BC COLLEGES

ACCESSIBLE. AFFORDABLE. APPLIED.

TRANSFORMING FOR TOMORROW

BC Colleges: Creating Opportunities for All

KEY FINDINGS

CAMOSUN COLLEGE

College of New Caledonia
CNC

Northern Lights College

NORTH ISLAND COLLEGE

Selkirk College

coast mountain college

COLLEGE OF THE ROCKIES

VANCOUVER COMMUNITY COLLEGE

okanagan college

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INTRODUCTION

The purpose of this document is to present Key Findings from relevant sources that were considered in the development "Transforming For Tomorrow: BC Colleges Adapt For The Future".

Between June and October 2018, the project team collated and read over forty substantive research reports and articles – the majority recommended to us during discussions with key stakeholders.

The primary subject of these materials was about the Future of Work and its potential impact on the Post Secondary education system, the students, and learning spaces. While many of the research reports and articles were of Canadian origin, a number came from international sources. Most provided substantial bibliographies on their research sources and data.

The project team employed a current post secondary student to help select Key Findings from their perspective. As such, the content of this document is not intended to replicate the original sources or be a comprehensive summary of research findings. The aim is to highlight some relevant facts and perspectives (with footnotes) that pertain to BC Colleges adapting for the future, that may enable the reader to decide if further review and research would help their understanding of the subject. All of the research reports and articles reviewed are available in full should any reader wish to read them.

Transformation begins with awareness followed by interest. We hope this document grows both for the future benefit of BC's colleges, it students, and community partners.

RELEVANT STUDIES & REPORTS

The following are the research resources identified by the project team to understand current thinking and leading practices with regards to the future of work, the emerging economy, innovation programs at colleges and optimum student learning spaces at institutions. These reports are the source of the Key Findings in this document.

These resources are all available in full online.

REPORT SOURCE	REPORT TITLE	RELEASED
Advisory Council on Economic Growth	The Path to Prosperity: Resetting Canada's Growth Trajectory	Dec-17
Advisory Council on Economic Growth	Building a Highly Skilled and Resilient Canadian Workforce Through the FutureSkills Lab	Feb-17
Advisory Council on Economic Growth	Ideas into Action: A Review of Progress Made on the Recommendations of the Advisory Council on Economic Growth	Dec-17
Advisory Council on Economic Growth	Investing in a Resilient Canadian Economy	Dec-17
Advisory Council on Economic Growth	Learning Nation: Equipping Canada's Workforce with Skills for the Future	Dec-17
BCARIN	Applied Research Success Stories	Dec-16
BCARIN	Building Innovation Across British Columbia	Dec-16
Business/Higher Education Roundtable by the Business Council of Canada	Taking the Pulse of Work-Integrated Learning in Canada	Apr-15
Business Council of BC	Scaling Up Talent in a Disruptive World	Nov-01
Colleges and Institutes Canada	Applied Research: Partnered Innovation for Businesses and Communities	2017
CICan & McConnell Foundation	Presidents' Roundtable: Building Social Infrastructure	Oct-01
Colleges and Institutes Canada	Highlights from the 2015-2016 CICan Applied Research Survey	May-17
Conference Board of Canada	Developing your Employability Skills: Toolkit for the Self-Managing Learner	Oct-17
Deloitte	The Future Belongs to the Bold: Canada Needs for Courage	2017
Deloitte	The Intelligence Revolution: Future-proofing Canada's Workforce	Oct-17
Deloitte	Age of Disruption: Are Canadian Firms Prepared?	Jun-17
Deloitte	Bold Bets for our Country: It's Time for Deliberate Action	Jun-17

REPORT SOURCE	REPORT TITLE	RELEASED
Information & Communications Technology Council	Digital Economy Talent Supply: Indigenous Peoples of Canada	2017
Institute for the Future for the University of Phoenix Research Institute	Future Work Skills 2020	Jul-09
Ministry of Jobs, Tourism and Skills Training	Labour Market Outlook 2018	2018
McKinsey	Education to employment: Designing a System that Works	Jan-13
McKinsey	Education to employment: Getting Europe's Youth into Work	Jan-14
McKinsey	Jobs Lost, Jobs Gained: Workforce Transitions	Dec-17
McKinsey	Technology, Jobs, and the Future of Work (Briefing Note)	May-17
Okanagan College	Keynote: The Digital Age Re-Energizes Electrician Apprenticeship Training in British Columbia	Oct-17
Planning for Higher Education Journal	Assessing the True Cost of Student Housing for community Colleges	Jul-Sep-13
Planning for Higher Education Journal	Community Colleges - Partners in Community Development	Oct-Dec-16
Planning for Higher Education Journal	Symbiosis	Oct-Dec-16
Planning for Higher Education Journal	The Library as Learning Commons	Apr-Jun-18
Planning for Higher Education Journal	Campus Renewal: Working with What You've Got	Apr-Jun-18
Royal Bank of Canada	Humans Wanted	Mar-18
Rita McGrath Group	Breaking up the Degree Stranglehold: Disruption in Higher Ed — Credentials by Skills Learned not Degrees	Jun-18
Society for College & University Planning, USA	Academy Report 2014	2014
Society for College & University Planning, USA	Kings of Infinite Space	2012
Society for College & University Planning, USA	Trends for Higher Education, Fall 2015: Looking at the External Environment	Fall 2015
Society for College & University Planning, USA	Trends for Higher Education, Spring 2016: Are You Prepared for Tomorrow's Students?	Spring 2016
Society for College & University Planning, USA	Trends for Higher Education, Fall 2016: The Future of Learning	Fall 2016

REPORT SOURCE	REPORT TITLE	RELEASED
Society for College & University Planning, USA	Trends for Higher Education, Spring 2017: Evolution of Higher Education	Spring 2017
Society for College & University Planning, USA	Trends for Higher Education, Fall 2017: Implications from the External Environment	Fall 2017
Society for College & University Planning, USA	Trends for Higher Education, Spring 2018: Evolution of Higher Education	Spring 2018
Stantec	Designing the Ultimate Campus Experience	2018
Work BC	BC's Skills for Jobs Blueprint: Re-engineering Education and Training	2014

KEY FINDINGS

EMERGING ECONOMY

- Where we're headed in terms of work, employment, productivity; the future of work. Deloitte calls it the Gig Economy: a fragmented workplace that tosses the "one job, one career, one employer" model out the window, but that also creates never-before-seen opportunities for people in the workforce.[1]

- A fragmented workplace and workforce. Workers operate on "gigs." Deloitte says the gig economy changes the nature of work, because participants act as both employees and self-employers, scheduling their work based on their own availability, not a corporate time clock.[2]

- Under the larger umbrella of the Internet of Things (IoT), social, mobile, apps, analytics, and cloud (SMAAC) technologies continue to reshape every facet of the Canadian economy and society. It is expected that in the next several years, these five key technology drivers will cause the greatest disruption in the digital economy.[3]

- Businesses need to understand and utilize Labour Market Information better.[4]

- Nationally, we can benefit from a move to a skills-based system that is tied to the EU qualification system that allows mobility in all directions.[5]

- By 2030, Canada is expected to see a significantly increased dependency ratio, with an expected ratio of over 70 Canadians over age 65 or under age 15 for every 100 Canadians between 15 and 65.[6]

- A general movement away from training for routine, repetitive tasks and towards non-routine and more complex activities, along with better planning around the adoption of appropriate technology as it becomes available.[7]

- Incumbents in industries as diverse as automotive manufacturing, financial services, and entertainment are under attack by new challengers such as Tesla, Wealthsimple, and Netflix.[8]

- The gig economy changes the nature of work, because participants act as both employees and self-employers, scheduling their work based on their own availability, not a corporate time clock.[9]

- The emergence of the gig economy is also leading to the rise of a major new workforce segment: contingent workers. These are independent contractors, freelancers, consultants, crowdsourced workers, or other off-the-books workers who join firms to complete a specific task and then move on to the next project.[10]

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1   Deloitte, *The Intelligence Revolution: Future-Proofing Canada's Workforce* (p. 9)

2   Deloitte, *The Intelligence Revolution: Future-Proofing Canada's Workforce* (p. 9)

3   The Information and Communications Technology Council, *Digital Economy Talent Supply: Indigenous Peoples of Canada* (2017) (p. 1)

4   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 10)

5   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 10)

6   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 23)

7   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 42)

8   Advisory Council on Economic Growth, *Investing in a Resilient Canadian Economy* (December 1, 2017) (p. 2)

9   Deloitte, *The Intelligence Revolution: Future-Proofing Canada's Workforce* (p. 9)

10   Deloitte, *The Intelligence Revolution: Future-Proofing Canada's Workforce* (p. 16)

- Since 1997, Canada's contingent workforce has grown from 4.8 million to 6.1 million. It now accounts for about one-third of all jobs, and is likely to keep growing. In fact, according to Statistics Canada, more than 90 percent of jobs created in 2015 and 2016 were temporary positions.[11]

- Although some Canadians may join the contingent workforce because they enjoy the variety and flexibility, others only turn to it because traditional jobs are becoming more scarce.[12]

• Deloitte research suggests that Canadian companies are typically underprepared for the shifts. They've narrowed down the essentials for preparedness:

- After speaking with business leaders, consulting frameworks from a number of key thinkers and researching successful, sustainably innovative companies, Deloitte has settled on four key elements of a prepared company: awareness, culture, organizational agility and resources.[13]

- A new generation of automated systems will replace humans, freeing us up to do the things we are good at and actually enjoy. In other domains, the machines will become our collaborators, augmenting our own skills and abilities. Smart machines will also establish new expectations and standards of performance.[14]

• **Six Drivers of Change** (as named and listed by the Institute for the Future for the University of Phoenix Research Institute):

- **Extreme Longevity**: Increasing global lifespans change the nature of careers and learning.[15]

- **Rise of smart machines and systems**: Workplace automation nudges human workers out of rote, repetitive tasks.[16]

- **Computational world**: Massive increases in sensors and processing power make the world a programmable system. [17]

- **New media ecology**: New communication tools require new media literacies beyond text.[18]

- **Super-structured organizations**: Social technologies drive new forms of production and value creation.[19]

- **Globally connected world**: Increased global interconnectivity puts diversity and adaptability at the centre of organizational operations.[20]

• The shift in value from physical to digital information goods—already reflected in financial markets—will only increase. Technology is now the largest sector of the world economy,

11   Deloitte, The Intelligence Revolution: Future-Proofing Canada's Workforce (p. 16)

12   Deloitte, *The Intelligence Revolution: Future-Proofing Canada's Workforce* (p. 17)

13   Deloitte, *Age of Disruption: Are Canadian Firms Prepared?* (p. 21)

14   Institute for the Future for the University of Phoenix Research Institute, *Future Work Skills 2020* (2011) (p. 3)

15   Institute for the Future for the University of Phoenix Research Institute, *Future Work Skills 2020* (2011) (p. 3)

16   Institute for the Future for the University of Phoenix Research Institute, Future Work Skills 2020 (2011) (p. 3)

17   Institute for the Future for the University of Phoenix Research Institute, *Future Work Skills 2020* (2011) (p. 4)

18   Institute for the Future for the University of Phoenix Research Institute, *Future Work Skills 2020* (2011) (p. 4)

19   Institute for the Future for the University of Phoenix Research Institute, Future Work Skills 2020 (2011) (p. 5)

20   Institute for the Future for the University of Phoenix Research Institute, Future Work Skills 2020 (2011) (p. 5)

eclipsing even financial services, and includes five of the top 20 public companies by market capitalization.5 These global phenomena are in full effect in Canada, too.[21]

- Advances in automation and digitization, combined with continued forces of globalization, are leading to fluid and mobile labour markets where employers' skills requirements evolve quickly and workers transition between jobs and industries more often than they did in the past.[22]

- 45% of paid activities can be automated, though not necessarily full jobs.[23]

- Advances in additive manufacturing, for example, are increasingly enabling manufacturers' customers to print their own parts, reducing the need for factory machines, production lines, and transportation services.[24]

- Automation is essential to maintaining living standards with an aging population and counteracting the rising dependency ratios and falling economic growth rates, adding between 0.9% to 1.5% to overall GDP growth.[25]

- It is too simplistic to draw a direct line from automation to job loss.

  - Automation may contribute to a net reduction in labour demand, but in countries that have more rapidly adopted robotics and automation, job losses were mitigated and more employment was preserved by being more competitive.[26]

  - Automation's impact may be a "transformation of jobs."[27]

- Businesses increasingly make use of digital products hosted on adaptable infrastructure, such as data centres, along with the internet connections to customers, either physical or wireless.[28]

- Training should anticipate that the same software-centred disruption will continue to happen in a wider range of industries as more digital technologies converge. These might connect together new forms of multi- purpose infrastructure, such as data centres, 3D printing, self-driving cars, autonomous drones and others.[29]

- Even as it causes declines in some occupations, automation will change many more—60 percent of occupations have at least 30 percent of constituent work activities that could be automated.[30]

- While about half of all work activities globally have the technical potential to be automated by adapting currently demonstrated technologies, the proportion of work actually displaced by 2030 will likely be lower, because of technical, economic, and social factors that affect adoption.[31]

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21   Advisory Council on Economic Growth, *The Path to Prosperity: Resetting Canada's Growth Trajectory* (December 1, 2017) (p. 2)

22   Advisory Council on Economic Growth, *Building a Highly Skilled and Resilient Canadian Workforce Through the FutureSkills Lab* (February 6, 2017) (p. 18)

23   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 10)

24   Advisory Council on Economic Growth, *Investing in a Resilient Canadian Economy* (December 1, 2017) (p. 2)

25   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 12)

26   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 8)

27   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 9)

28   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 24)

29   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 24)

30   McKinsey MGI, *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation* (December 2017) (p. ii)

31   McKinsey MGI, *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation* (December 2017) (p. ii)

- Our scenarios across 46 countries suggest that between almost zero and one- third of work activities could be displaced by 2030, with a midpoint of 15 percent.[32]

- Five technologies believed to have considerable disruptive potential: advanced robotics, artificial intelligence, networks, advanced manufacturing and collaborative connected platforms.[33]

  - Robots started to change the industrialized world more than a half century ago. Since then, they've transformed how businesses manufacture goods large and small, and replaced the need for human labour in a vast range of applications, from fulfilling warehouse orders to maintaining nuclear reactors.[34]

  - AI has evolved into a multidisciplinary field that includes not only computers and robotics but computer science, mathematics, neuroscience, linguistics and psychology.[35]

  - Integrated Services Digital Networks enabled voice and data to be transmitted simultaneously over traditional copper phone lines, sparking a technological revolution that led to widespread Internet adoption, mobile connectivity, online commerce, social media and more.[36]

  - 3D printers, nanomaterials, biomaterials, rapid prototyping, custom product creation – these advanced technologies and approaches will define 21st-century manufacturing. The days of mass-produced, one-size-fits-all goods are rapidly drawing to a close.[37]

  - Increased connectivity and Internet capacity have made crowdsourcing, crowdfunding and cloud computing possible, giving people and organizations alike access to skills, knowledge, funds and resources in ways that were never before possible.[38]

1. Workforce Development

- Education providers must focus more on what happens to their students after they leave. Specifically, they should track what happens to their graduates, both in terms of employment and job satisfaction. To improve student prospects, education providers could work more closely with employers to make sure that they are offering courses that really help young people prepare for the workplace.[39]

- We face the prospect of societal instability caused by rapid, widespread technological disruption. According to some studies, 42 percent of Canada's workforce faces substantial risk from automation in the coming years.[40]

32   McKinsey MGI, *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation* (December 2017) (p. ii)

33   Deloitte, *Age of Disruption: Are Canadian Firms Prepared?* (p. 5)

34   Deloitte, Age of Disruption: Are Canadian Firms Prepared? (p. 6)

35   Deloitte, Age of Disruption: Are Canadian Firms Prepared? (p. 8)

36   Deloitte, Age of Disruption: Are Canadian Firms Prepared? (p. 10)

37   Deloitte, Age of Disruption: Are Canadian Firms Prepared? (p. 13)

38   Deloitte, *Age of Disruption: Are Canadian Firms Prepared?* (p. 14)

39   McKinsey & Company, *Education to Employment: Getting Europe's Youth into Work* by M. Mourshed, J. Patel and K. Suder (January 2014) (p. 13)

40   Deloitte, *Bold Bets for our Country: It's Time for Deliberate Action* (June, 2017) (p. 11)

- **Which jobs will disappear?**

  ○ The impact pattern depends on the type of automation being examined. As an example of the mechanized kind, Canada has seen a loss in manufacturing employment, with present employment at roughly 76% of the level in 2002, despite employment in the economy as a whole growing by roughly 20% over the same period.[41]

  ○ In Japan, overall manufacturing today is at 86% of the levels seen in 2002, and Germany has seen similar disruptions, having fallen somewhat since the peak in 2007, and is now at 94% of that peak level.[42]

  ○ 42% of current jobs in the Canadian labour market are at high risk—lower paid jobs in particular, such as data collection, data processing, predictable physical work. Lower skilled workers have the highest vulnerability.[43]

  ○ There is a lower risk for automation in areas like stakeholder interaction/relations management, human interaction/ services, education.[44]

  ○ Regional trends in automation are affected by diversity of local labour pools—wide variations by region, with some more vulnerable than others.[45]

  ○ Osborne and Frey, in 2013, examined the U.S. labour market from an occupation- based approach and estimated that in the next 10 to 20 years, as many as 47% of U.S. jobs could be automated. Using a similar methodology, Employment and Social Development Canada (ESDC) estimated that within the Canadian economy, approximately 43.6% of occupations had a "high probability of computerization." According to these studies, occupations susceptible to automation tended to be in areas requiring less than university while occupations with a "low probability of computerization" were primarily in management, university or college-level categories.[46]

  ○ By 2031, the labour force is expected to grow to between 20.5 and 22.5 million, but the share of the population participating in the labour force is expected to fall to 59.7% and 62.6%, the lowest levels since the 1970s.[47]

  ○ The WEF estimates, "In absolute terms, men will face nearly four million job losses and 1.4 million gains, approximately one job gained for every three jobs lost, whereas women will face three million job losses and only 0.55 million gains, more than five jobs lost for every job gained."[48]

  ○ The occupations most at risk involve physical activities in highly structured environments—jobs often held by relatively low-skilled and often low-paid workers.[49]

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41 The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 7)

42 The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (pp. 7-8)

43 The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 10)

44 The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 10)

45 The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 10)

46 The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 11)

47 The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 23)

48 The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 35)

49 Advisory Council on Economic Growth, *Learning Nation: Equipping Canada's Workforce with Skills for the Future* (December 1, 2017) (p. 2)

- Advances in artificial intelligence (AI) are increasingly making it possible to automate complex cognitive tasks, putting jobs that require higher skill levels in jeopardy. Machine learning will also affect white-collar workers, particularly those who focus largely on collecting and processing data.[50]

- Dentistry, mining, graphic design, radiology, surveying, farming, sales — in the new workplace, every occupation can be disrupted.[51]

- **Which Jobs will Appear?**

  - The newer digital type of automation is summed up by the 2011 essay, *Why Software Is Eating the World*, and by participants of the Canadian Chamber's roundtables who stated, "Now, every business is a software business." Examples of this kind include the move from physical to digital media, digital finance, online sales, online work and mobile ordering.[52]

  - The high profile stories [the bankruptcy of Blockbuster in 2013, Sears in June of 2017 and music store chain HMV in January of 2017] overlook the innumerable small businesses and part-time work arrangements created online, which challenge standard definitions of "jobs." While these do raise valid concerns about stability and job quality, this also represents an opportunity for workers who would not otherwise have the chance to participate in the economy at all and allows many entrepreneurs to start a small business that they otherwise could not.[53]

  - Estimates of the connection between GDP growth and employment link a 1% increase in GDP to an increase in employment of 0.3% to 0.38%. In Canada, for a workforce of 19 million, the additional 0.9% to 1.5% GDP growth from automation would translate into between 51,000 and 108,000 additional new jobs per year.[54]

  - As machines take over more tasks, jobs performed by people will increasingly entail interacting with these machines and complementing their work.[55]

  - U.S. Small Business Administration estimates that almost two-thirds of net new jobs have been developed through small businesses (under 500 employees) over the past 17 years. Additionally, they estimate that small firms accounted for 67 percent of net new jobs from mid-2009 to 2011.[56]

  - Several trends that may serve as catalysts of future labor demand could create demand for millions of jobs by 2030. These trends include caring for others in aging societies, raising energy efficiency and meeting climate challenges, producing goods and services for the expanding consuming class, especially in developing countries, not to mention the investment in technology, infrastructure, and buildings needed in all countries.[57]

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50   Advisory Council on Economic Growth, Learning Nation: Equipping Canada's Workforce with Skills for the Future (December 1, 2017) (p. 2)

51   RBC, Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption (p. 11)

52   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 7)

53   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 9)

54   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) p. 23)

55   Advisory Council on Economic Growth, Learning Nation: Equipping Canada's Workforce with Skills for the Future (December 1, 2017) (p. 5)

56   Planning for Higher Education Journal, *Community Colleges: Partners in Community Development* (October - December 2016) (p. 33)

57   McKinsey MGI, *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation* (December 2017) (p. 1)

- While automation's displacement of labor has been visible for many years, it is more difficult to envision all the new jobs that will be created. Many of these new jobs are created indirectly and spread across different sectors and geographies.[58]

- Previous MGI research has estimated that 1 billion more people will enter the consuming class by 2025. Using external macroeconomic forecasts, we estimate that global consumption could grow by $23 trillion between 2015 and 2030, and most of this will come from the expanding consuming classes in emerging economies. As incomes rise, consumers spend more on all categories. But their spending patterns also shift, creating more jobs in areas such as consumer durables, leisure activities, financial and telecommunication services, housing, health care, and education. The effects of these new consumers will be felt not just in the countries where the income is generated, but also in economies that export to those countries. Globally, we estimate that 300 million to 365 million new jobs could be created from the impact of rising incomes.[59]

- By 2030, there will be at least 300 million more people aged 65 years and above than there were in 2014. As people age, their spending patterns shift, with a pronounced increase in spending on health care and other personal services. This will create significant demand for a range of occupations, including doctors, nurses, and health technicians, but also home health aides, personal care aides and nursing assistants in many countries, even as it reduces demand for paediatricians and primary-school teachers. Globally, we estimate heath care and related jobs from aging and rising incomes could grow by 80 million to 130 million by 2030.[60]

- Infrastructure and buildings are two areas of historic underspending that may create significant additional labor demand if action is taken to bridge infrastructure gaps and overcome housing shortages. MGI has estimated that the world needs to invest about 3.8 percent of GDP annually, or an average of $3.3 trillion per year to fill infrastructure gaps, compared with $2.5 trillion currently.[61]

- Investments in renewable energy, such as wind and solar, energy efficiency technologies, and adaptation and mitigation of climate change may create new demand for workers in a range of occupations, including in manufacturing, construction, and installation.[62]

- The last trend we consider is the potential to pay for services that substitute for currently unpaid and primarily domestic work—including cooking, childcare, and cleaning. This so-called "marketization of previously unpaid work" is already prevalent in advanced economies, and rising female labor force participation worldwide could accelerate the trend. About 75 percent of the world's total unpaid care is undertaken by women and amounts to as much as $10 trillion of output per year, roughly equivalent to 13 percent of global GDP.[63]

- Across all countries, the categories with the highest percentage job growth net of automation include health-care providers; professionals such as engineers, scientists, accountants, and analysts; IT professionals and other technology specialists; managers and executives, whose work cannot easily be replaced by machines; educators,

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58   McKinsey MGI, *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation* (December 2017) (p. 6)

59   McKinsey MGI, *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation* (December 2017) (p. 6)

60   McKinsey MGI, *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation* (December 2017) (pp. 6-7)

61   McKinsey MGI, *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation* (December 2017) (p. 8)

62   McKinsey MGI, *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation* (December 2017) (p. 8)

63   McKinsey MGI, *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation* (December 2017) (p. 8)

especially in emerging economies with young populations; and "creatives," a small but growing category of artists, performers, and entertainers who will be in demand as rising incomes create more demand for leisure and recreation.[64]

◦ If Canada wants to be the home of emerging companies, then it needs to ensure it has the people to build and maintain it. This requires a mix of workers with newly emerging qualifications in university, college and skilled trades, working in fields such as power, telecommunications, construction and various forms of engineering. These are the kind of technical, job-specific skills that require a high level of coordination between businesses and educators.[65]

  » **Deloitte predicts 8 job "archetypes"** for the future of work:[66]

  » **The Protector** provides the human element machines cannot deliver, demonstrating qualities like empathy and judgment, especially in stressful situations when trust is critical.

  » **The Innovator** is an idea-generator who can think creatively, thrive in ambiguity, and operate in rapidly evolving environments by anticipating problems.

  » **The Influencer** demonstrates the broad leadership capacity to inspire others, drive innovation, and challenge the status quo in the face of disruptive change.

  » **The Integrator** connects systems and people to create competitive advantage. As technological disruption causes work to become more fragmented, Integrators will be needed to bring together new combinations of machines and people in ways that engage employees and deliver business results.

  » **The Scorekeeper** develops and implements organizational controls, including policies, rules, and standards that guide people and, increasingly, machines. Scorekeepers will help orchestrate the controls to ensure the workforce aligns with organizational goals.

  » **The Performer** is a master of creative expression in all forms, using new technologies to deliver entertainment in more innovative and accessible ways.

  » **The Builder** implements the systems, programs, and processes to create both physical and virtual assets. Builders will be needed for the immense task of integrating AI and robotics into a cohesive workforce operating side-by-side with people.

  » **The Curator** designs and delivers highly tailored, customer-centric experiences. Curators will be essential to entrepreneurs and startups, helping them evaluate markets, understand customers, and develop products and services people want the transition; displacement and training; concerning the shift

◦ Waiting until after employees lose their jobs to automation and relying on traditional full-length programs could mean a training challenge affecting hundreds of thousands of people and costing an estimated $6-18 billion per year.[67]

◦ Government support for employee development requires updating funding mechanisms for training to recognize the various educational pathways and ensure quality and access. The measurement of the skills and competencies needed in the workforce, the

64   McKinsey MGI, *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation* (December 2017) (p. 9)

65   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 24)

66   Deloitte, *The Intelligence Revolution: Future-Proofing Canada's Workforce* (pp. 6-7)

67   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 5)

transferability of qualifications and more flexibility for educational institutions can all support the workforce adaptation for future technology.[68]

○ Between 390,000 to 1.7 million Canadians may need to be fully retrained into new fields as their prior employment may cease to exist, while 6.6 million to 11 million workers may require additional training in order to remain employed in their present positions as technology transforms their occupation.[69]

• Canada's skills development infrastructure is simply not equipped to meet the challenges that lie ahead. Our system today rests primarily on two pillars. The first one supports the development of skills before people enter the workforce, through K-12 and post-secondary education. The second pillar supports individuals when they leave the workforce, by providing assistance to the unemployed and the retired. That leaves a large gap in institutional support and training during Canadians' most productive years—and it is in this phase that workers will be most affected by the labour market turmoil. While our system has served us well in a relatively stable environment to date, it is not set up to address the coming labour-market disruptions.[70]

○ Canada urgently needs a third pillar that focuses on supporting working adults. The Council anticipates that managing the expected labour market changes will require an additional $15 billion of annual investments in adult skills development.[71]

• The cost of retraining depends on the assumptions about the level and intensity of training. According to most of the estimates, the largest changes will happen to lower-skilled jobs that do not require higher education, and expansions of demand will most likely happen in areas that require some kind of post-secondary qualification or formal training.[72]

• If retraining does not occur until after workers have already been displaced, the budget impacts could be substantial. Assume those facing the elimination of their employment require a full two years of full-time training (the duration of a two-year college program or a two-year postgraduate degree), and those facing transformation will require an average of one year of full-time training (the duration of a shorter credential). When the cost of living is considered, the estimated cost of one year of attending higher education, according to the Canadian University Survey Consortium, is approximately $15,798 per year.[73]

• Studying while working drastically reduces this figure. If we assume these workers can take the same educational programs while still in employment and pay only the average undergraduate tuition in Canada of $6,37327 for each year of study, the figures are less than half of the above amount.[74]

• The need for specific technical skills in employment is equally echoed in the Burning Glass report on arts graduates, *The Art of Employment*. Short technical programs can double the number of potential job opportunities available for students with general education and high levels of core competency.[75]

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68   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 5)

69   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 17)

70   Advisory Council on Economic Growth, *Learning Nation: Equipping Canada's Workforce with Skills for the Future* (December 1, 2017) (p. 1)

71   Advisory Council on Economic Growth, *Learning Nation: Equipping Canada's Workforce with Skills for the Future* (December 1, 2017) (p. 1)

72   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 17)

73   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 17)

74   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 18)

75   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 24)

- As technologies mature, training institutions will have to be ready to adapt to train workers in short periods of time.[76]

- Canada's economic-growth challenges are largely due to an aging population, which will be acutely felt given the country's historical reliance on an expanding workforce to drive GDP growth. In a "do nothing" scenario, Canada's GDP growth rate could fall to just 1.5 percent annually for the next 50 years.[77]

  ◦ If the country could match the workforce participation rates achieved by leading countries, GDP per capita would rise by up to six percent.[78]

- One-third of new jobs created in the United States in the past 25 years were in industries that were not around before or existed in very different forms, such as mobile app development. In short, the net impact of technological advances on employment can be strongly positive.[79]

- As automation and AI creep up the skills ladder from repetitive, manual tasks to cognitive and analytical ones, they will hollow out a range of "mid-skilled" professions and affect a large swath of the middle class. The challenge is exacerbated by the fact that labour conditions vary significantly across the country. Detailed and timely data on regional labour-market shifts will be necessary to craft an effective response.[80]

- Our scenarios suggest that by 2030, 75 million to 375 million workers (3 to 14 percent of the global workforce) will need to switch occupational categories.[81]

- **Occupations can be grouped into six broad "clusters"** which we've called Solvers, Providers, Facilitators, Technicians, Crafters and Doers. The clusters aren't grouped by industry, educational attainment, collar colour or income; they're grouped by the skills required to do the work. This allows us to see how skills apply across a wide range of jobs, and how young people might be able to move from one profession to another by upgrading just a small number of skills. Out of 35 foundational workplace skills, it takes upgrading just four skills, for example, for someone in the Facilitator cluster to transition from dental assistant to graphic designer.[82]

  ◦ **Technicians**: High in technical skills; car mechanic to electrician; moderate chance of disruption

  ◦ **Crafters**: Medium in technical skills, low in management skills; farmer to plumber; very high chance of disruption

  ◦ **Doers**: Emphasis on basic skills; greenhouse worker to crane operator; high chance of disruption

  ◦ **Solvers**: Emphasis on management skills and critical thinking; mathematician to software engineer; minimal chance of disruption

76   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 24)

77   Advisory Council on Economic Growth, *Ideas into Action: A Review of Progress Made on the Recommendations of the Advisory Council on Economic Growth* (December 1, 2017) (p. 8)

78   Advisory Council on Economic Growth, *Ideas into Action: A Review of Progress Made on the Recommendations of the Advisory Council on Economic Growth* (December 1, 2017) (p. 8)

79   Advisory Council on Economic Growth, *Learning Nation: Equipping Canada's Workforce with Skills for the Future* (December 1, 2017) (p. 5)

80   Advisory Council on Economic Growth, *Learning Nation: Equipping Canada's Workforce with Skills for the Future* (December 1, 2017) (p. 2)

81   McKinsey MGI, *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation* (December 2017) (p. ii)

82   RBC, *Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption* (p. 5)

- ○ **Facilitators**: Focus on emotional intelligence; dental assistant to graphic designer; moderate chance of disruption

- ○ **Providers**: High in analytical skills; real estate agent to police officer; low chance of disruption

- Many other leaps are just a handful of upgrades apart. Dental assistant to photographer? Four skills upgraded. Miner to veterinary technician? Three skills upgraded. Cardiology technician to graphic designer? Zero skills upgraded. Of course, similar skills requirements alone don't guarantee easy transitions. Not every dental assistant has an aptitude for photography. And a lab technician would need to acquire a great deal of job-specific knowledge to succeed as a graphic designer. But the research shows that the underlying skills are nearly identical.[83]

- **45%** of working Canadians will belong to the **Solvers** and **Providers** clusters by 2021.[84]

- **74%** of **Crafters** will be highly susceptible to automation.[85]

2. Skills sought and required by employers

- Employers have shown a willingness to hire outside of traditional program pathways as long as the workers can demonstrate they have the necessary competencies, even in high-skilled science and technology fields.[86]

- ○ According to U.S. census data, representing one of the world's largest technology workforces, only approximately 33% of STEM graduates worked in a STEM field, and approximately 22% of STEM jobs were held by non-STEM graduates.[87]

- Employers everywhere report skills shortages. In the survey of the eight U countries, one-third of employers said that lack of skills is causing major business problems, in the form of cost, quality or time. 27 percent of employers reported that a lack of skills was a major reason they did not fill vacancies. Employers from countries with the highest youth unemployment reported the greatest problems due to skills shortages.[88]

- A critical reason for youth not getting the skills employers need is that education providers, young people, and employers do not understand one another.[89]

- Only four in ten employers surveyed, in widely different countries and industries, reported that they were confident they could find enough skilled graduates to fill entry-level positions. The reasons differ depending on where you look. In Germany, for example, there is evidence that the fairly buoyant economy is demanding more skilled entry-level candidates than exist in the population.[90]

- The OECD provides some guidance on the skills mix required to capitalize on these emerging technological sectors. The Skills 2017 report states, "Industries need workers with literacy,

83   RBC, *Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption* (p. 16)

84   RBC, Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption (p. 17)

85   RBC, *Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption* (p. 20)

86   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 37)

87   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 37)

88   McKinsey & Company, *Education to Employment: Getting Europe's Youth into Work* by M. Mourshed, J. Patel and K. Suder (January 2014) (p. 9)

89   McKinsey & Company, *Education to Employment: Getting Europe's Youth into Work* by M. Mourshed, J. Patel and K. Suder (January 2014) (p. 9)

90   McKinsey & Company, *Education to Employment: Getting Europe's Youth into Work* by M. Mourshed, J. Patel and K. Suder (January 2014) (p. 17)

numeracy and problem solving skills, prowess in management and communication and a readiness to keep learning. [91]

- Canada requires a mix of workers with newly emerging qualifications in university, college and skilled trades, working in fields such as power, telecommunications, construction and various forms of engineering. These are the kind of technical, job-specific skills that require a high level of coordination between businesses and educators.[92]

- Workers of the future will spend more time on activities that machines are less capable of, such as managing people, applying expertise, and communicating with others. They will spend less time on predictable physical activities, and on collecting and processing data, where machines already exceed human performance. The skills and capabilities required will also shift, requiring more social and emotional skills, and more advanced cognitive capabilities, such as logical reasoning and creativity.[93]

- An assessment of 20,000 skills rankings across 300 occupations and 2.4 million expected job openings shows an increasing demand for foundational skills such as critical thinking, co-ordination, social perceptiveness, active listening and complex problem solving.[94]

- Among the 2.4 million jobs in ESDC's forecast, demand will be nearly universal for several key human skills, the ones that help us learn and acquire knowledge. Active listening, speaking, critical thinking and reading comprehension will
be "relatively" or "very" important for virtually 100 percent of these job openings, across all industries. Breadth of skills will be more critical than proficiency; this is good for young Canadians, who typically lack the years of experience needed to develop expert proficiency.[95]

  - We should emphasize that the skills above will be in demand across all occupations — including STEM (Science, Technology, Engineering and Math) and trades occupations, whose reputations play down the demand for social skills.[96]

- Canada has begun to take steps to measure employment profiles in terms of a range of specific essential skills in the workforce, listing nine key skills: reading, writing, document use, numeracy, computer use, thinking, oral communication, working with others and continuous learning. The importance of this competencies model is also reflected in the CMEC Global Competencies initiative, which is centred on six "pan-Canadian Global Competencies:" critical thinking and problem solving; innovation, creativity, and entrepreneurship; learning to learn/self-awareness and self-direction; collaboration; communication; and global citizenship and sustainability.[97]

- Opportunities are closed to millions of people who could quite adequately perform a role. And, all because we continue to use a degree as a proxy for other things we really care about – soft skills, the ability to write cogently, the ability to interact with technology and so on.[98]

91   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 23)

92   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 24)

93   McKinsey MGI, Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation (December 2017) (p. 15)

94   RBC, Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption (p. 3)

95   RBC, Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption (p. 16)

96   RBC, Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption (p. 16)

97   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 13)

98   Rita Gunther McGrath, Breaking Up the Degree Stranglehold: Disruption in Higher Ed... (June 11, 2018)

- Digital fluency will be essential to all new jobs. This does not mean we need a nation of coders, but a nation that is digitally literate.[99]

- Global competencies like cultural awareness, language, and adaptability will be in demand.[100]

- Cultural competency is now up there with algorithm writing as a core need.[101]

- It's one of the painful ironies of our time. We keep telling ourselves, "The world needs more Canada." And yet not enough Canadians feel they need the world. A lack of global skills was something we heard at every stop.[102]

- Virtually all job openings will place significant importance on judgment and decision making and more than two thirds will value an ability to manage people and resources.[103]

- While the majority of Canadian employers agree that most post- secondary graduates are prepared for entry-level jobs, their expectations of worker competencies are changing. This suggests that training and education systems need to be updated to meet these changing needs, especially those driven by technological change and automation. With job and career transitions becoming more frequent, workers will also need to build skills throughout their working lives. And other skills will be needed, such as the entrepreneurial flair to not only start but successfully scale innovative companies in Canada.[104]

- Employers cite work ethic and teamwork as the most important skills in almost every country. Second, employers note a mismatch between what they need and what they are seeing; they rank the competence of new hires in each of the various skills lower than the importance they give it. Third, in some skills, there is a wide gap between the perspectives of employers and education providers on the competence of new hires. The difference is particularly stark in theoretical and hands-on training, problem solving, and computer literacy.[105]

- **Credentials**

- In a bright spot that might be an early warning of companies being more open to sorting out their hiring pools on the basis of something other than a degree, some companies are willing to seek out so-called "new collar" people. Partly in response to an increasingly tight labor market and partly in response to an inability to hire enough people at the salaries they are willing to pay, other forms of skill certification are becoming more widely practiced.[106]

  ○ Somewhat reluctantly, one gets the impression, these companies are looking at graduates of community colleges and boot camps, and some are launching internship and apprenticeship programs.[107]

- The current educational requirements of the occupations that may grow are higher than those for the jobs displaced by automation. In advanced economies, occupations that currently

99   RBC, *Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption* (p. 3)

100   RBC, *Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption* (p. 3)

101   RBC, *Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption* (p. 38)

102   RBC, *Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption* (p. 37)

103   RBC, Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption (p. 3)

104   Advisory Council on Economic Growth, *Building a Highly Skilled and Resilient Canadian Workforce Through the FutureSkills Lab* (February 6, 2017) (p. 4)

105   McKinsey & Company, *Education to Employment: Designing a System that Works* by M. Mourshed, D. Farrell and D. Barton (January 2013) (p. 33)

106   Rita Gunther McGrath, *Breaking Up the Degree Stranglehold: Disruption in Higher Ed…* (June 11, 2018)

107   Rita Gunther McGrath, *Breaking Up the Degree Stranglehold: Disruption in Higher Ed…* (June 11, 2018)

require only a secondary education or less see a net decline from automation, while those occupations requiring college degrees and higher grow.[108]

- Employers can't simply sit back and rely on educators to produce workers with the skills and knowledge required to succeed in the age of the Intelligence Revolution. Canadian businesses need to take an active role in creating innovative ways for the workers of tomorrow to arrive on the job ready to succeed. Potential approaches include:[109]

  - Collaborating with colleges and universities on curriculum reforms that reflect both current and emerging workforce needs.

  - Expand the traditional trade-oriented apprenticeship programs into white-collar market segments to develop talent from the ground up for future workplaces.

  - Focus work and educational activities around projects and teams selected based on conscious assessment of the capabilities needed for success.

  - As the economy accelerates into an economy of advanced technology and innovation, it is estimated that 70% of the jobs created will need, at least, some post-secondary education.[110]

- **Preparedness**

  - Deloitte has settled on **four key elements** of a company prepared for disruption: awareness, culture, organizational agility and resources.[111]

    » **Awareness**

      - Refers to a firm's understanding of changing technologies, the accelerating pace of change itself and the potential for technology-driven disruption in its industry and overall business environment.[112]

      - You can't prepare for a threat you don't know about, so you need to build your own
        early warning system. Be aware of developments in your sector – and in others, because disruption can come from surprising directions. Talk to your customers, front-line staff and suppliers to understand emerging trends. Engage with your wider business ecosystem, especially startups, business incubators and accelerators, and postsecondary institutions. And above all, always be curious.[113]

    » **Culture**

      - In the context of this report, culture is the extent to which a firm promotes, encourages and provides incentives for innovative behaviours and practices. Our research clearly showed that executive leadership, employee engagement and cross-enterprise collaboration are essential to creating the kind of organizational culture that stimulates innovation.[114]

108   McKinsey MGI, *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation* (December 2017) (p. 15)

109   Deloitte, The Intelligence Revolution: Future-Proofing Canada's Workforce (p. 45)

110   Planning for Higher Education Journal, *Community Colleges: Partners in Community Development* (October - December 2016) (p. 25)

111   Deloitte, Age of Disruption: Are Canadian Firms Prepared? (p. 21)

112   Deloitte, Age of Disruption: Are Canadian Firms Prepared? (p. 26)

113   Deloitte, *Age of Disruption: Are Canadian Firms Prepared?* (p. 26)

114   Deloitte, *Age of Disruption: Are Canadian Firms Prepared?* (p. 28)

- Surviving disruption takes resilience, adaptability and creativity. Leaders can encourage those qualities in their people by embracing them each day and being open to new ideas and new ways of working. Give your people the freedom to pursue creative ideas and bold innovations – and reward them for doing so. You'll create a workforce that will rise to disruption's challenge.[115]

  » **Organizational agility**

  - Agile organizations are those able to respond rapidly – even proactively – to changes and challenges in their environment. They are structured for quick deployment of systems, assets and people to address external opportunities or threats. They continually challenge the status quo, testing new processes and products to stay nimble and competitive.[116]

  - These days, change happens *really* fast. To keep up, you need to be agile. Does your company encourage innovation or just pay lip service to it? Are decisions made quickly, or are they subject to endless deliberation? When a new opportunity arises, can you rapidly assign people, capital and other resources to exploit it? If not, then it's time for some fresh thinking.[117]

  » **Resources**

  - We describe the technology, human capital and financial assets that enable change as effective resources. Access to the right people, capital and partnerships is critical to a firm's capacity to respond to disruption – or create it on its own. It's vital that companies have the right people and technology to compete and evolve effectively; having just one or the either is a recipe for failure.[118]

  - In today's business environment, there's no need to go it alone. Solve vexing business problems through the wisdom of the crowd. Gain access to innovative thinking and exciting new technology by tapping into local incubators and innovation hubs. Find funding sources before you need them. And make sure your people have up-to-date tools and the training to use them like pros.[119]

3. Essential Skills

- To help predict and guide the nature of our future workplace and workforce, work types (or job archetypes) have been theorized and named: RBC lists: Technicians, Drafters, Doers, Solvers, Facilitators, and Providers[120] as a way of grouping skill types. This, they say, will help guide young workers as they face displacement. Deloitte lists: The Protector, Innovator, Influencer, Integrator, Scorekeeper, Performer, Builder, and the Curator.[121] These are predictive of the workforce we will need.

115   Deloitte, *Age of Disruption: Are Canadian Firms Prepared?* (p. 28)

116   Deloitte, Age of Disruption: Are Canadian Firms Prepared? (p. 30)

117   Deloitte, Age of Disruption: Are Canadian Firms Prepared? (p. 30)

118   Deloitte, *Age of Disruption: Are Canadian Firms Prepared?* (p. 32)

119   Deloitte, Age of Disruption: Are Canadian Firms Prepared? (p. 32)

120   RBC, *Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption* (p. 5)

121   Deloitte, *The Intelligence Revolution: Future-Proofing Canada's Workforce* (pp. 6-7)

- By 2021, ICTC predicts the most in-demand, but short supply roles in the digital economy will include: information systems analysts and consultants, computer programmers and interactive media developers, industrial instrumentation technicians and technologists, computer and information systems managers, and database analysts and data administrators.[122]

- **Skills & Competencies**

  - To gain the maximum benefit from automation, training institutions will have to continue to instil the mix of literacy and numeracy skills as well as technical qualifications that are required.[123]

  - Many of the new jobs will require relatively high levels of "soft" skills, be it to manage and develop talent, interact with stakeholders from diverse cultural and social groups, or find creative solutions that go beyond simple analytical thinking. These skills tend to fall into the categories of social and emotional intelligence, critical thinking and problem solving.[124]

  - Evidence from a recent LinkedIn insiders' survey of knowledgeable Learning and Development specialists shows a softening of the traditional model. 60% of those they surveyed believed that employers are well on their way to skills-based-hiring, in other words, "choosing candidates based on what they can do, rather than degree or pedigree". 57% of respondents in the same study said they believe employers will start to place more value on non-traditional credentials, with one respondent going so far as to say that traditional credentials are "boring."[125]

  - The strongest demand is for the foundational skills that separate good from great in every walk of life, and especially in Canada's increasingly services-oriented economy. Communication, emotional intelligence, critical thinking, analysis: young Canadians will need these skills in an age of rapid change.[126]

  - Historically, most workers prepare to enter the workforce by honing the skills required to succeed at a single job. Auditors learned how to audit; auto mechanics learned how to fix cars. Yet this skills-based approach is rapidly becoming obsolete, as skills quickly become out of date. The shelf-life of a learned skill is now about five years.[127]

  - Instead of focusing training and education on technical skills, Canadians are better served to think in terms of sustainable capabilities that are portable and transferable between many occupations— where AI and robots cannot compete in the foreseeable future— and that will pass the test of disruption. These include talents such as collaboration, adaptability, and conceptual thinking that will always be a competitive advantage for humans over machines.[128]

  - **Ten skills for the future workplace** (as named and listed by the Institute for the Future for the University of Phoenix Research Institute)

122   The Information and Communications Technology Council, *Digital Economy Talent Supply: Indigenous Peoples of Canada* (2017) (p. 2)

123   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 24)

124   Advisory Council on Economic Growth, *Learning Nation: Equipping Canada's Workforce with Skills for the Future* (December 1, 2017) (p. 5)

125   Rita Gunther McGrath, *Breaking Up the Degree Stranglehold: Disruption in Higher Ed…* (June 11, 2018)

126   RBC, *Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption* (p. 16)

127   Deloitte, *The Intelligence Revolution: Future-Proofing Canada's Workforce* (p. 27)

128   Deloitte, *The Intelligence Revolution: Future-Proofing Canada's Workforce* (p. 27)

- » **Sense making**: ability to determine the deeper meaning or significance of what is being expressed.[129]

- » **Social intelligence**: ability to connect to others in a deep and direct way, to sense and stimulate reactions and desired interactions.[130]

- » **Novel and adaptive thinking**: proficiency at thinking and coming up with solutions and responses beyond that which is rote or rule-based.[131]

- » **Cross cultural competency**: ability to operate in different cultural settings.[132]

- » **Computational thinking**: ability to translate vast amounts of data into abstract concepts and to understand data-based reasoning.[133]

- » **New-media literacy**: ability to critically assess and develop content that uses new media forms, and to leverage these media for persuasive communication.[134]

- » **Transdisciplinarity**: literacy in and ability to understand concepts across multiple disciplines.[135]

- » **Design mindset**: ability to represent and develop tasks and work processes for desired outcomes.[136]

- » **Cognitive load management**: ability to discriminate and filter information for importance, and to understand how to maximize cognitive functioning using a variety of tools and techniques.[137]

- » **Virtual Collaboration**: ability to work productively, drive engagement, and demonstrate presence as a member of a virtual team.[138]

- Employers have shown a willingness to hire outside of traditional program pathways as long as the workers can demonstrate they have the necessary competencies, even in high-skilled science and technology fields.[139]

  - ° According to U.S. census data, representing one of the world's largest technology workforces, only approximately 33% of STEM graduates worked in a STEM field, and approximately 22% of STEM jobs were held by non-STEM graduates.[140]

- A "robot-proof" education, Aoun argues, is not concerned solely with topping up students' minds with high-octane facts. Rather, it calibrates them with a creative mindset and the mental elasticity to invent, discover, or create something valuable to society—a scientific proof, a hip-hop recording, a web comic, a cure for cancer.[141]

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129   Institute for the Future for the University of Phoenix Research Institute, *Future Work Skills 2020* (2011) (p. 8)

130   Institute for the Future for the University of Phoenix Research Institute, *Future Work Skills 2020* (2011) (p. 8)

131   Institute for the Future for the University of Phoenix Research Institute, *Future Work Skills 2020* (2011) (p. 9)

132   Institute for the Future for the University of Phoenix Research Institute, *Future Work Skills 2020* (2011) (p. 9)

133   Institute for the Future for the University of Phoenix Research Institute, *Future Work Skills 2020* (2011) (p. 10)

134   Institute for the Future for the University of Phoenix Research Institute, Future Work Skills 2020 (2011) (p. 10)

135   Institute for the Future for the University of Phoenix Research Institute, *Future Work Skills 2020* (2011) (p. 11)

136   Institute for the Future for the University of Phoenix Research Institute, *Future Work Skills 2020* (2011) (p. 11)

137   Institute for the Future for the University of Phoenix Research Institute, *Future Work Skills 2020* (2011) (p. 12)

138   Institute for the Future for the University of Phoenix Research Institute, *Future Work Skills 2020* (2011) (p. 12)

139   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 37)

140   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 37)

141   MIT Press, Summary of Joseph E. Aoun's *Robot Proof: Higher Education in the Age of Artificial Intelligence*

- The new literacies of Aoun's humanics are data literacy, technological literacy, and human literacy. Students will need data literacy to manage the flow of big data, and technological literacy to know how their machines work, but human literacy—the humanities, communication, and design—to function as a human being. Life-long learning opportunities will support their ability to adapt to change.[142]

  » Few young Canadians will need the type of coding proficiency required to work in Silicon Valley, but most will need a healthy dose of digital fluency and comprehension. Soon, we'll come to think about digital literacy like we do regular literacy: a prerequisite for nearly any job.[143]

  » A recent study by the Brookings Institution in Washington, DC found that 71 percent of U.S. jobs now require medium or high amounts of digital skills, up from 45 percent between 2002 and 2016. The share of jobs requiring low digital skills plunged from 56 to 30 percent. The percentages may vary in Canada, but the trend will not.[144]

- **Credentials**
  - Students need to build three new sets of cognitive capacities, namely: **systems thinking** (holism and inter- disciplinarily thinking), **entrepreneurship** (being a self-starter and an innovator), and **cultural agility** (that is, the ability to understand and negotiate cultural differences sufficiently to fit easily into different working milieus).[145]

    » Students need to be provided with useful and relevant information early on about the demand for skills in the labour market, with an emphasis on providing information on the diverse pathways to acquiring the skills and the certifications that are available.[146]

    » Students need their credentials recognized. Immigrants face barriers due to credential recognition. Estimates show that hundreds of thousands of immigrants are not seeing their credentials fully recognized in Canada, hindering their ability to fully participate in the labour market. Increasing the use of tools for measuring transferrable skills before arrival, making prior learning assessment programs more accessible to new immigrants and supporting language training to overcome essential skills barriers can all contribute to the success of new Canadians.[147]

    » Online education start-up Udacity offers "nanodegrees": short programs focused on developing specific skills in data science, machine learning, mobile programming and other highly sought occupations. Students need only invest about 10 hours a week for six to 12 months, at a cost of about $200 per month. Nanodegrees are designed in collaboration with leading employers such as Google, Mercedes-Benz, or IBM and, if completed successfully, lead to formal credentials that have helped many participants secure jobs.[148]

142   MIT Press, Summary of Joseph E. Aoun's *Robot Proof: Higher Education in the Age of Artificial Intelligence*

143   RBC, *Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption* (p. 21)

144   RBC, *Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption* (p. 21)

145   Alex Usher, *Higher Education Strategy Associates' Review of Aoun's Book* Robot Proof: Higher Education in the Age of Artificial Intelligence (March 1, 2018)

146   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 32)

147   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 36)

148   Advisory Council on Economic Growth, *Learning Nation: Equipping Canada's Workforce with Skills for the Future* (December 1, 2017) (p. 7)

» Modular courses are most beneficial when they can be complemented with further training in the same or related field. In some cases, students can transfer the credits they have accumulated to other institutions where they continue building their skills base and potentially obtain a diploma or a degree.[149]

• The Australian state of New South Wales has developed a "stackable" vocational education and training system, whereby workers' existing skills are measured and then built upon with new training modules. The Massachusetts Institute of Technology (MIT), meanwhile, has introduced MicroMasters programs: Students earn credentials for completing a set of online courses and examinations, and the most successful among them can pursue a full-time Master's degree at MIT or another university.[150]

◦ Some programs recognize the skills students have acquired even if they have not earned traditional post-secondary degrees.[151]

» In Canada, the prior learning assessment and recognition (PLAR) program run by most polytechnics allows individuals with non-traditional education such as former and current Canadian Forces members to get formal validation of formal and informal learning they have previously engaged in. Thus, PLAR makes it easier for such mid-career individuals to transition to new occupations or get advanced placement in post-secondary programs.[152]

◦ Digital platforms are great for disseminating knowledge, they are terrible at demonstrating what knowledge you have to others. For that, a credential from a respected institution can't be beat.

» But, what if we could have credentials without a college degree? Think of the music business. When music began to be sold (or stolen) by the song and not by the album, the resulting unbundling decimated the industry's revenues. Imagine if something similar happened in higher education, with credentials offered at the level of a skill, rather than a degree?[153]

» Why pay for a *degree* if all you need or want is a *skill*?[154]

149   Advisory Council on Economic Growth, *Learning Nation: Equipping Canada's Workforce with Skills for the Future* (December 1, 2017) (p. 9)

150   Advisory Council on Economic Growth, *Learning Nation: Equipping Canada's Workforce with Skills for the Future* (December 1, 2017) (p. 9)

151   Advisory Council on Economic Growth, *Learning Nation: Equipping Canada's Workforce with Skills for the Future* (December 1, 2017) (p. 9)

152   Advisory Council on Economic Growth, *Learning Nation: Equipping Canada's Workforce with Skills for the Future* (December 1, 2017) (p. 9)

153   Rita Gunther McGrath, *Breaking Up the Degree Stranglehold: Disruption in Higher Ed…* (June 11, 2018)

154   Rita Gunther McGrath, *Breaking Up the Degree Stranglehold: Disruption in Higher Ed…* (June 11, 2018)

- **Guidance**

  ○ The federal and provincial governments need to transform Canada's network of employment centres so they provide hands-on guidance to Canadians as they navigate the labour market changes brought about by technological change.[155]

  ○ Given the rapid and often confusing changes in the labour market, individuals need expert advice to understand the changing conditions and emerging opportunities.[156]

  ○ Studies share a heavy focus on the number of jobs potentially affected by automation. But they offer little if any guidance on how Canada should prepare for a disrupted future, much less turn it to our advantage.[157]

  ○ Most Canadians do not appear to feel much urgency about the future of work and its implications.

  ○ Some people are overwhelmed by the pace of change, others never see it coming. Or, by the time they do, it's too late to adapt.

  ○ Students needs this knowledge and guidance early enough to formulate a sturdy pathway for themselves.

4. Economy, Reports, Statistics

  ○ By 2021, Canada will need to fill more than 216,000 ICT positions, making the effective and inclusive utilization of our local workforce a top priority.[158]

  ○ The ICT occupations with the highest proportion of Indigenous peoples include information systems analysts and consultants, user support, technicians, computer network technicians, and graphic designers and illustrators.[159]

    » However, despite being employed in some crucial occupations in the digital economy, on a comparison of the share of Indigenous workers in ICT jobs relative to the rest of the Canadian workforce, it is evident that Indigenous peoples are underrepresented in ICT professions.[160]

    » Given that more and more people of working age are filling the labour market, even when economies recover, young people will continue to be at a disadvantage because too many just don't have the skills the market demands. They face a Catch-22 situation: because they have not been able to develop relevant workplace skills during or immediately on leaving education, they cannot find a workplace to give them an opportunity. Unless there is some movement, this generation of young people risks being scarred the way a previous generation has. Adults who were unemployed before age 23 in the 1980s were still earning 12-15 percent less than their peers, ten years later.[161]

155 Advisory Council on Economic Growth, *Learning Nation: Equipping Canada's Workforce with Skills for the Future* (December 1, 2017) (p. 1)

156 Advisory Council on Economic Growth, *Learning Nation: Equipping Canada's Workforce with Skills for the Future* (December 1, 2017) (p. 12)

157 Deloitte, *The Intelligence Revolution: Future-Proofing Canada's Workforce* (p. 21)

158 The Information and Communications Technology Council, Digital Economy Talent Supply: Indigenous Peoples of Canada (2017) (p. 2)

159 The Information and Communications Technology Council, *Digital Economy Talent Supply: Indigenous Peoples of Canada* (2017) (p. 7)

160 The Information and Communications Technology Council, *Digital Economy Talent Supply: Indigenous Peoples of Canada* (2017) (p. 8)

161 McKinsey & Company, Education to Employment: Getting Europe's Youth into Work by M. Mourshed, J. Patel and K. Suder (January 2014) (p. 19)

IMPORTANCE OF COLLEGES

1. Community Hubs

- Today's colleges and institutes act as community anchors and can play an important role in addressing key issues of our times- social inclusion of new Canadians, reconciliation with Indigenous people, rural/regional social resilience and economic development, providing second chances for people who have dropped out, fostering economic prosperity and employment through industry partnerships, etc.[162]

2. Applied Learning

- Applied research refers to solving problems, acquiring solutions for business, industry and community partners, and knowledge transfer that supports the economic and social prosperity of communities.[163]

- Applied research opportunities are necessary for students across the province to strengthen BC's innovation capacity — more opportunities lead to more innovations.[164]

- Applied research helps fill skills gaps by preparing students to enter the workforce quickly.[165]

- Applied research creates "innovation literacy", by teaching participants about product development, customer needs, communication, teamwork and project management. [166]

THE FUTURE LEARNER

- Barriers to education and employment affect potential workers due to income, immigration status, language, First Nations or Indigenous status or a range of other reasons, and solutions should be likewise diverse.[167] These barriers need to be broken down.

- Improving national accreditation standards will help skilled immigrants access suitable productive employment opportunities.[168]

  ○ Foreign direct investment (FDI) are critical for driving growth, creating jobs, and integrating Canadian companies into global markets—but Canada is falling behind here. While OECD countries expanded their inbound FDI an average of seven percent annually since 2005, Canada's has grown only two percent a year—in 2016, Canada ranked 33rd out of 40 countries for FDI restrictiveness.[169]

- The establishment of a FutureSkills Lab and training programs supporting adult workers are critical components of the strategy to boost the country's competitiveness and productivity.[170]

162   CICan & McConnell Foundation, *Presidents' Roundtable: Building Social Infrastructure* (October 2017) (p. 1)

163   BCARIN, *Building Innovation Across British Columbia* (December 16, 2016) (p. 6)

164   BCARIN, *Building Innovation Across British Columbia* (December 16, 2016) (p. 2)

165   BCARIN, *Building Innovation Across British Columbia* (December 16, 2016) (p. 14)

166   BCARIN, *Building Innovation Across British Columbia* (December 16, 2016) (p. 14)

167   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 34)

168   Advisory Council on Economic Growth, *Ideas into Action: A Review of Progress Made on the Recommendations of the Advisory Council on Economic Growth* (December 1, 2017) (p. 3)

169   Advisory Council on Economic Growth, *Ideas into Action: A Review of Progress Made on the Recommendations of the Advisory Council on Economic Growth* (December 1, 2017) (p. 2)

170   Advisory Council on Economic Growth, *Investing in a Resilient Canadian Economy* (December 1, 2017) (p. 8)

- Seamless transfers for core curriculum within a university system are enhancing degree completion for transfer students (e.g., associate programs to baccalaureate programs or between baccalaureate programs).[171]

ADAPTING EDUCATION AND DELIVERY

1. Nimble & Shorter Programs

- There is wide expectation that "everyone" needs a four-year education, yet more are settling for two-year (or even less) post-secondary education/ training.[172]

- Dual credit programs are developed in partnership with school districts and local post-secondary institutions. They let students take relevant courses and programs and help them move into post-secondary studies or the workplace faster and with the skills they need. Students taking these programs are graduating from high school with credentials and skills that are in demand and are going on to work in manufacturing, hospitality, high-tech, healthcare, construction and business. Dual credit programs appeal to students of all academic levels, including those with special needs and disabilities.[173]

2. Online Learning

- Online courses offer one possible avenue for bringing marginalized groups into higher education because they can easily accommodate people's locations and work schedules. However, the recognition of credentials remains an issue as online education tends to correlate with prior education.[174]

- Many institutions now offer blended programs for adult learners that include in-person and online components. This approach not only gives students flexibility, but allows educational institutions to serve larger student cohorts at their facilities. Fully digital approaches are also being tried.[175]

- Distance education has not slowed down face-to- face learning; staff reaffirm that students get their value from an institution by being able to problem solve and collaborate with peers in active learning- type classes with lectures online[176]

3. Accessibility

- Tuition-driven models are no longer feasible and public funding has declined for the last decade. To be relevant and innovative, institutions and their leaders must focus more deeply on the organizational structure and the processes that maximize effectiveness.[177]

171   Society for College and University Planning, *Academy Report 2014* (2014) (p. 18)

172   Society for College and University Planning, *Academy Report 2014* (2014) (p. 18)

173   Work BC, *BC's Skills for Jobs Blueprint: Re-engineering Education and Training* (2014) (p. 10)

174   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 31)

175   Advisory Council on Economic Growth, *Learning Nation: Equipping Canada's Workforce with Skills for the Future* (December 1, 2017) (p. 9)

176   Society for College and University Planning, *Academy Report 2014* (2014) (p. 19)

177   Society for College and University Planning, *Academy Report 2014* (2014) (p. 10)

- The most important barrier to enrolling in post-secondary education is cost. Although university tuition fees are generally highly subsidized in Europe, many students find the cost of living while studying still too high to sustain. Also, in a number of countries, vocational courses are not subsidized and can therefore be prohibitively expensive.[178]

- To improve financing, governments and private financial institutions can offer low-interest loans for students pursuing courses that have a strong employment record; they can also explore initiatives that allow young people to pay for part of their education or training in the form of services.[179]

- 39 percent of education providers believe the main reason students drop out is that the course of study is too difficult, but only 9 percent of youth say this is the case (they are more apt to blame affordability).[180]

- 31 percent of high-school graduates indicating they did not continue their education because it was too expensive.[181]

- Our survey indicates that youth who do not pursue postsecondary education see themselves in one of two segments: those who cannot afford to and those who cannot be bothered to. Both segments have poor outcomes, including high levels of unemployment.[182]

INNOVATION, TECHNOLOGY, AND APPLIED RESEARCH

1. Importance of Applied Innovation

- Applied research opportunities are necessary for students across the province to strengthen BC's innovation capacity --- more opportunities lead to more innovations.[183]

- Participating in applied research and social innovation projects provides students with enhanced real- world, hands-on learning experiences and it deepens their learning experiences and the teaching experiences that instructors provide for students. The projects provide innovative solutions for business and community partners. The process develops an innovative and entrepreneurial mindset in our developing workforce.[184]

- The 2015 Conference Board of Canada's "How Canada Performs: A Report Card of Canada" states that Canadian businesses need to invest more in R&D in order to remain globally competitive Canada is falling behind on all indicators of innovation, earning a "C" grade on innovation and ranking 9th among 16 international peers.[185]

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178   McKinsey & Company, *Education to Employment: Getting Europe's Youth into Work* by M. Mourshed, J. Patel and K. Suder (January 2014) (p. 10)

179   McKinsey & Company, Education to Employment: Getting Europe's Youth into Work by M. Mourshed, J. Patel and K. Suder (January 2014) (p. 13)

180   McKinsey & Company, Education to Employment: Designing a System that Works by M. Mourshed, D. Farrell and D. Barton (January 2013) (p. 15)

181   McKinsey & Company, *Education to Employment: Designing a System that Works* by M. Mourshed, D. Farrell and D. Barton (January 2013) (p. 16)

182   McKinsey & Company, *Education to Employment: Designing a System that Works* by M. Mourshed, D. Farrell and D. Barton (January 2013) (p. 21)

183   BCARIN, *Building Innovation Across British Columbia* (December 16, 2016) (p. 2)

184   BCARIN, *Building Innovation Across British Columbia* (December 16, 2016) (p. 6)

185   BCARIN, *Building Innovation Across British Columbia* (December 16, 2016) (p. 9)

- Applied research projects help students develop employable skill sets by providing them with hands on, real world learning experiences in the workplace. An overwhelming number of students who participate in applied research projects have better opportunities for good jobs after they graduate. Opportunities such as coops, work placements, internships, and participation in innovation and applied research projects provide experiential learning and help students transition into the workforce. [186]

- Applied research creates "innovation literacy", by teaching participants about product development, customer needs, communication, teamwork and project management.[187]

- Businesses in Canada urgently need to get more innovative. According to the Science, Technology and Innovation Council, Canada is falling steadily behind its global competitors on key measures of innovation. Most notably, Canada ranks 26th among international competitors for business spending on research and development as a share of gross domestic product, sitting at just over one-third of the threshold amount spent by the top five performing countries.[188]

- College and institute faculty are typically expected to teach full time. To support growth in applied research activity, more colleges and institutes are allocating resources to offer faculty release time, which enables teachers and professionals to conduct collaborative research and participate in projects as co-researchers, partners or associate scientists. In 2014-15, 89% of respondent institutions offered their faculty release time for research.[189]

- Canada is fortunate to have an infrastructure in place, through colleges and institutes, to support the innovation needs of SMEs. Considering small businesses make up 98% of companies in Canada, but only 31% invest in R&D,1 there is much potential to improve their innovation capacity and productivity.[190]

- **SME focus**

  ○ Small and medium-sized enterprises (SMEs) are the backbone of Canada's economy, representing 60 percent of private-sector employment and a third of Canada's GDP.[191]

    » The government should expand its advisory service programs, prioritize its export support programs, and promote the adoption of innovation and technology. These changes will stimulate greater investment by SMEs from coast to coast, helping them achieve sustainable growth.[192]

  ○ Many SMEs fall short of their potential. Most struggle to achieve significant scale, with only one in 1,000 companies passing the milestone of 100 employees—40 percent fewer than in 2001. Those that remain small do not prioritize innovation; on a per employee basis, SMEs invest one-fifteenth the amount of R&D as do large businesses. Canadian SMEs also underperform their foreign peers in terms of foreign market reach and productivity. And their exports represent only 25 percent of Canada's total; by contrast, the OECD average for SMEs is 40 percent.[193]

186   BCARIN, Building Innovation Across British Columbia (December 16, 2016) (p. 13)

187   BCARIN, *Building Innovation Across British Columbia* (December 16, 2016) (p. 14)

188   CICan, *Applied Research: Partnered Innovation for Businesses and Communities* (2016) (p. 1)

189   CICan, *Applied Research: Partnered Innovation for Businesses and Communities* (2016) (p. 15)

190   CICan, *Applied Research: Partnered Innovation for Businesses and Communities* (2016) (p. 4)

191   Advisory Council on Economic Growth, *Investing in a Resilient Canadian Economy* (December 1, 2017) (p. 2)

192   Advisory Council on Economic Growth, *Investing in a Resilient Canadian Economy* (December 1, 2017) (p. 2)

193   Advisory Council on Economic Growth, *Investing in a Resilient Canadian Economy* (December 1, 2017) (p. 20)

- **Employers to help develop curricula**

  - Models of sectoral initiatives around training are also a potential avenue for improving collaboration. In the 2013 report, *Closing the Skills Gap: Mapping a Path for Small Business*, participants of a symposium organized by the Canadian Chamber endorsed a model of sectoral cooperation that could support collaboration to make training more relevant for small businesses by working with sectors to develop and deliver programs.[194]

  - Skills transfer needs to be seen as an activity that moves in every direction: employer feedback to educators can help target programs on the needs of business, and educator feedback to employers can help businesses adopt new technologies and modes of work.[195]

- **Apprenticeships**

  - Apprenticeships are work integrated learning.

  - In the United States, apprenticeships are seen as expensive for employers, and they often are snubbed by the most talented applicants, who see them as less prestigious than heading off to college.[196]

    - » Some employers, however, are revisiting the idea of an apprenticeship track. One often-cited example is that of Switzerland, in which 70 percent of students who have completed the 9th grade elect to go on a vocational track. As the Times reports, "Beginning in 10th grade, students rotate among employers, industry organizations and school for three to four years of training and mentoring. Learning is hands-on, and they are paid. Switzerland's unemployment rate for the young is the lowest in Europe and about a quarter that of the United States'."[197]

  - Apprenticeships traditionally have provided hands-on experience, but there are not enough spaces to meet demand. Technology, in the form of "serious games" and other kinds of simulations, can help here, too, by offering tailored, detailed, practical experience to large numbers at a comparatively low cost. Serious-game simulation could become the apprenticeship of the 21st century. In a sense, the future of hands-on learning may well be hands-off.[198]

  - Employers play a central role in apprenticeship training. Without the participation of employer sponsors, apprenticeships are not possible. We need to do more to actively encourage employers to step up and become sponsors.[199]

194   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 40)

195   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 40)

196   Rita Gunther McGrath, *Breaking Up the Degree Stranglehold: Disruption in Higher Ed…* (June 11, 2018)

197   Rita Gunther McGrath, *Breaking Up the Degree Stranglehold: Disruption in Higher Ed…* (June 11, 2018)

198   McKinsey & Company, *Education to Employment: Designing a System that Works* by M. Mourshed, D. Farrell and D. Barton (January 2013) (p. 18)

199   Work BC, *BC's Skills for Jobs Blueprint: Re-engineering Education and Training* (2014) (p. 18)

TRANSFORMING FOR TOMORROW

2. Work Integrated Learning

- Though they are upskilling, people don't have time to go to school for four years.[200]

- As technologies mature, training institutions will have to be ready to adapt to train workers in short periods of time.[201]

- If training means going to school, small businesses don't have the dollars to help train formally — but, they have extensive experience at informal training.[202]

- There needs to be a bridge, including time to train and adapt.

- With targeted skills development plans, single courses and short boot camps can be sufficient for many transitions between jobs.[203] There is a strong need for these shorter credential opportunities; i.e., micro credentials.

- Further savings can be realized if the requirements for retraining are reduced to short-duration, targeted courses and the recognition of skills learned while on the job as well as by encouraging better use of freely available resources for self-directed learning.[204]

   ○ A single prior learning assessment, for example, can cost under $100 for a single course or under $700 for an entire program, compared to thousands of dollars for a full year of higher education.[205]

- Experiential training can be integrated with work experience. This method gives adult learners the confidence
that the skills they acquire can be immediately applied in the workplace.[206]

   ○ Red River College in Winnipeg, Manitoba, has worked in partnership with truck manufacturer Peterbilt to design and deliver a highly practical 12-week technician training program, which so far has helped all of its graduates secure jobs upon completing it.[207]

- Those who have experienced work-integrated learning know it can be the great social leveler of the skills economy, opening doors for young people regardless of their background.[208]

- We've ended up coupling things that shouldn't be and decoupling things that should be. We decouple learning and work—these things need to be coupled together.[209]

- 58 percent of youth said that practical, hands-on learning is an effective approach to training. However, only 24 percent of academic-program graduates and 37 percent of vocational graduates said that they spend most of their time in this manner.[210]

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200   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 15)

201   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 24)

202   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 15)

203   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 19)

204   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 19)

205   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 19)

206   Advisory Council on Economic Growth, *Learning Nation: Equipping Canada's Workforce with Skills for the Future* (December 1, 2017) (p. 9)

207   Advisory Council on Economic Growth, *Learning Nation: Equipping Canada's Workforce with Skills for the Future* (December 1, 2017) (p. 9)

208   RBC, *Humans Wanted: How Canadian Youth Can Thrive in the Age of Disruption* (p. 36)

209   Deloitte, The Intelligence Revolution: Future-Proofing Canada's Workforce (p. 43)

210   McKinsey & Company, *Education to Employment: Designing a System that Works* by M. Mourshed, D. Farrell and D. Barton (January 2013) (p. 33)

- If training means going to school, small businesses don't have the dollars to help train formally — luckily, SME's have extensive experience at informal training.[211] Work integrated learning includes apprenticeships, and applied research.

- Work-integrated learning is the process through which students come to learn from experiences in educational and practice settings. It includes the kinds of curriculum and pedagogic practices that can assist, provide, and effectively integrate learning experiences in both settings.[212]

- We have identified nine types of WIL that are currently used in Canadian postsecondary institutions: Apprenticeship; Co-op; Internship; Field experience; Mandatory Professional Practice; Applied Research Project; Service Learning; Incubators and Accelerators; and Bootcamps and Hackathons.[213]

- One recent development in WIL has been the popularization of incubators and accelerators. Intended primarily to promote entrepreneurship, an incubator is "an enterprise or facility that directly supports the early-stage development of new business ventures by providing things like office space, shared business or legal services, and other forms of business assistance" (Sá, Kretz, and Sigurdson 2014). Incubators are formal or informal spaces catering to aspiring entrepreneurs who typically must apply to receive access to the space and its resources. Qualified applicants may receive funding, supervision, and mentorship from experienced practitioners. Accelerators offer similar services but for more advanced ventures.[214]

- Generally focused on software development, bootcamps and hackathons have in recent years emerged as a means for computer programmers and interface designers to develop or showcase their skills. According to CourseReport, a website that publishes reviews of bootcamps, the industry was expected to graduate more than 16,000 students across North America in 2015, up from 5,987 in 2014.[215]

- Key barriers to providing WIL opportunities affecting employers and community partners typically cluster around issues of resourcing. In many cases, employers may be reluctant to participate in WIL programs due to the perceived costs involved. These costs may include not only providing fair compensation to the student, but the considerable time and effort required to supervise and mentor students effectively. In some cases, specifically with apprenticeships, employers have expressed reluctance to invest in student employees for fear that the student will subsequently get "poached" by a competitor (Brisbois et al. 2008). Some employers have also reported concerns about being able to find suitable projects for WIL students (Jackson, Ferns, Rowbottom, & McLaren 2015).[216]

- WIL programs and experiences should be designed with the desired end state in mind. Successful WIL initiatives must be deliberately constructed from a foundation of clearly articulated objectives. As Stirling et al. (2016) suggest, the first step in building any WIL opportunity should focus on defining desired outcomes, the means of assessment, and the learning plan. Moreover, the specific form of WIL as well as its implementation should be directed by the objectives of the program.[217]

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211   The Canadian Chamber of Commerce: Skills for an Automated Future (March 2018) (p. 15)

212   Business/Higher Education Roundtable, *Taking the Pulse of Work Integrated Learning in Canada* (April 2015) (p. 8)

213   Business/Higher Education Roundtable, Taking the Pulse of Work Integrated Learning in Canada (April 2015) (p. 15)

214   Business/Higher Education Roundtable, *Taking the Pulse of Work Integrated Learning in Canada* (April 2015) (p. 36)

215   Business/Higher Education Roundtable, Taking the Pulse of Work Integrated Learning in Canada (April 2015) (p. 37)

216   Business/Higher Education Roundtable, *Taking the Pulse of Work Integrated Learning in Canada* (April 2015) (p. 42)

217   Business/Higher Education Roundtable, *Taking the Pulse of Work Integrated Learning in Canada* (April 2015) (p. 47)

FUTURE LEARNING PLACES AND SPACES

1. Why does it matter?

- The intersection of design excellence and education has a profound impact on society as a whole.[218]

2. Infrastructure: Re-thinking the future campus from bricks and mortar

- Investment in productivity-enhancing infrastructure—such as improving transportation of people, goods, energy, and data, or improving the urban environment—is a key enabler of economic growth.[219]

- Each dollar of such investment brings 60 cents worth of additional economic activity in the short term and has a 20 to 50 percent return on investment in the long term.[220]

- 15 jobs are created for every $1 million invested.[221]

- Canada faces a major infrastructure gap—anywhere from as "low" as $150 billion to as high as $1 trillion—that needs to be addressed.[222]

- Many post secondary buildings were built during the campus construction boom experienced throughout North America during the 1960s and '70s.

  - With infrastructure approaching a half-century of use and dated facilities that lack the kinds of amenities both students and advances in pedagogy require, things need a facelift.[223]

- A study by Barnes & Noble College, the bookseller's higher education retail division, finds that 51 percent of students in Gen Z—the cohort born between 1995 and 2010, now entering the college pipeline—like to learn by doing. (Thirty-eight percent say they are visual learners, while 12 percent say they learn best through listening.) "Gen Z wants engaging, interactive learning experiences," the study says. Researchers found that, in the classroom, Gen Zers value the use of technology, hands-on learning, and individual attention.[224]

- Many institutions are contributing to their communities by providing meeting spaces, developing the arts, taking visible roles with public and private agencies, and serving as a resource for community education programs and discussions.[225]

- Community colleges can, and should, play a larger role in community and economic

218   Stantec, *Designing the Ultimate Campus Experience* (p. 16)

219   Advisory Council on Economic Growth, *Ideas into Action: A Review of Progress Made on the Recommendations of the Advisory Council on Economic Growth* (December 1, 2017) (p. 1)

220   Advisory Council on Economic Growth, *Ideas into Action: A Review of Progress Made on the Recommendations of the Advisory Council on Economic Growth* (December 1, 2017) (p. 1)

221   Advisory Council on Economic Growth, *Ideas into Action: A Review of Progress Made on the Recommendations of the Advisory Council on Economic Growth* (December 1, 2017) (p. 1)

222   Advisory Council on Economic Growth, *Ideas into Action: A Review of Progress Made on the Recommendations of the Advisory Council on Economic Growth* (December 1, 2017) (p. 1)

223   Planning for Higher Education Journal, *Campus Renewal: Working with what You've Got,* by Sydney Browne and Gary McCluskie (April - June 2018) (p. 1)

224   Society for College and University Planning, *Trends for Higher Education* (Fall, 2016) (p. 2)

225   Planning for Higher Education Journal, *Community Colleges: Partners in Community Development* (October - December 2016) (p. 26)

development. They can serve as leaders for resolving community issues even when a solution is not one of education.26 Community colleges are comprised of highly educated and creative people who can assist with problem-solving in any number of issues that may affect a community.[226]

- The college should lead the effort to strengthen town-and-gown relations so that the development is positive and not a dilapidated section of town, with no investment, that exploits the students' experience and proximity.[227]

- Livable communities strive to: 1) preserve green space; 2) ease traffic congestion; 3) restore a sense of community; 4) promote collaboration among neighboring communities, and 5) enhance the economic competitiveness of the community. Community colleges should play a key role in developing livable communities. First, the community college is often a very visible presence in a community and can act as a convener of community leaders for the purpose of discussions around creating livable communities. Second, the community college employs highly educated people with a variety of backgrounds who can assist with the development and planning of livable communities. These include faculty and staff with backgrounds in: sociology, psychology, design, art, criminal justice, business, etc. Third, community colleges can bring events and social venues to a community.[228]

- **Housing**

  ◦ Housing can assist in the recruitment of international students, student athletes, and out-of-district residents. Surveys across college campuses have found that these students are more likely to live in campus housing.[229]

    » These students may also provide the institution with additional tuition income.[230]

  ◦ A residential complex will also help strengthen the campus community by establishing a 24–7 presence that requires the development of programming, activities, and campus connections. Numerous studies and analyses, including *How College Affects Students* by Pascarella and Terenzini (2005), note that students living on campus consistently matriculate and graduate at higher rates.[231]

  ◦ There is a growing trend for many rural community colleges to have (or to consider building) student housing. Community colleges that are providing or considering student housing should discuss broadening their thinking from student housing alone, to creating an integrated college town.[232]

  ◦ Student housing is buffing up from old to contemporary (pods, village communities, etc.) and reducing space per student to save money; also, interesting collaborations link student housing to senior housing in an ongoing learning initiative.[233]

  ◦ The addition of a 24–7 population will also increase the demand for facilities like student

226 Planning for Higher Education Journal, *Community Colleges: Partners in Community Development* (October - December 2016) (p. 29)

227 Planning for Higher Education Journal, *Community Colleges: Partners in Community Development* (October - December 2016) (p. 32)

228 Planning for Higher Education Journal, *Community Colleges: Partners in Community Development* (October - December 2016) (pp. 40-41)

229 Planning for Higher Education Journal, *Assessing the True Cost of Student Housing for Community Colleges* by Craig Levin and Matt Bohannon (July - September 2013) (pp. 117-118)

230 Planning for Higher Education Journal, *Assessing the True Cost of Student Housing for Community Colleges* by Craig Levin and Matt Bohannon (July - September 2013) (p. 118)

231 Planning for Higher Education Journal, *Assessing the True Cost of Student Housing for Community Colleges* by Craig Levin and Matt Bohannon (July - September 2013) (p. 118)

232 Planning for Higher Education Journal, *Community Colleges: Partners in Community Development* (October - December 2016) (p. 33)

233 Society for College and University Planning, *Academy Report 2014* (2014) (p. 29)

unions, libraries, and fitness centers across all hours of operation. Further, many campuses have found that the addition of campus residences provides an opportunity to better manage parking demand as fewer trips to campus occur.[234]

- **Costs of Housing**

  - Housing, like other auxiliary operations, is typically self- sustaining, whereby the revenue generated through room rents covers the operation and associated debt of the project. In developing a housing financial model, the direct costs are typically fairly straightforward and cover the following areas:[235]

    - » Salaries and benefits of full-time staff

    - » Part-time wages

    - » Annual Building upkeep

    - » Utilities for the building

    - » Administrative expenses

    - » Campus overhead

    - » Debt service or lease payments

    - » Replacement reserves

- **Student Centres**

  - Today's student centers are integral to campus life—just ask any student. A crossroads of academics, social activity, and campus culture, the student center is an important deciding factor for students comparing post-secondary schools.[236]

  - At the City University of New York, for example, 40 percent of students reported having issues around access to food. After finding that a quarter of its students skipped meals to save money, the University of California allocated $75,000 to each of its campuses to improve student food security.[237]

  - The deep inter-penetration of traditional student life spaces, particularly the student union, with spaces having historically separate identities, like the library or open computing laboratories, points out a weakness of the existing space taxonomy. Are student unions and libraries separate facilities? Do we need student unions as single conglomerate buildings? These are not questions the standard model admits, yet they are urgent and consequential.[238]

- **The Library**

  - To remain relevant in the current academic climate, libraries must be centers of the knowledge economy, of collaborative learning, and of creative production.[239]

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234   Planning for Higher Education Journal, *Assessing the True Cost of Student Housing for Community Colleges* by Craig Levin and Matt Bohannon (July - September 2013) (p. 118)

235   Planning for Higher Education Journal, *Assessing the True Cost of Student Housing for Community Colleges* by Craig Levin and Matt Bohannon (July - September 2013) (p. 119)

236   Stantec, *Designing the Ultimate Campus Experience* (p. 18)

237   Society for College and University Planning, *Trends for Higher Education* (Fall, 2016) (p. 9)

238   Society for College and University Planning, *Kings of Infinite Space* by Gregory Janks (2012) (p. 12)

239   Planning for Higher Education Journal, *The Library as Learning Commons* by Derek Jones and Andrew Grote (April - June 2018) (p. 1)

» The library is now a facilitator, bringing together individuals, interdisciplinary groups, creative technologies, collections, and more into a vibrant, learning-focused place. A revitalized library will be a "preferred destination," an active participant in supporting knowledge creation—a "want to" space for the diverse disciplines it serves.[240]

» Innovation labs, makerspaces, entrepreneurship hubs, and centers for digital scholarship are just a few of the unique programs libraries are hosting to draw together multiple disciplines in a single place to begin tackling the grand challenges of our times.[241]

» New amenities have crept into the library to not only support multiple modes of learning but also blur the distinction between formal academic learning and the social learning that occurs beyond the directed class curriculum. Nap rooms, gaming modules, pop-up event spaces, and branded food service have permeated the academic library to support serendipitous sharing and extended time on task.[242]

  • Nap rooms, gaming modules, pop-up event spaces, and branded food service have permeated the academic library to support serendipitous sharing and extended time on task.[243]

» A makerspace called the Technology Sandbox is a new destination where visitors can test out new devices and prototype ideas (figure 5). An ultra-low-profile smart floor brings power and data cables to any region of the open learning commons and can be flexed to accommodate new configurations with little effort. Behind the scenes, there are now two properly sized telecom closets (IDF rooms)—one on each floor of the library to manage data infrastructure today while easily flexing to future needs.[244]

  • User demand has led many libraries to develop consulting services, workshops, and access to technology to support data visualization for learners and researchers.[245]

240   Planning for Higher Education Journal, *The Library as Learning Commons by Derek Jones and Andrew Grote* (April - June 2018) (p. 1)

241   Planning for Higher Education Journal, *The Library as Learning Commons* by Derek Jones and Andrew Grote (April - June 2018) (p. 1)

242   Planning for Higher Education Journal, *The Library as Learning Commons* by Derek Jones and Andrew Grote (April - June 2018) (pp. 1-2)

243   Planning for Higher Education Journal, *The Library as Learning Commons* by Derek Jones and Andrew Grote (April - June 2018) (p. 2)

244   Planning for Higher Education Journal, *The Library as Learning Commons* by Derek Jones and Andrew Grote (April - June 2018) (p. 7)

245   Society for College and university Planning, *Trends for Higher Education* (Spring, 2018) (p. 6)

3. Modernizing education delivery platforms

- In order to create technology-rich 21st century learning environments, schools must have the necessary infrastructure. However, there remains a digital divide between Indigenous communities, particularly rural and Northern communities, and the rest of Canada.

  ○ While a number of communities have become connected over the past several years, — either through terrestrial backhaul, high throughput satellite or industrial/institutional capable broadband — many Indigenous communities still fall short of the CRTC's and ISED's target connectivity speeds.[246]

- Five outcomes of modernization have been identified from a strategic plan by Laurentian University. The plan has broad-based input from faculty, administration, and students. Champions aligned with each outcome:[247]

  ○ Improve teaching spaces,

  ○ Enhance gathering and study spaces,

  ○ Integrate student services,

  ○ Create a Welcome Centre,

  ○ Support the intellectual milieu

1. The schooling we need

  ○ Canada's education system was designed to meet the needs of the 19th- and early 20th-century workplaces. It won't serve the nation's needs or keep its businesses and workers competitive in the decades to come. Canada must start reinventing its education system today. We should be experimenting aggressively in areas such as:[248]

    » Overhauling the curricula to ensure young Canadians are acquiring the capabilities needed to succeed in a digital world.

    » Re-examining how we organize our schools, from the physical setup to the school year itself.

      - Placing a greater emphasis on interdisciplinary work, mental agility, critical thinking, teamwork, relationship management, and the capacity to learn itself—in other words, coaching the integrated capabilities needed for the future instead of teaching individual subjects.

      - Encouraging students of all ages to take risks, fail, and begin again to equip them with the courage and resilience they'll need to learn new capabilities, start a new career, or launch a new business.

    » Post-secondary institutions must be redesigned into vibrant, diverse learning zones.[249]

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246 The Information and Communications Technology Council, *Digital Economy Talent Supply: Indigenous Peoples of Canada* (2017) (p. 15)

247 Planning for Higher Education Journal, *Campus Renewal: Working with what You've Got,* by Sydney Browne and Gary McCluskie (April - June 2018) (p. 2)

248 Deloitte, *The Intelligence Revolution: Future-Proofing Canada's Workforce* (p. 42)

249 Deloitte, *Age of Disruption: Are Canadian Firms Prepared?* (p. 36)

» More research dollars must be oriented towards commercially viable innovations.[250]

- Canadian researchers often struggle to turn their discoveries and innovations into marketable businesses. While Canadian governments have begun to tie university research funding to partnerships with business, notably with the Canada First Research Excellence Fund and the Ontario Research Excellence Fund, more must be done at post-secondary institutions to build out these partnerships. Universities should develop robust strategies to bring the best of their applied research out of the labs and into the market – perhaps in collaboration with other business or ecosystem partners.[251]

» Educational institutions at the primary, secondary, and post-secondary levels, are largely the products of technology infrastructure and social circumstances of the past. The landscape has changed and educational institutions should consider how to adapt quickly in response. Some directions of change might include:[252]

- Placing additional emphasis on developing skills such as critical thinking, insight, and analysis capabilities.

- Integrating new-media literacy into education programs.

- Including experiential learning that gives prominence to soft skills—such as the ability to collaborate, work in groups, read social cues, and respond adaptively.

- Broadening the learning constituency beyond teens and young adults through to adulthood.

- Integrating interdisciplinary training that allows students to develop skills and knowledge in a range of subjects.

» Establishing an education system where students can "learn to learn" will be critical to building
a skilled and resilient labour force. There is a role for the FutureSkills Lab to play in identifying new innovations in youth training and disseminating best practices.[253]

» Recent research by the Conference Board of Canada notes that credentialing in Canada is centered on education and work experience, neglecting softer skills. As a result, it is difficult for job applicants to signal their qualifications clearly beyond technical skills and industry exposure. Credentialing methods could be improved to reflect both technical and soft skills, allowing employers to better communicate their needs, and workers to better communicate their qualifying strengths.[254]

» Students want to learn in a variety of styles and settings, and at their own pace. Whether they're flexible, technology- enhanced classrooms, student lounges, and learning commons or just cozy alcoves, the spaces we create encourage learning and discovery.[255]

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250   Deloitte, *Age of Disruption: Are Canadian Firms Prepared?* (p. 36)

251   Deloitte, *Age of Disruption: Are Canadian Firms Prepared?* (p. 36)

252   Institute for the Future for the University of Phoenix Research Institute, Future Work Skills 2020 (2011) (p. 13)

253   Advisory Council on Economic Growth, *Building a Highly Skilled and Resilient Canadian Workforce Through the FutureSkills Lab* (February 6, 2017) (p. 3)

254   Advisory Council on Economic Growth, *Building a Highly Skilled and Resilient Canadian Workforce Through the FutureSkills Lab* (February 6, 2017) (p. 6)

255   Stantec, *Designing the Ultimate Campus Experience* (p. 14)

4. Technology Needed. New learning labs, simulation, VR, mobile learning

- Investments in technology make companies more productive and competitive, helping them grow. Moreover, the need for companies to both innovate and adopt existing innovations will only become more urgent as the pace of global economic change quickens. Smaller firms, however, tend to underinvest in new technologies and R&D, in part because the potential benefits that such advances can offer are not widely known.[256]

- Quality of space, flexibility for future change, and ability to foster multidisciplinary research appeal to elite students and researchers.[257]

- Equally important are the support spaces—cafes and collaborative places outside the lab—where students and faculty can meet to share ideas.[258]

- Researchers have shown that games can help students retain knowledge and keep learners engaged in learning. Your institution may offer courses or even a major in game development, but how well does it understand the science that connects games and learning? How effectively does it integrate games into the curriculum? What kinds of resources would it take to invest in gaming pedagogy?[259]

1. Labs and Tools

  - For post-secondary and lifelong learners, George Brown College invests in the development and delivery of e-learning courses using labs and robotic simulation software, reaching a wide and diverse audience of students and minimizing per-student training costs.[260]

  - Facilities such as health simulation labs and manufacturing workshops with up-to-date machinery and interfaces are expensive to build and maintain, but essential in fully engaging many students in their fields of study.[261]

  - The most successful academic medical centers are integrated platforms for interprofessional education focused on healing, discovery, and learning.[262]

256 Advisory Council on Economic Growth, *Investing in a Resilient Canadian Economy* (December 1, 2017) (p. 22)

257 Stantec, *Designing the Ultimate Campus Experience* (p. 27)

258 Stantec, *Designing the Ultimate Campus Experience* (p. 27)

259 Society for College and University Planning, *Trends for Higher Education* (Fall, 2016) (p. 3)

260 Advisory Council on Economic Growth, *Building a Highly Skilled and Resilient Canadian Workforce Through the FutureSkills Lab* (February 6, 2017) (p. 10)
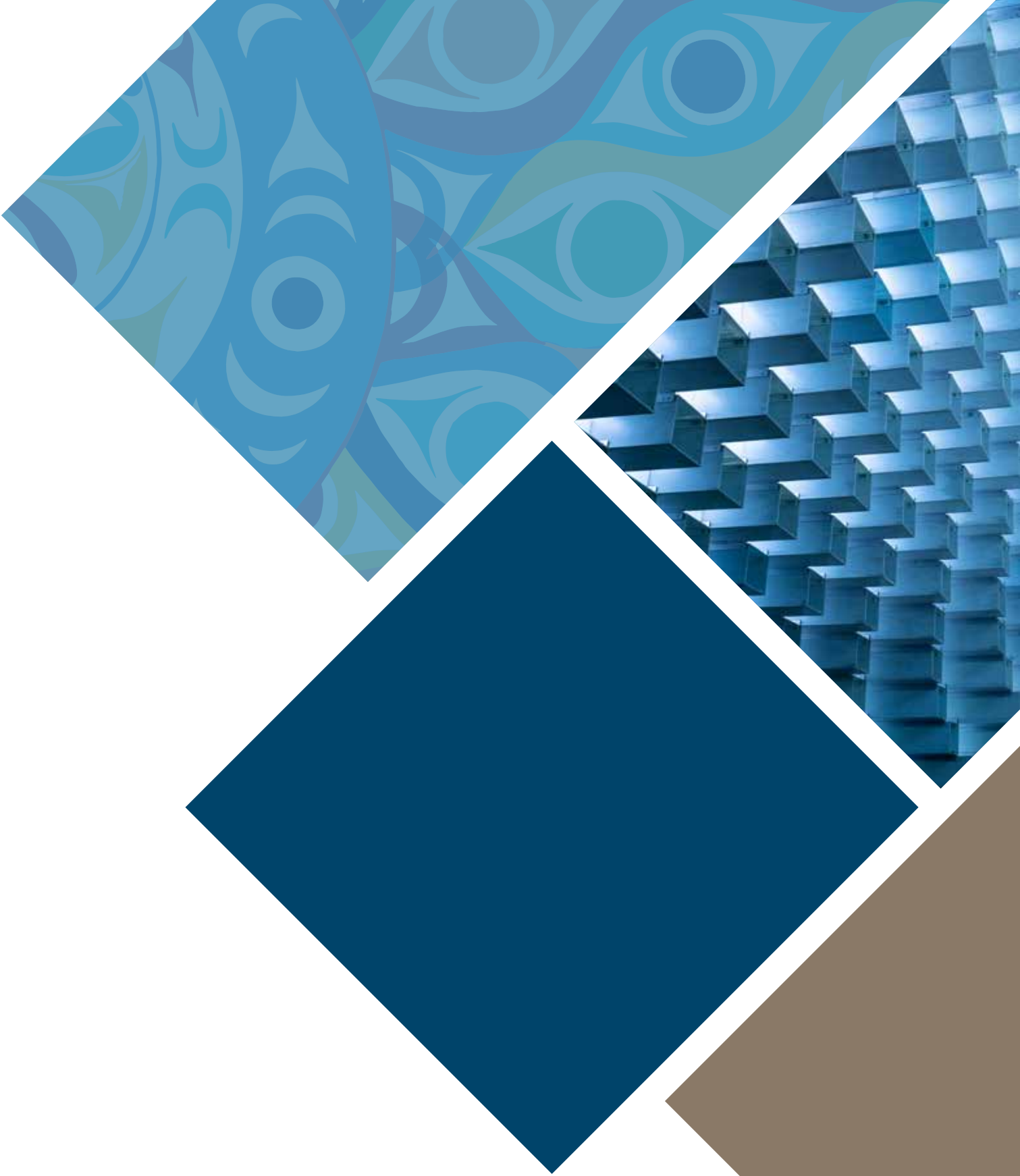
261 Planning for Higher Education Journal, *Symbiosis: Community Colleges Strengthen Mission by Engaging Their Host Communities…*, by B. Irwin and T. Patrick (Fall, 2016) (p. 119)

262 Stantec, *Designing the Ultimate Campus Experience* (p. 30)

○ Teaching laboratories are similar to classrooms, although more complex. They require a function-based taxonomy. We distinguish between wet and dry labs, and then focus on discipline specific requirements; i.e. for biology, say, we need to identify general biology labs, anatomy & physiology labs, micro-biology labs, etc. The usual policy discussions then apply, with two additional layers. The first involves sharing: must every relevant department have its own A&P lab? The second tackles the false dichotomy between classrooms and teaching laboratories. Lab utilization can sometimes be improved by including traditional classroom activity. Inventive flexible lab design solutions support this, by for example, placing services at the perimeter of the room.[263]

○ Major policy questions must be answered when creating or reconfiguring lab space: is research discipline or problem based, are platform driven approaches which allow sharing of equipment and ideas appropriate, etc. These decisions drive lab support requirements. Total lab needs are computed by aggregating required lab modules and support requirements across primary investigators and their groups, and require careful thought in the context of available capital, and particularly for lab buildings, ongoing operating commitments.[264]

263   Society for College and University Planning, *Kings of Infinite Space* by Gregory Janks (2012) (pp. 27-28)

264   Society for College and University Planning, *Kings of Infinite Space* by Gregory Janks (2012) (p. 40)

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