian education or work experience may find their job prospects cut in half compared to candidates who have studied or worked here previously.

I work with an immigration agency, and I find signalling is such a huge part of it. You could have someone come to Canada with a master's degree from the best university in their country, but for some reason, they come here and it's not enough of a signal to that employer. So do they go back to school for a second degree? An online course? At what rate is it really worth their time? It's a genuine dilemma. ”

– Supply taskforce Jul 2019

In the context of municipal economic development for smart cities, Canadian regions may sponsor newcomers to boost their educated populations. In order to mitigate the issues discussed above around Canadian work experience, it is therefore important to combine sponsorship with support for newcomers as they attempt to enter the workforce, along with demand-side measures like foreign credential recognition and employer awareness. In a recent paper evaluating the efficacy of foreign credential equivalency processes, Banerjee et al. found that immigrants from some countries of origins saw wage and employment gains, while others saw little to no change: the authors suggest that employer biases against the legitimacy of credentials for certain ethnicities and countries have not yet been solved.[161]

159 Ibid.

160 ICTC Survey of Employers: Perspectives on Diversity, Equity, and Inclusion, 2020.

161 Rupa Banerjee et al., "Evaluating Foreign Skills: Effects of Credential Assessment on Skilled Immigrants' Labour Market Performance in Canada," Canadian Public Policy 47, no. 3 (September 1, 2021): 358–72, https://doi.org/10.3138/cpp.2021-014

The Atlantic Canada Example: Immigration Retention, Economic Development, Quality of Life, and Cost of Living

Immigration is important for smart cities talent in general but can be particularly important for less populated regions of Canada. Research participants emphasized that it was important for cities of all sizes to offer a high quality of life and amenities for newcomers. In addition, visa programs such as the provincial nominee programs (PNPs), lower cost of living, and other incentives could help regionalize immigration and talented workers. One respondent said, "it's about leaving where they are I think primarily and then a secondary concern is, it'd be nice to go to a cool city as well."

A city trying to develop as a "smart city"—pursuing the policies of municipal development and attraction discussed earlier—may be doing many of the same things as it would do to attract and retain newcomers. Canadian researchers have long noted that less-populated provinces face greater challenges in retaining newcomers. For example, the 10-year retention rate for immigrants (based on tax filings) who entered Canada in 2009 was the following in 2019:

Ontario	91.6%
British Columbia	87.3%
Alberta	86.3%
Quebec	83.8%
Saskatchewan	73.9%
Manitoba	73.6%
Territories	66.7%
Nova Scotia	58.6%
New Brunswick	43.2%
Newfoundland and Labrador	39.6%
Prince Edward Island	13.6%[162]

162 "Mobility of immigrant taxfilers by census metropolitan areas and tax year," Statistics Canada, December 10, 2021, https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=4310002201

Atlantic Canada has many attributes that make it an interesting case study in smart cities development, particularly in the context of building talent supply. Atlantic provinces have low newcomer retention rates, sitting at the lowest end of the spectrum compared with the rest of Canada.[163] Nevertheless, Atlantic Canada has numerous programs in place to bring newcomers in, including provincial nominee programs and the Atlantic Immigration Program (formerly the Atlantic Immigration Pilot Program).[164] Provincial Nominee Programs (PNPs) are one system designed to promote immigration to underpopulated parts of Canada. Starting in 1996, these programs are intended to support regionalization in Canadian immigration without using coercion, meaning that newcomers are sponsored to a particular region but not required to stay there to retain their visas.[165] Jurisdictions attract applicants with particular skill sets based on regional labour market information.

Given that the Provincial Nominee Programs take care to attract newcomers whose skills match in-demand jobs in their regions, it is clear that newcomers need more than job matching in order to stay in a region. This Atlantic Canada case study expands on the other tools smaller smart cities can use to promote economic development and attract workers, particularly in an era of remote work.

First, a newcomer's match to in-demand jobs is not enough alone to retain a talented worker: even if a newcomer has a job for themselves, they must have a job for their spouse, along with opportunities to transition to other jobs if they are unhappy in their workplace or facing career ceilings. Furthermore, a skill match does not necessarily mean that employers will understand and value international credentials. Emphasizing this point, study's guiding taskforce provided the following comment on the Atlantic Immigration Program, identifying a mismatch between work promised during immigration, and the work that newcomers could find on the ground:

If we're looking at the Atlantic pilot program, a pilot program to attract immigrants in Atlantic Canada in smaller and medium-sized cities, the evaluation of the program is more complex. But in a nutshell, the place is nice, the people feel supported, but the jobs are not the kind of quality jobs that would keep you, or you don't have a job for your spouse. So in the end, you may leave for these reasons. One might say, "Oh you could become an entrepreneur and even create jobs for others," and some people do. But that's why we see people going to Vancouver, Toronto, and Montreal. ❞

– Taskforce Member

163 Ibid.

164 "Atlantic Immigration Program," Government of Canada, April 5, 2022, https://www.canada.ca/en/immigration-refugees-citizenship/services/immigrate-canada/atlantic-immigration.html

165 Nathaniel M. Lewis, "A Decade Later: Assessing Successes and Challenges in Manitoba's Provincial Immigrant Nominee Program," Canadian Public Policy / Analyse de Politiques 36, no. 2 (2010): 241–64. p. 243.

Two interviews with internationally educated professionals also suggested that newcomers to Atlantic Canada were facing difficulties finding work that matched their qualifications and the growing cost of living. Furthermore, as mentioned earlier, knowledge workers shift jobs frequently and require a critical mass of opportunities to retain skilled talent.[166]

Second, smart cities themselves have an opportunity to improve newcomer retention. In practice, immigration authority is shared by the Canadian federal, provincial, and territorial governments, but municipalities also have an important role to play in developing the resources and safe communities that newcomers need.[167] Municipalities in Canada can support newcomers through formal settlement policies; diversity, multiculturalism, and antiracism policies; and access and equity policies, as well as through committees or councils specifically designed to administer and oversee these groups.[168] Furthermore, cities can adopt many of the same measures that help promote civic engagement and public participation for everyone in a smart city, including accessible technologies and vibrant urban and outdoor spaces.

Domestic and International Migration to Atlantic Canada in the Era of COVID-19

In addition to employer-side programs and creating safe communities, smaller smart cities now have yet another opportunity to attract and retain workers: remote employment. How remote work changes policies like the PNP is yet to be seen: but cities now have an opportunity to attract skilled talent working in other jurisdictions. If remote work continues to proliferate and resolve issues of job availability, workers may choose to live in cities and regions based on the quality of life rather local work opportunities. Technology sector newcomers interviewed in ICTC research noted that they saw Atlantic Canada as an attractive place to raise a family, with more space and a safe city closer to nature. Atlantic cities have used this image strategically to attract skilled workers of all kinds. The "Work From Nova Scotia" campaign in 2021, for example, advertised affordability, inclusivity, and nature as reasons to migrate from teleworking in a larger city to teleworking in Atlantic Canada.[169] According to The Halifax Partnership, the city has succeeded in creating knowledge economy jobs and attracting relevant employees, with Policy and program researchers, consultants and officers; and Computer and information systems professionals each growing by over 4,000 workers over the last 10 years (see Figure 25).

166 Tan Yigitcanlar, Scott Baum, and Stephen Horton, "Attracting and Retaining Knowledge Workers in Knowledge Cities," Journal of Knowledge Management 11 (September 18, 2007), https://doi.org/10.1108/13673270710819762

167 Livianna S. Tossutti, "Municipal Roles in Immigrant Settlement, Integration and Cultural Diversity," Canadian Journal of Political Science / Revue Canadienne de Science Politique 45, no. 3 (2012): 607–33.

168 Ibid.,p. 614.

169 See for example, Cassidy Chisholm, "New work-from-home campaign invites people to move to Nova Scotia," CBC News, February 3, 2021. https://www.cbc.ca/news/canada/nova-scotia/work-from-home-campaign-invite-1.5899917

HALIFAX: NET CHANGE IN EMPLOYMENT

Key occupations 2012–2021

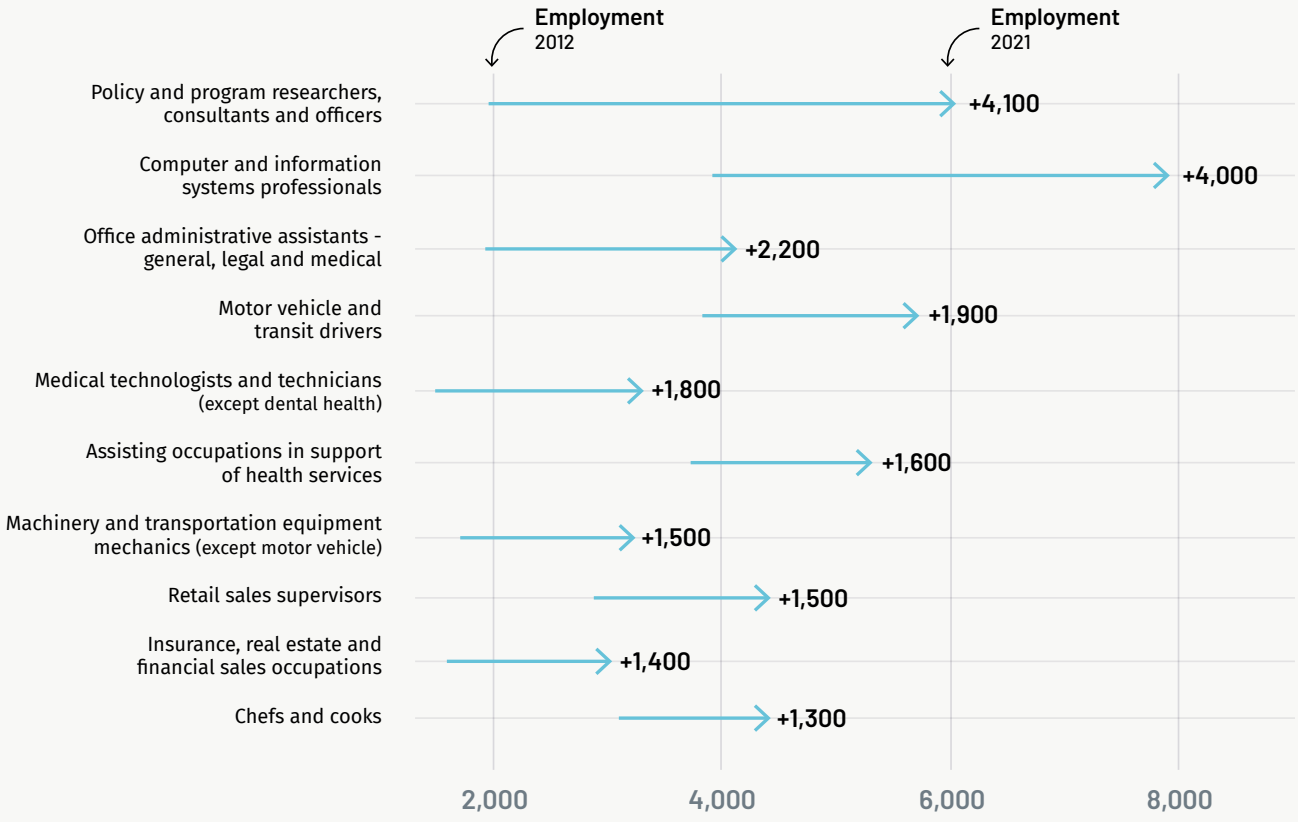


Figure 25: Net change of employment in Halifax from 2012–2021 by select occupations. Statistics Canada, Labour Force Survey, Table 14-10-0389-01 via The Community Data Program via the Halifax Partnership, 2021, https://halifaxpartnership.com/research-strategy/halifax-index-2022/labour/

Certain cities in Canada saw increased population inflow even during a general downturn in international immigration to Canada: Atlantic cities more so than others. COVID-19 is changing migration patterns and knowledge economy labour mobility, but to what extent (and how lasting remote work will be) is yet to be determined. Many cities pursuing greater economic development are considering how they will need to change traditional incentive programs, housing distribution, and urban space planning, to name just a few examples. Data to measure the extent of COVID-19's impact is also emerging. Figure 26 shows the percentage of growth in population in the post-pandemic period (combined domestic and international migration, excluding natural growth). It compares key cities in the Atlantic provinces and select cities across the rest of Canada, and shows that even when international migration to Canada dropped significantly due to the pandemic, most cities in Atlantic Canada saw a significant jump in the relative contribution of migration to population growth.

MIGRATION AS A CONTRIBUTOR TO POPULATION GROWTH

Percentage growth in population between July 2020 and July 2021 caused by domestic and international migration in key cities in the Atlantic provinces and rest of Canada.

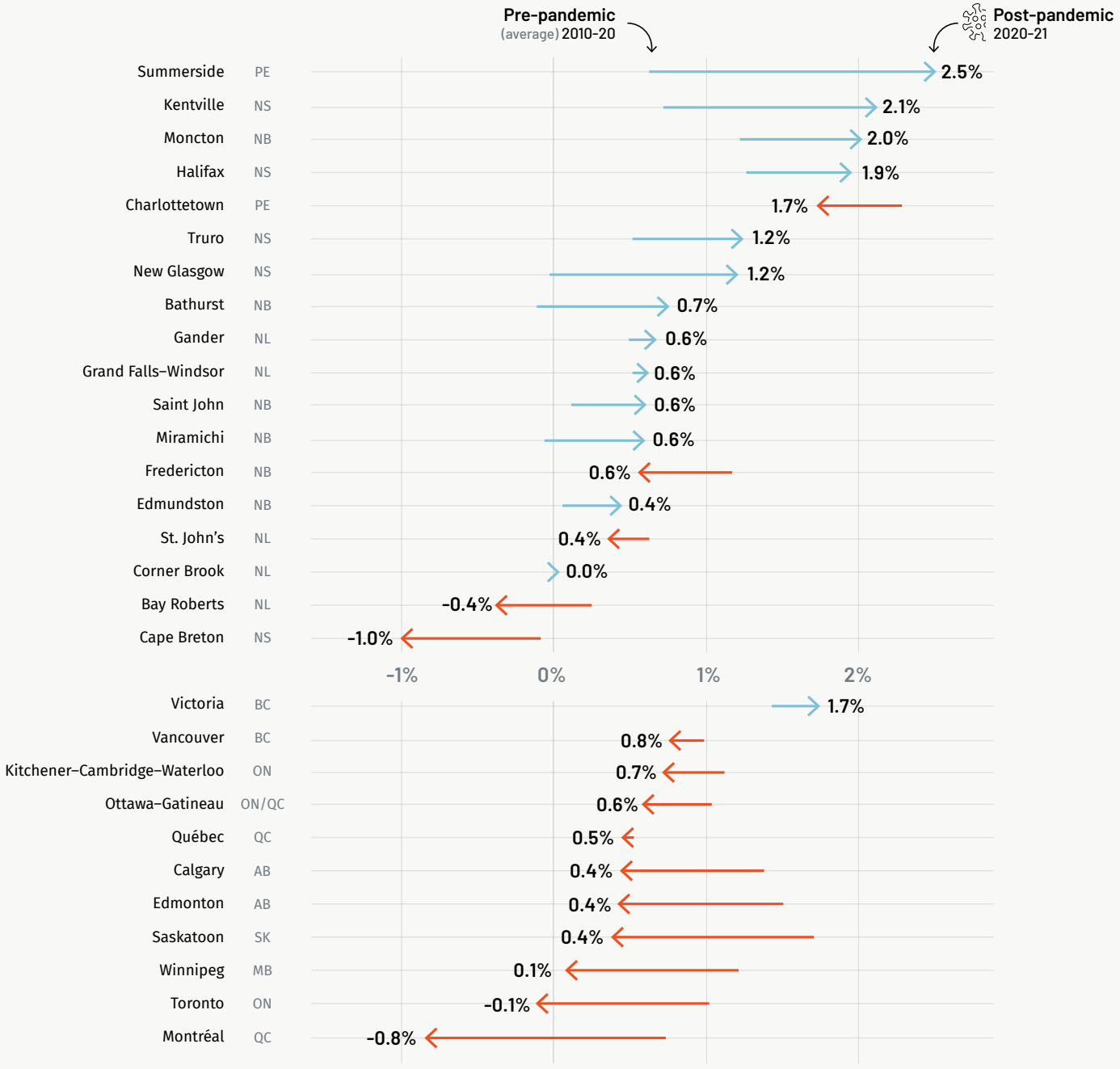


Figure 26: Size and direction of the arrow marks the deviation in post-pandemic migration (2020–21) compared to the average trend in pre-pandemic decade (2010–20). Statistics Canada, 2021.

Population centres in Atlantic Canada saw a net increase in migration (domestic and international), suggesting that this growth comes from more than one source and attraction initiative. Figure 27 takes a closer look at the relative contribution to domestic and international migration in Atlantic Canada by census division.

Domestic migration might be a result of the aforementioned campaign in some Atlantic provinces to attract remote workers during the pandemic, while international migration might result from targeted programs such as the PNPs. Both domestic and international migration have increased in population centres in Atlantic Canada, as well as in regions immediately surrounding the key cities in the Maritimes.

ATLANTIC CANADA: MIGRATION AS A CONTRIBUTOR TO POPULATION GROWTH

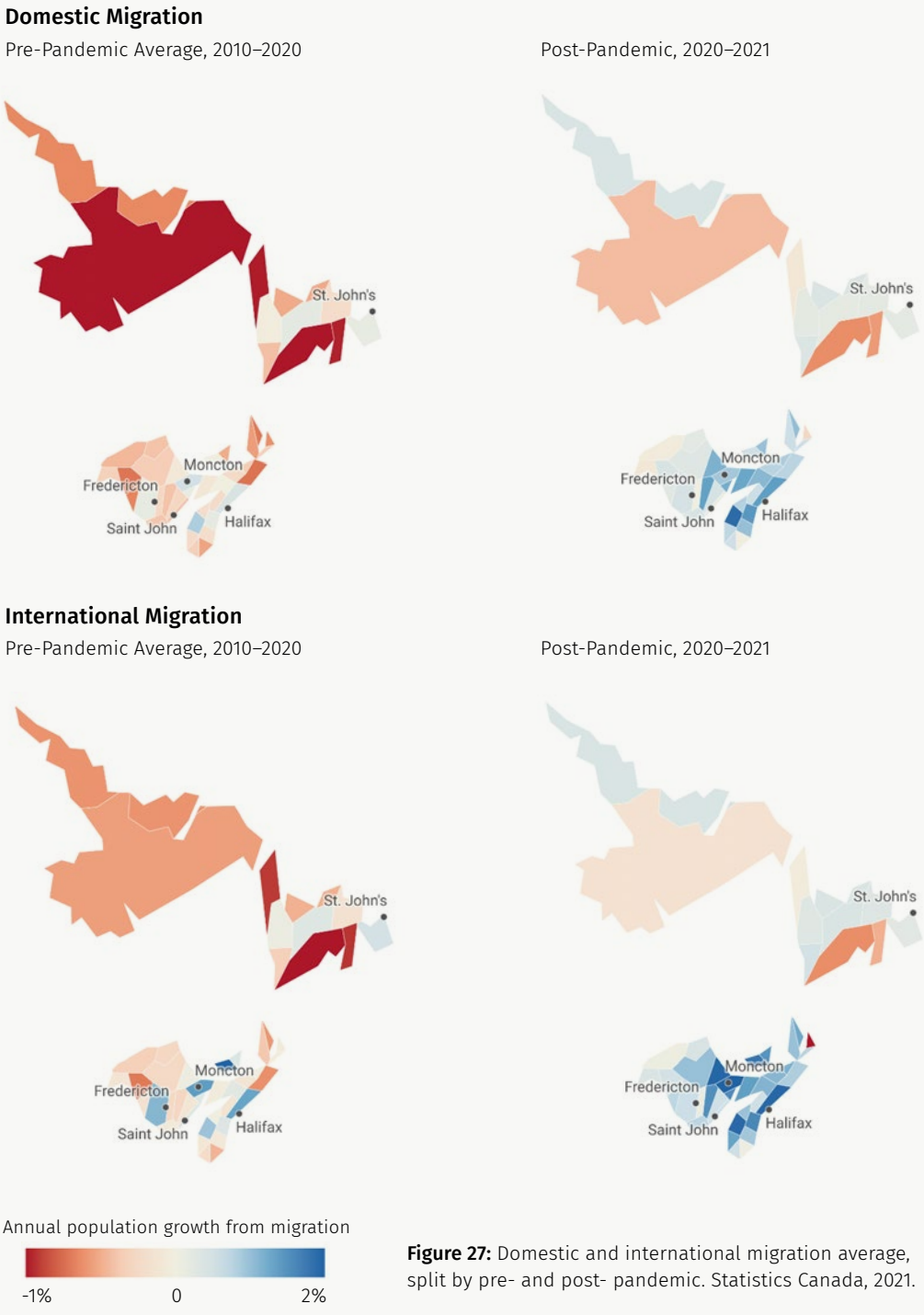


Figure 27: Domestic and international migration average, split by pre- and post- pandemic. Statistics Canada, 2021.

Atlantic Canada is showing signs of great success in attracting new residents: however, housing affordability may threaten this trend. From May 2021 to May 2022, the benchmark housing price in New Brunswick went up by 29.8%; 31.7% in Nova Scotia; 18.7% in Prince Edward Island; and 9.2% in Newfoundland and Labrador. In comparison, Vancouver and Toronto, known to be two of Canada's highest housing markets, went up by 14.7% and 23.9% respectively.[170] Importantly, while median income in the Atlantic provinces remains well below that of Ontario and British Columbia,[171] average rent in Halifax is also below Vancouver's (the most recent estimate available for 2022 suggests that a one-bedroom unit in Halifax is $1,602, compared with $2,176 in Vancouver and $2,013 in Toronto).[172]

In the long run, immigration retention rates in Atlantic cities will indicate whether this growth has stuck post-pandemic—a question that it is too soon to answer. Cities that achieve high net immigration may be victims of their own success if population increases faster than housing supply, essential services such as healthcare, and amenities. If low housing supply drives up the cost of living, smaller cities lose the attractive element of affordable quality of life—essential to building a smart city, retaining a diverse population, and knowledge workers.

Balancing Quality of Life and a Smart City in Halifax – Municipal Priorities

In ICTC's "Let's Talk Smart Cities" virtual engagement session with the City of Halifax (March 30, 2021), respondents emphasized resident-centred design; food security and sustainability; and improved mobility. Quality of life was a high priority for participants, who named "thriving public spaces," a "connected, intelligent and forward-thinking city that improves quality of life," and "No Haligonian left behind" as cornerstones of what they thought of as a "Smart Halifax." In the same session, participants said that housing and infrastructure to support new Halifax residents would be challenge.[173]

170 "National Price Map," Canadian Real Estate Association, accessed June 21, 2022, https://www.crea.ca/housing-market-stats/national-price-map/

171 For example, in 2020, median after-tax household income in the Atlantic Provinces was 57,800, compared with $70,100 in Ontario and $67,500 in British Columbia. See Statistics Canada, Table 11-10-0190-01, "Market income, government transfers, total income, income tax and after-tax income by economic family type," March 23, 2022, https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1110019001

172 Erica Alini and John Sopinski, Globe and Mail (source: rentals.ca listings and globe and mail calculations), accessed July 5, 2022, via https://www.blogto.com/real-estate-toronto/2022/02/how-much-money-need-to-earn-afford-rent-toronto-apartment/

173 Tyler Farmer, "Let's Talk Smart Cities: Halifax Regional Municipality," Digital Think Tank by ICTC, 2021, https://medium.com/digitalthinktankictc/lets-talk-smart-cities-halifax-regional-municipality-bd11d2dc7f0e

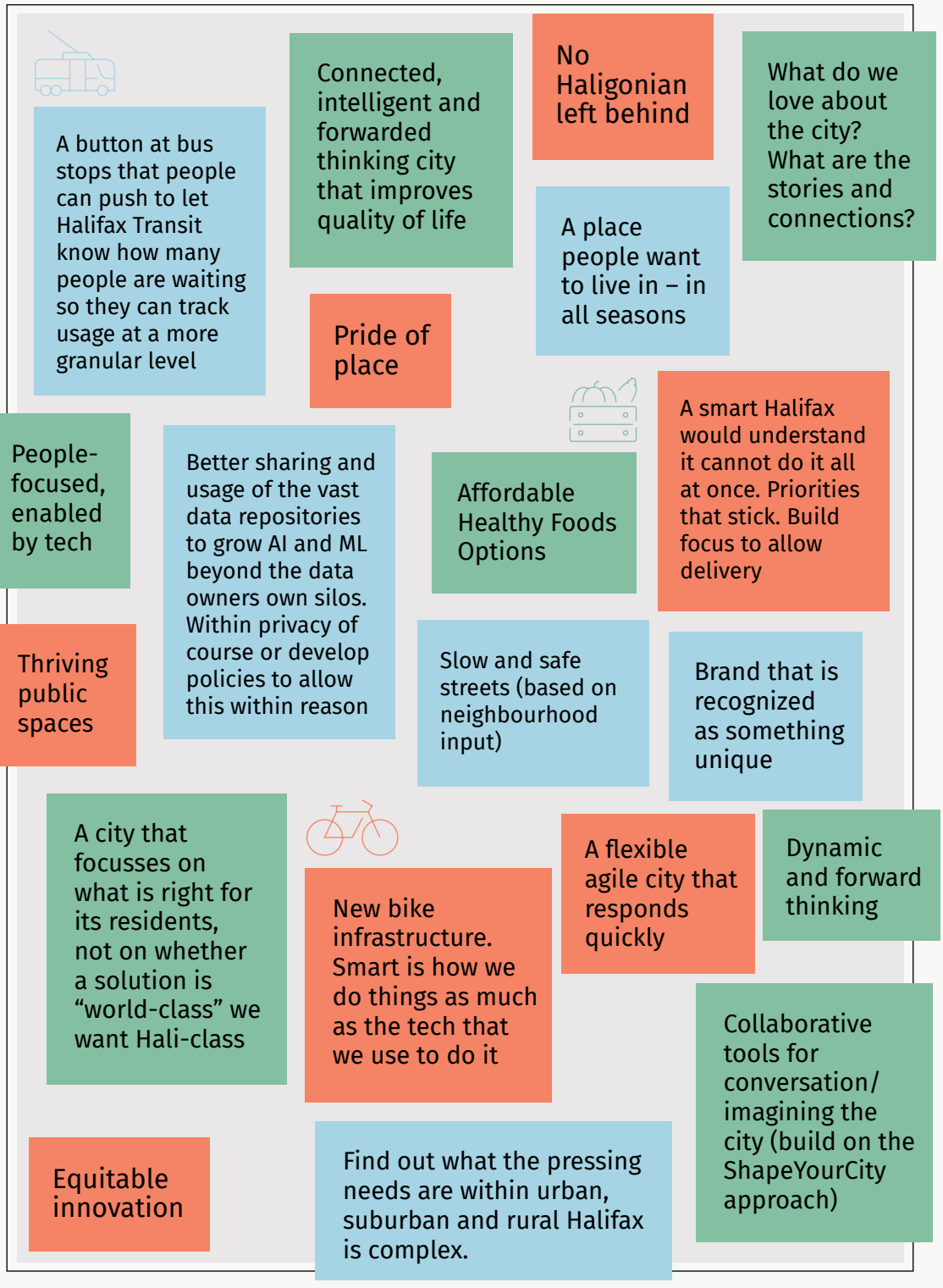


Figure 28: Group commentary on Google Jamboard (digital engagement tool). Halifax Smart Cities virtual public engagement session, ICTC 2021.

In Halifax's Economic Growth Plan, the city names lifestyle, technology and innovation, and education as key elements of its value proposition, and names core goals that show clear parallels to the actions that economic development officers recommended in making a smart city:

- **Promoting and Maximizing Growth** by making Halifax better for businesses, supporting post-pandemic economic recovery, increasing housing stock, and other measures
- **Attracting and Retaining Talent** by connecting immigrants to settlement services, combatting systemic barriers to workplace involvement, and other measures
- **Making Halifax a Better Place to Live and Work** by encouraging arts, culture, recreation, and public spaces; improving environmental sustainability; improving mobility; and strengthening "the dynamism of our downtowns, main streets, and rural centres"[174]

Issues such as credential recognition for internationally educated professionals, housing affordability, access to transit, and vibrant public spaces and infrastructure thus take centre stage for cities like Halifax for a number of reasons. Beyond developing the talent supply for a smart city, such policies are essential to sustainable economic development and fostering a burgeoning technology sector. As the Halifax Index, a public data initiative started to monitor goal progress, continues to publish figures evaluating the city's strides in achieving its goals, Halifax will continue to be an interesting case study in smart city development policies, challenges, and successes.

174 "People, Planet, Prosperity: Halifax's Inclusive Economic Strategy 2022-2077," (Halifax, NS: Halifax Regional Municipality, March 2022), https://halifaxpartnership.com/sites/default/uploads/People.Planet.Prosperity.Halifaxs-Inclusive-Economic-Strategy-2022-27-Mar-23.pdf

Conclusion

In investigating pathways into smart city careers, this paper finds that a city must support its talent in more than one way: employment is only part of the equation. Affordability, housing and food security, and quality of life are all essential to a smart city. Across Canada, these issues have increasingly appeared in ICTC's public engagement sessions and may be the most urgent needs for a true smart city to tackle.

In addition, several areas of ongoing study will be important for Canada as it continues to develop and retain a well-educated workforce. First, traditional post-secondary education may be at a crossroads, hastened by remote education and growing competition among education providers during the COVID-19 pandemic. Furthermore, alternatives to four-year degrees are proliferating, including shorter vocational programs and micro-credentials. As some universities and colleges adjust their programming while other types of credentials acquire recognition, the learning and labour market outcomes associated with each merit ongoing investigation, including a particular focus on human and transferable skills, as well as accessibility and diversity in each type of program. Current efforts to develop standards for shorter-term credentials may help raise their value in the hiring process, but more research should be conducted into their effectiveness and inclusivity. Second, municipal economic development and urban planning are sizable, multi-variate experiments: as crucial issues like housing affordability grow in urgency in Canada, cities will need to monitor the ongoing impact of COVID-19 on labour mobility and living patterns.

In short, this study finds that in order to develop, attract, and retain talent supply, a city must also guarantee that its residents can live well and securely. Strong and diverse educational institutions, collaborations between sectors (including schools, industry, the public, and the public sector), appealing and open public spaces, and affordable options for living are the foundations upon which a smart city is built.

Appendix A:
Research Methods and Tools

This report marks the end of a multi-year study on smart cities in Canada. Along with its sister report on labour demand in smart cities, it explores the skills, programs, and workforce development tools needed to supply smart city projects in Canada with talent. The supply project has been overseen by a Smart Cities Supply Taskforce, quoted throughout this study and acknowledged in the introduction. Furthermore, it has drawn from extensive primary and secondary research.

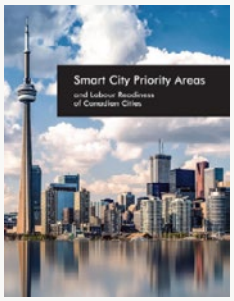
Other Reports in the ICTC Smart Cities Series

Cutean, Alexandra, and Tyler Farmer. "**Essential Infrastructure for the Smart Economy ICTC Smart Cities Roundtables: Smart Infrastructure**." Ottawa, ON: Information and Communications Technology Council (ICTC), February 2020.

https://www.digitalthinktankictc.com/policy-briefs/essential-infrastructure-for-the-smart-economy

Cutean, Alexandra, Rosina Hamoni, and Trevor Quan. "**Collectively Building the Framework to Shape Our Future Cities: A Year of Engagement with the ICTC Smart Cities Taskforces**." Information and Communications Technology Council, March 2020.

https://www.ictc-ctic.ca/wp-content/uploads/2020/04/Smart-Cities-Engagement-Report-FINAL1.ENG_.pdf



Cutean, Alexandra, Trevor Quan, and Holly Brown. "**Smart City Priority Areas and Labour Readiness of Canadian Cities**." Ottawa, ON: Information and Communications Technology Council (ICTC), August 2019.

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Farmer, Tyler, Mairead Matthews, and Faun Rice. "**Procurement Office or 'Living Lab?**' Experimenting with Procurement and Partnerships for Smart Cities Technologies in Canada." Ottawa, ON: Information and Communications Technology Council, February 2021.

https://www.ictc-ctic.ca/wp-content/uploads/2021/03/ICTC_Report_SmartCities_ENG.pdf

Hamoni, Rosina, Mairead Matthews, and Maya Watson. "**Smart Health and Wellbeing: A Canadian Policy Roundtable**," March 2022.

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Ivus, Maryna, and Peter Taillon. "**Smart Mobility in the Future City ICTC Smart Cities Roundtable on Smart Mobility in Canada**." Ottawa, ON: Information and Communications Technology Council (ICTC), June 2021.

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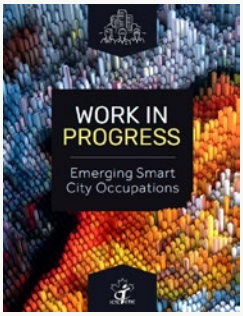

Kotak, Akshay, and Khiran O'Neill. "**Work in Progress: Emerging Smart City Occupations**." Ottawa: Information and Communications Technology Council, August 2021.

https://www.digitalthinktankictc.com/reports/work-in-progress

Martell, Tracy, and Trevor Quan. "**Smart Developments at Home and Abroad: Smart Cities Monitoring Report 2019-2020**." Ottawa, ON: Information and Communications Technology Council, September 2020.

https://www.ictc-ctic.ca/wp-content/uploads/2020/10/SC-Monitoring-ENG-Oct15.pdf.pdf

Matthews, Mairead, and Khiran O'Neill. "**Smart Cities, Smart Government ICTC Policy Roundtable on Smart Government in Canada**." Ottawa, ON: Information and Communications Technology Council (ICTC), July 2021.

https://www.digitalthinktankictc.com/policy-briefs/smart-cities-smart-government

Matthews, Mairead, and Faun Rice. "**Designing Smart and Sustainable Communities: ICTC Smart Cities Roundtables, Smart Energy and Environment**." Ottawa, ON: Information and Communications Technology Council, February 2021.

https://www.ictc-ctic.ca/wp-content/uploads/2021/03/Smart-Energy-and-Environment-English-FINAL.pdf

Quan, Trevor, and Zhenzhen Ye. "**Lessons from Abroad: Smart Cities Developments from the European Region**." Ottawa, ON: Information and Communications Technology Council (ICTC), April 2022.

https://www.digitalthinktankictc.com/policy-briefs/lessons-from-abroad

Rice, Faun. "**Transformative Technologies for Smart Canadian Cities**." Ottawa, ON: Information and Communications Technology Council (ICTC), September 2019.

https://www.digitalthinktankictc.com/policy-briefs/transformative-technologies

Rice, Faun, Maya Watson, and Phil Dawson. "**Building Human Rights into Intelligent Community Design A Focus on Canada**." Ottawa, ON: Information and Communications Technology Council (ICTC), April 2022.

https://www.digitalthinktankictc.com/policy-briefs/building-human-rights-into-intelligent-community-design

Furthermore, to visit the full summaries of ICTC's series of public engagements, visit:

The ICTC Research and Policy Website at: https://www.digitalthinktankictc.com/articles/

The ICTC Research and Policy Medium publication at: https://medium.com/digitalthinktankictc

Secondary Research

Literature review

The qualitative and quantitative portions of this project are supported by a thorough review of available literature. The literature review helped shape research methodology and questions and provide information to help further validate findings in this report. The initial literature review helped identify advisory committee participations, focus group participants, and interviewees for the research.

Primary Research

Surveys Informing this Study

Several surveys, listed below are featured in the study.

Name	Population	Abridged name	Data Collection	Sample
ICTC Survey of Employers: Perspectives on Diversity, Equity, and Inclusion	Hiring decision-makers in Technology, Financial Services, Engineering, Technical & Professional Services	Employer DEI Survey	2020	1,000
ICTC Survey of Smart City Employers' Perceptions of Career Transitions and Credentials	Hiring decision-makers in Smart Cities Occupations*	Smart City Employer Survey	2021	404
ICTC Survey of Recent and Future Graduates in Smart Cities-Related Fields	Soon-to-be and recent graduates who want to work in (or are working in) Smart Cities Occupations*	Smart City Graduate Survey	2021	601
ICTC Survey of Employer Perceptions of Human or Soft Skills	Hiring decision-makers across the economy	Human Skills Survey	2021	400

*Smart Cities Occupations = Health Technology; Augmented/Virtual Reality & Gaming; Smart Mobility; Artificial Intelligence, Machine Learning, and Human-Computer Interaction; Business and Policy Analysis; Agricultural Technology (e.g., vertical farming); Urban Design & Sustainability; Clean Technology; Hardware Design and Development; Web or Software Development; IT Operations; Cybersecurity; Data Science; Cloud Computing & Databases.

Smart Cities Supply Taskforce

Over the course of the Inclusive Smart Economy project (2019–2022), the Smart Cities Supply Taskforce met on average bi-annually, at first in person and then virtually. It was comprised of 27 members of educational institutions, smart city consultants and professionals, persons with expertise in migration, workplace diversity, career transitions, and other members of industry and civil society. Taskforce members advised on research directions and methods, and heard reports of findings and offered commentary. Some taskforce meetings were held as generative, discussion-based focus group sessions, and these were incorporated into the study's qualitative thematic analysis.

Focus Group of Municipal Economic Development Officers

In April 2021, ICTC hosted a virtual focus group with nine municipal development officers across Canada (specifically, Ontario, British Columbia, Yukon, Saskatchewan). The participants specialized in a variety of topics including smart cities, immigration, economic development, and communications. Questions asked who populates a smart city, along with relevant attraction and retention strategies. The authors conducted a thematic analysis of focus group transcripts to inform the final paper.

Interviews

Informed by the literature and secondary data review, ICTC conducted 10 semi-structured interviews with three groups of respondents with subject matter experts in education, smart cities, and the gig economy. Interviews were conducted from May 2021 to July 2021. Each interview was between 30 minutes and one hour long. The authors conducted a thematic analysis of interview transcripts to inform the final paper.

Research Limitations and Opportunities for Further Investigation

ICTC offers micro-credentials and WIL programming, an important potential bias when describing these types of education. Further, the methods used in this study have several limitations. Primarily, the surveys of employers and graduates across Canada were conducted through online panels and are limited to respondents with internet access. Where reference population distributions were available from Statistics Canada or other sources, responses were appropriately weighted. However, often times there isn't a reasonable estimate of the underlying distribution of the populations being studied and, in this case, conclusions from the sample are limited to respondents and cannot necessarily be taken as representative of students and employers across Canada. Further, the topic of smart cities supply is of significant scope, and there are several opportunities for further investigation that this study does not address. Discussion of youth education and secondary education was deemed out of scope but was identified by taskforce members as significant for building interest and aptitude in technology-related skills. Finally, data sources informing prevalence of remote work after COVID-19 and migration patterns for 2022 forward are limited and emerging, and ongoing investigation will help address some of the questions raised in this study around municipal economic development, resettlement, retention, and affordability.