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GENERATION INNOVATION: The Talent Canada Needs for the New Economy

November 2016





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Acknowledgments

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FOREWORD: TALENT FOR AN INNOVATION ECONOMY

Canada's capacity for innovation will provide the basis for our competitiveness in an increasingly globalized world. One resource is more important than any other in fueling our capacity to innovate and that is our people.

Innovation happens everywhere. It goes from small everyday improvements in how we approach our work to disruptive changes that can totally redefine markets, but it always starts with people and the skills they have.

At a minimum, we need Canadians to possess the skills to adapt to these massive disruptive changes to make our economy resilient in these fast-changing times. Our aim should be to build a nation where everybody looks to continually make small improvements in what they do, where we have the right blend of skills to develop, promote and spread innovative ideas and where we can identify areas where Canada can be a leader in innovation and build the talent to deliver.

Based on where we rank internationally across a range of innovation metrics, we can, and must, do better. The federal government's Innovation Agenda is a good start to provide a strong vision for what we need to do to have an innovative society and where we should look to lead. But we all have a role to play in nurturing the diverse talent we need to deliver on our potential.

This journey will be guided by a close ongoing dialogue with employers to understand the particular skills needed to deliver innovation.

We must then build systems that encourage continuous skills development through dynamic collaborations across education and business.

The nature of innovation is that it does not stand still, and neither will our international peers and competitors. We need to develop an environment for skills development that can quickly adapt to changing trends and needs – one that has taken away any barriers to collaboration and one that provides the right incentives to develop talent for innovation.

No one organization can solve this challenge alone. That is why we worked with our business and academic partners to jointly develop this report and provide our recommendations to deliver talent for an innovation economy. We look forward to working with the government to make sure we make the most of our greatest asset when it comes to innovation – our people.

**Hon. Perrin Beatty, President and CEO,
The Canadian Chamber of Commerce**

Innovation: *the implementation of a new or significantly improved product (good or service) or process, a new marketing method or a new organizational method in business practices, workplace organization or external relations.*

Oslo Manual, OECD 2005

INTRODUCTION AND BACKGROUND

Countries, companies and individuals compete on their ability to develop and make money from new ideas, approaches and products in a fast-changing world. Today's global economy is characterized by accelerating disruption, deepening integration and increasing complexity. To succeed in such a tough environment, Canada needs to develop a society imbued with an innovation mindset and with the skills to match.

We are in the midst of what some call the “fourth industrial revolution.” This is an age of smart, integrated systems, intelligent manufacturing, automated supply chains and artificial intelligence and machine learning. We are also in an era of global competition. To survive, compete and thrive, businesses must continually evolve and innovate. Individuals also have to continue to develop their skills and knowledge to find their place in an economy that keeps changing. Canada should create an environment that promotes the desire, expertise and competencies for Canadians to lead the world in innovations to deliver real economic, ecological and social impact.

Having a population capable of churning out new ideas or adapting to new innovations will be the foundation of Canada's economic success and social cohesion. The state of competitiveness, productivity, innovation and talent in Canada has been an area of concern for a number of years, but it is an effort that cannot stand still. Over this time, numerous government, third party and expert panel reports have presented prescriptions for improvement. While a number of recommendations have been implemented in recent years, more action is necessary.¹

The federal government's efforts to reinvigorate Canada's innovation agenda are a step in the right direction. The government's six focus areas do well to recognize that innovation is much more than just technology. It involves nurturing skills, working together, focusing on strengths, recognizing trends and societal needs and, perhaps most importantly, providing an environment where making changes in the way we do things is easier. At the heart of innovation is talent, and, in order to succeed, Canada must build a system that enables and encourages people to innovate.

¹ Sulzenko 2016

Figure 1: Government of Canada Innovation Agenda

The Canadian government is focused on six areas for action:

1. Promoting an entrepreneurial and creative society
2. Supporting global science excellence
3. Building world-leading clusters and partnerships
4. Growing companies and accelerating clean growth
5. Competing in a digital world
6. Improving ease of doing business

Source: Government of Canada (2016)

The pursuit of innovation for innovation's sake is insufficient. The value of innovation lies in driving economic growth, creating jobs and raising living standards for the largest number of people. We must also understand innovation comes from a spectrum of input – from fundamental research to applied research and incremental changes in everyday business practices. Finally, we must recognize that talent is the raw material for that innovation.

Approach

This report explores how we can develop a workforce equipped for innovation and entrepreneurship. In doing so, we must resolve:

- What is the state of Canada's innovation talent?
- What skills will be most in demand to drive and adapt to innovation?

- How can we best prepare our current and emerging workforce to cultivate the essential skills that drive innovation?
- What role can businesses, governments and academia play in creating an environment that nurtures talent for innovation?

Individually, no single group can shape national talent development to deliver the best ecosystem for innovation. But through coordination, initiatives across the stakeholder base will create a variety of sustained talent development models necessary for Canada to not only compete but lead internationally.

CANADA IN THE WORLD: WHERE ARE WE NOW?

| World Economic Forum (Global Competitiveness Report 2015-16) | Out of 140 | Global Innovation Index (2016 Index) | Out of 128 |
|--|-------------------|--|-------------------|
| Competitiveness | 13 th | Overall | 15 th |
| Capacity for innovation | 23 rd | Innovation linkages | 21 st |
| Capacity to retain talent | 14 th | Knowledge workers | 26 th |
| Capacity to attract talent | 10 th | Knowledge-intensive employment | 16 th |
| Quality of education system | 14 th | Firms offering formal training | n/a |
| Quality of math and science education | 18 th | GERD performed by business | 24 th |
| Availability of specialized training | 16 th | Human capital and research | 22 nd |
| Venture capital availability | 20 th | Gross expenditure on R&D | 22 nd |
| State of cluster development | 20 th | State of cluster development | 19 th |
| Quality scientific research institutions | 18 th | Research talent in business enterprise | 16 th |
| Company spending on R&D | 26 th | Knowledge creation | 19 th |
| University-industry collaboration (R&D) | 19 th | Knowledge and technology outputs | 23 rd |
| Govt. procurement of advanced tech | 55 th | Creative outputs | 23 rd |

Compared to its international peers, Canada is at best in the middle of the pack when it comes to innovation across a spectrum of measures. Reports from both the Conference Board of Canada and the Centre for Digital Entrepreneurship and Economic Performance both find that Canada is struggling to even keep pace with its peers when it comes to innovation and has to crank up its efforts to stand out as a leader. As Canada looks to build a future around a knowledge economy, this should start with first understanding what innovation is in a Canadian context and how to deliver the talent to feed it.

The big scientific breakthroughs get the headlines, but Canada’s businesses, academic institutions and governments practise innovation daily. While historically treated as the barometer of innovation, research and development investment levels do not tell the whole story.² In fact, most innovations come through incremental improvements.³

Take a BlackBerry or iPhone launch. While each new device released may not represent a breakthrough innovation in itself, there is always an incremental process of improvement. That goes for the technology within the device to the refinement of all the processes for delivering the new device to market and into the hands of eager customers as early as possible.

Bringing devices like these to market involve multiple complex processes that are ripe for innovation. Building an iPhone, for example, relies on 24 primary suppliers on three continents and many more subcontractors, with the parts travelling the equivalent to the moon and back.⁴ Without the innovation it has brought to its best-in-class supply chain, Apple would not be the dominant force in technology it is now.

Figure 2: The Innovation Spectrum

| | Breakthrough Innovation | Disruptive Innovation | Incremental Innovation | Everyday Innovation |
|-----------------|--|---|--|---|
| Rate of change: | Revolutionary new concept that defines new markets | Makes something easier to use, lower cost, and available to more people | Noticeable improvement or step forward | Processes and practices that continually evolve, improve & simplify |
| Exponential | | | | |
| High | | | | |
| Medium | | | | |
| Low | | | | |
| | Very low frequency | Low frequency | High frequency | Very high frequency |

Source: BeyondCurious

2 Sulzenko 2016, p. 5

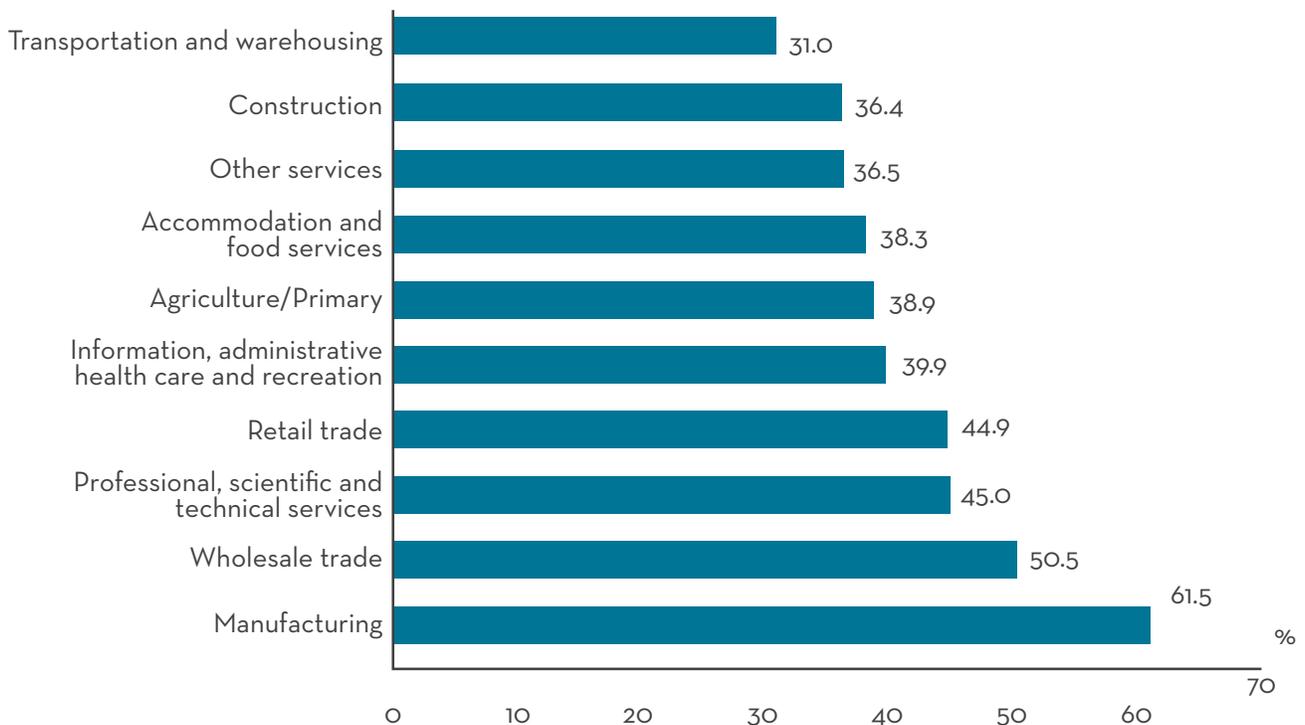
3 Government of Canada, p. 2-1; Toner 2011, p. 28

4 Wired, 2016

There is no single character trait responsible for innovation, nor is there a single way of innovating.⁵ Innovation in a law firm is very different from innovation in a mobile gaming company or a natural resource company. For

Canada, there is an opportunity to be a leader in many areas of competitive strength where a focus on innovation has lagged but where the potential impacts could be huge.

Figure 3: Percentage of SMEs Innovating within the Last Three Years by Industrial Sector (2012-14)



Source: Government of Canada (2016c)

⁵ CCA 2009, p. 26, Toner 2011

As global competition intensifies, government policies to enhance innovation have focused on market access, research and development (R&D) partnerships, education and talent attraction. Many countries have seen the value of finding a place in global value chains. This means companies and academic institutions must find their unique place in the procurement, innovation, R&D and multi-tier contracting ecosystems of the world's leading and largest companies.

By enabling access to global markets and supporting their scale up and expansion, integration within global value chains is particularly valuable to small and medium enterprises.⁶ Similarly, attraction of specialized expertise and highly qualified and skilled personnel has a heightened emphasis in many countries looking to address skills gaps or to enhance their positions as innovators in key sectors.⁷

Canada is just one of many countries that has identified global value chain strategies and immigration as a critical pillar of economic development and innovation. However, with so many countries adopting a similar emphasis, the question of the unique value and comparative advantage of the Canadian business and

innovation environment and the skills needed to deliver must be front and centre. The real innovation challenge may no longer be just about seeking comparative advantage but delivering a competitive advantage.

This issue is critically important given Canada's comparative position. Many other countries across the Organisation for Economic Co-operation and Development (OECD) have already developed sectoral acceleration, innovation and talent strategies. Canada risks becoming a "me too" player in the development of many important technologies and market areas and may continue to be the second or third choice location for skilled talent.⁸ This poses the question, do we want to limit our ambitions to being a fast follower or pursue a strategy to diversify and specialize to get from behind the queue of leading innovative countries?

Canada maintains a strong innovative business base across small- and medium-sized enterprises (SMEs) and large enterprise, has a highly skilled, educated and creative workforce, a strong and reputable academic sector (including colleges, polytechnics and universities) and an excellent reputation for quality of life and ease of business creation.⁹

6 OECD 2014, p. 15

7 OECD 2014, p. 16

8 Government of Canada 2016a, p. 29, 30; OECD 2014, p. 184

9 CCA 2015, p. xvi; Cheung 2012, p. 8; Government of Canada p. 2-14; Sulzenko 2016, p. 28

When assessing Canada's competitive position, we must recognize that globally, "at any point in time, the majority of firms are not actively engaged in innovation."¹⁰ The *2014 Survey of Advanced Technology: Innovation and Business Practices*, found that of 12,000 enterprises surveyed, 55% were deemed "innovative," having introduced at least one type of innovation over the period.¹¹ Process and organizational innovation were most common, followed closely by product innovation.

Large organizations surveyed were relatively more innovative than medium-sized and small businesses, but no specific reasons for the difference were identified. Potential reasons may be as varied as working capital access, government support or the enhanced ability to invest in advanced technology.

The government's most recent report on key small business statistics indicates that, depending on the industry, between 31% and 61% of SMEs were innovating from 2012 through 2014.¹² Although innovation levels within SMEs cannot be expected to equal those in larger businesses, the discrepancy in investment levels is cause for concern. We must also distinguish between SMEs that are growth-oriented and those that can more easily be described as "mom and pop" shops. Growth-oriented companies should be held to a higher standard.



¹⁰ Toner 2011, p. 24

¹¹ Statistics Canada 2016

¹² Government of Canada 2016c, p. 17

Five Years after the *Jenkins Report*: The Bold Action Not Yet Taken

Dr. Nobina Robinson, CEO, Polytechnics Canada

The October 2011 report, *Innovation Canada: A Call to Action*, also known as the *Jenkins Report*, had called for a fundamental rethink of how government support for business innovation is structured and delivered. In the intervening years, a mixed record of implementing only a few of the report's six bold recommendations has not helped to improve business innovation measures, such as BERD (business expenditure on R&D) or Canada's world innovation rankings.

As a member of the Expert Panel on the Review of Federal Support to Research and Development, Nobina Robinson, CEO of Polytechnics Canada, suggests the 2016 priority for federal action on the Innovation Agenda must squarely focus on three key areas.

First: the question of the machinery of government and the 2011 recommendation for creating an Industrial Research and Innovation Council. Consolidating all federal research support for industrial innovation into one entity that will use common nomenclature, set national standards for outcomes of federal programs that support business innovation (as opposed to those that support discovery and pure science) and make it easier for business to use the multitude of grants, loans and contribution programs is urgent now, especially given the constraints on the federal budget.

Second: no material action has been taken to implement the *Jenkins Report's* recommendation that "business innovation should be one of the core objectives of procurement." In this context, the *Jenkins Report* had urged the government to consider the U.S. Small Business Innovation

Research program as a model, whereby federal agencies set aside a percentage of their own R&D budgets to stimulate small business innovation. If Canada had an SBIR program today, it would foster large-scale collaborative R&D that is demand-driven and solutions-oriented with government as first customer.

Finally, the *Jenkins Report* had made a strong call for the development of a federal business innovation talent strategy to be delivered by the Industrial Research and Innovation Council. Specifically, the call was for a "talent strategy that was focused on increasing business access to, and use of, highly qualified and skilled personnel."

The vision remains unfulfilled: "to consolidate federal industrial internship and youth employment programs, creating a larger, more flexible program open to all senior undergraduate and graduate students and all post-doctoral fellows from across our post-secondary educational institutions ... creating opportunities for entrepreneurship, mentoring and ... developing the full range of industrial relevant research, development and commercialization skills for trainees, including both technical and professional 'soft' skills."

The Innovation Agenda of 2016 gives Canada a rare chance at acting on these long-standing recommendations. We see a renewed interest in discussing national strategies or whole-of-government action, made more urgent as the country seeks to eke out growth across all industrial sectors.

We must overcome the false dichotomy between the need for innovation skills and the need for a more innovative workforce: do we need more R&D performers in our talent pool or do we need to ensure the full talent pool has acquired innovation skills? Or, do we need both?

Data indicate that in December 2015, there were 1,143,630 small businesses, 21,415 medium-sized businesses and 2,933 large businesses.¹³ In 2013, investment in R&D totalled \$3.9 billion for SMEs, \$2.7 billion for medium-sized business and \$9 billion for large business.¹⁴

To better position ourselves to deliver a better system for talent development for innovation, it is also important we recognize progress already made. While R&D and innovation investments must increase to maintain and grow Canada's position in the global market, significant R&D and innovation programs already exist that can be built on.

Still, the need for a deeper understanding of the current state of innovation is particularly important given the level of government investment dedicated to innovation and R&D programs. The Expert Panel Review of Federal Support to Research and Development identified over 60 programs across 17 government entities and concluded that the combination of program fragmentation and inadequate size resulted in an ineffective and inefficient application of resources.¹⁵

Significant gaps were identified in the area of large-scale industry-facing, demand-driven, outcome-oriented, collaborative R&D and innovation projects.¹⁶ As well as with the lack of a national business innovation talent strategy focused on "increasing business access to, and use of, highly qualified and skilled talent."¹⁷

Whether these many innovation programs stimulate the development of innovation talent is debateable since this outcome is rarely a measurement of success. Instead, we often assume that if money is provided to support an R&D initiative, talent development will result. Such an assumption should not be so readily made. Indeed, many external factors affect the development of innovation talent. These factors must be taken into account for government investment to have a long-term cumulative impact on Canada's status as an innovator.

We should neither be satisfied with our current state nor overreact with fear. Instead, we should recognize our strong foundation and build upon it in order to enhance our competitive position. Talent is one of the most important building blocks in this pursuit. This report provides critical prescriptions for the further development of our talent.

¹³ Government of Canada 2016c, p. 3

¹⁴ Government of Canada 2016c, p. 17

¹⁵ Government of Canada 2011, p. 3-12

¹⁶ Government of Canada 2011, p. 7

¹⁷ Government of Canada 2011, p. 5-14

Views from the Roundtables

Toronto: Shooting for Better Results Means Changes in Approach

When it comes to developing an innovation strategy for Canada, Dr. Wendy Cukier, former Vice President of Ryerson University, is as familiar as anyone with the past efforts by the federal government. As one of the presenters at a Canadian Chamber roundtable discussion, held in Toronto in late June 2016, she made it clear that past approaches to stimulate innovation have had gaps.

Commenting on the recurrent complaint that investments in university research are not producing the innovation payoff government expects, she noted, “If you invest in research, you get research. If you reward professors only for publishing research papers, that is what you will get. If government wants more focus on markets, on commercialization, on innovation and societal impact, it needs to provide a system that rewards success in these domains.”

“We keep doing the same thing over and over and expecting different outcomes. While government talks about wanting to drive more economic development, the reward system is unchanged. There is a gap between rhetoric and action,” she said. “Is the creation of a post-doctoral (position) the same as the creation of sustainable job? I would argue not.”

When one thinks about talent to support an innovative economy, it is not just about supporting the social sciences, humanities and design as much as computer scientists and engineers, in her view. “Yes, we need them but we also have to look at issues that are related to technology adoption and ensuring that graduates in *all* disciplines have the skills needed to assess, use and explore the implications of technology.”



Alex Parizeau, Managing Director, Ubisoft Toronto, Perrin Beatty, President and CEO, The Canadian Chamber of Commerce, The Honourable John McCallum, Minister of Immigration, Refugees and Citizenship, and Jim Copeland, Chief Operating Officer and Regional Managing Partner, Central Canada, Grant Thornton LLP, discuss the talent Canada needs for an innovation economy during a roundtable held in Toronto on June 27, 2016.

She gives kudos to the B.C. government for introducing coding as a core skill in its K-12 curriculum. And she believes we have to get serious about women in technology. “There are fewer women in computer science than there were 25 years ago,” she noted.

Alex Parizeau, Managing Director of Ubisoft’s Toronto studio, is equally enthusiastic about coding skills and the need for more women in technology. He said that schools have to get the attention of girls at ages eight to 10 years to get them into science and technology. Ubisoft is involved in several initiatives on both fronts.

As a growing, more diverse talent pool for video gaming is being developed, Parizeau relies in the short term on hiring senior talent to help train new entrants. By 2020, the Toronto studio will grow to 800 employees from its current level of just over 400.

While Parizeau also credits the federal SR&ED program for “allowing us to surpass the competition in innovation,” he makes it clear that talent is at the heart of a video game industry that could be a driver of innovation in Canada.

A willingness to partner and collaborate—including between the private and public sectors—will make a difference to Canada’s innovation record, according to Dr. Rick Huijbregts, Vice President of Industry Transformation and Innovation for Cisco in Canada. For him that also means figuring out how to work with the public sector to bring digital skills to schools. Cisco’s Networking Academy currently teaches IT and network skills to over 22,000 secondary and post-secondary students in Canada.

For start-ups, it is more than information and communications technology skills that are needed, pointed out Pat Horgan, Vice President of Operations for IBM Canada. “The gap is not just the coding or the analytics; it is actually a lot of the business skills that are required. Entrepreneurs line up (at mentoring sessions) to ask questions to someone who has been through it,” he said.

Horgan urges businesses to try offering help at incubators and accelerators, where putting the disciplines together—the business and social skills, along with the technology—can make a difference to a start-up’s success.

Among other observations on innovation talent in Canada, participants said, “it is more than the information technology sector;” it is “more than the Toronto-Waterloo nexus;” and “doing the same stuff over and over, is not getting us where we want to go.”

Vancouver: An Ecosystem Seeks Scale

Entrepreneurial spirit is strong in Vancouver, according to participants at the Canadian Chamber’s roundtable discussion, held in early June 2016. Scale (the ability of companies to scale up to become global companies), however, is lacking.

Among the 9,000 technology companies in B.C., only 4% have more than 50 employees, says Bill Tam, CEO of the BC Tech Association.

Access to global companies affects the talent pipeline, too. Co-op students in Waterloo, Ontario may have work terms with global companies and then graduate in higher demand as a result, says Tam. In Vancouver, there are fewer global firms, though Microsoft, SAP and others are active in training and mentorship.

For players in the innovation ecosystem, the challenge is to embrace a growth mindset rather than a “fate mindset,” as one participant said. Dr. Kim Dotto, Dean of Applied Research at the British Columbia Institute of Technology, believes the government may need to change the way it measures success if it wants to spur growth.

“The numbers of patents and papers may be poor indicators of economic success or value,” he said. “Government should base funding programs on outcomes it wants to achieve and allocate to whomever will best reach those outcomes.”

Educators are concerned about business skills. “We need to develop the business acumen of our students,” says Dr. Joy Johnson, Vice President, Research, at Simon Fraser University (SFU). She sees a role for universities to foster entrepreneurial activities. “We have to create a culture where students can take risks,” she says. At SFU’s Venture Connections, for example, students have opportunities to incubate business ideas.

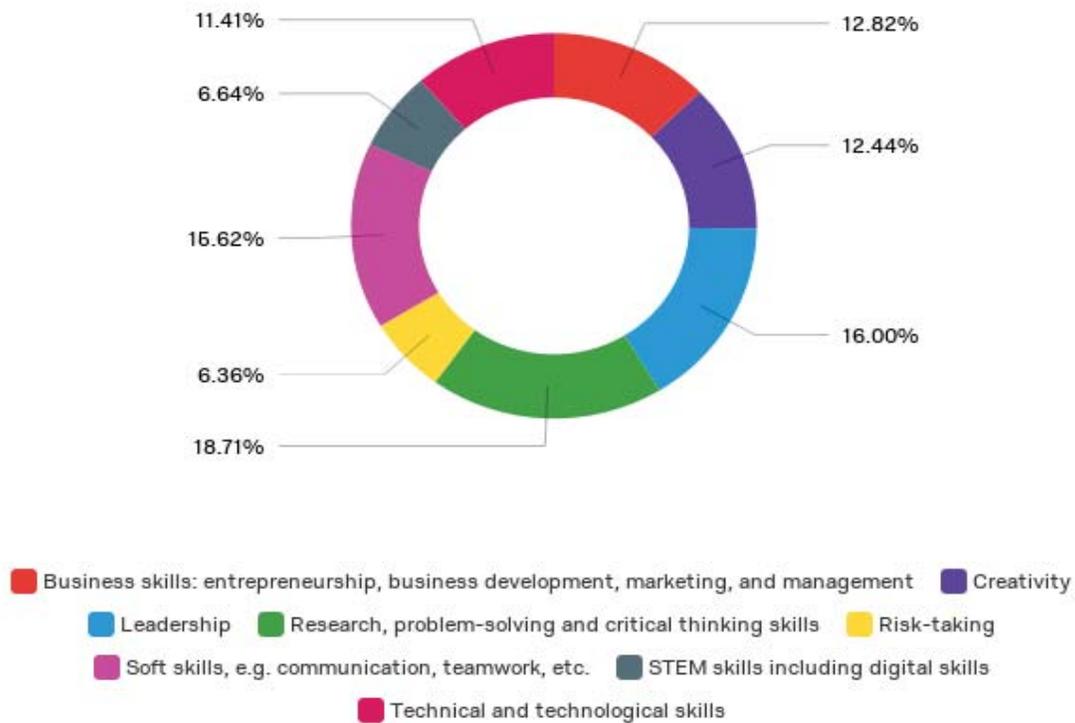
SKILLS FOR INNOVATION

Much research on innovation equates it directly with R&D or science and technology. This assumption implies that better innovation demands increased and higher quality science, technology, engineering and mathematics (STEM) participation in the workforce. High-level STEM skills are needed to advance scientific knowledge and deliver technological breakthroughs, but having a broader STEM-literate society helps turn those ideas into products and services.¹⁸ According to the Council of Canadian Academies

(CCA), STEM skills provide the basis for the scientific and technological breakthroughs that can have long-term impacts on productivity.

STEM skills are very important but, alone, are not enough. A survey from the Human Resources Professionals Association found that when it comes to innovation the most in-demand skills are research, problem-solving and critical thinking.¹⁹ The survey also indicates a range of skills is both needed and desired, including communication, teamwork and leadership.

Figure 4: Innovation Skills in Demand



Source: HRP: 2016

¹⁸ Council of Canadian Academies, 2016

¹⁹ HRP, 2016

In spite of a dearth of empirical studies considering innovation-specific skills,²⁰ appreciation of the extent to which non-STEM occupations are critical to innovation in the 21st century economy is increasing. Recent years have seen a shift from radical, linear innovation assumptions to more incremental, agile innovation.²¹ Progress from pure science to discovery to “big bang” disruptions, is very important but relatively rare. Iterative design, build, test and adjust cycles, resolving key technical and user issues and delivering “new- to-firm” innovation is much more common and makes a daily contribution to building overall productivity and economic competitiveness.²²

This distinction between radical and incremental innovation affects supply and demand for skills, knowledge and occupations.²³ The incremental innovation process involves greater participation by non-STEM occupations, such as technologists, tradespeople, designers, marketing, quality assurance, procurement and others, to support prototype development, applied research, product and process enhancement and commercialization. In OECD studies, non-STEM occupations comprise 46% of the innovation workforce.²⁴

Incremental innovation also requires new forms of entrepreneurial management and entrepreneurial skills. This a critical area of skills development that has received greater focus in Europe²⁵ and has been identified as a gap in Canada, particularly within SMEs.²⁶

Across industry, the nature of innovation varies. While incremental innovation pervades industry, it is particularly influential within SMEs and across information and communications technology (ICT) and manufacturing. The pharmaceutical and medical industries still favour radical, linear innovation strategies.

Skills vary as organizations pursue different innovation strategies at different phases of their development (from start-up to scale-up to expansion) or based on external competitive drivers and urgencies. It is often the stage of the product or technology life cycle, not the stage of the company, that determines the type of innovation and the necessary skills that a company needs.²⁷

The existing literature fails to differentiate between the specific talent requirements based on firm size or stage. A better approach would

20 OECD 2011, p. 9

21 Sulzenko 2016, p. 23

22 OECD 2011, p. 10

23 Toner 2011, p.10

24 Toner 2011, p. 25

25 OECD 2014, p. 238

26 Cheung 2012, p. 24, Institute for Competitiveness & Prosperity 2016, p. 28

27 Toner 2011, p. 29

recognize that no “one-size-fits-all” strategy for innovation talent development exists.²⁸ In other words, to put a strong emphasis on STEM over non-STEM occupations, or vice versa, would be inadvisable.²⁹

The overwhelmingly emergent theme is that regardless of size or stage, the challenge is getting people with the core capabilities and competencies to approach problems effectively, to work together to solve complex problems and to develop creative solutions. As a result, skilled talent development strategies and related policies must pursue a balanced approach that recognizes the essential contribution of a blend of skills toward a high-octane innovation economy.

Experts have long called for a focus on “21st century skills.”³⁰ Recent reports have begun to differentiate between the various competencies that enable innovation, with “technical” expertise representing one of a number of individual characteristics viewed as necessary to develop an individual’s innovative abilities. Soft skills,

emotional intelligence, creativity, design thinking, interpersonal skills, entrepreneurship and organizational awareness are all viewed as the complementary foundation upon which innovative attitudes are developed.³¹ Without them, efforts to transition highly qualified and skilled personnel into an innovation-driven 21st century workforce will not reach their potential.

Whether identified through formal apprenticeship designations or by educational attainment, an individual’s ability to perform a particular function or role has been assessed, until recently, by formal qualifications or credentials. Today’s thinking shows a growing recognition that competencies that cross disciplines better indicate job knowledge and performance.³² These competencies comprise technical and soft skills, characteristics and abilities in combinations appropriate to the function, role and industry. They further complement workplace-specific skill combinations that evolve through life-long learning.³³

28 Toner 2011, p. 15

29 CCA 2015, p. xvii

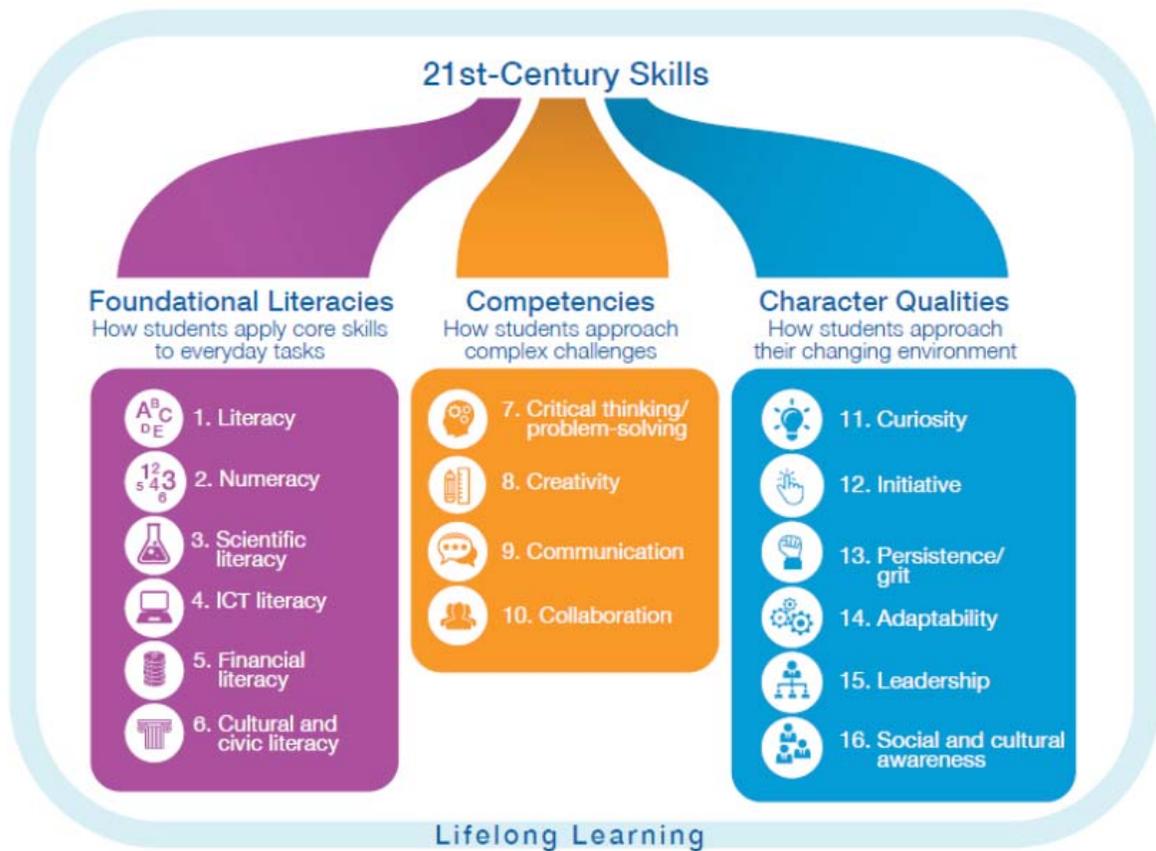
30 Cobo 2013, p. 69

31 ICTC 2016, p. 21; OECD 2011, p. 9; Toner 2011, p. 8, 14; Cobo 2013, p. 67; Vandemeyer 2016

32 Cobo 2013; Toner 2011, p. 55

33 WEF 2015

Figure 5: Sixteen Skills Required for the 21st Century



Note: ICT stands for information and communications technology.

Source: WEF (2015)

Innovation Skills 2.0

According to the Conference Board of Canada, successful innovation in organizations requires a combination of skills, supportive cultures and climates, structures and processes and leadership. The key skills the Conference Board of Canada notes are:

1. Creativity, problem solving and continuous improvement skills
2. Risk assessment and risk taking skills
3. Relationship building and communication skills
4. Implementation skills

Source: Conference Board of Canada, 2012

In the United States, the O*NET database provides an initial step in this direction. It characterizes 965 occupational categories according to their required component skills, abilities and knowledge.³⁴ The OECD Programme for the International Assessment of Adult Competencies (PIAAC) similarly analyzes the skills and competencies of adults across 25 countries.³⁵ With support from the *Jenkins Report* Expert Panel's recommendations for a national talent strategy,³⁶ a greater focus on competencies in Canada can better define characteristics of workforce innovation and enable greater workforce flexibility.

That some of these capabilities and competencies germinate through the course of a STEM education is of course understood. But in creating an innovation culture, the value of a STEM education also lies in the acquisition of many of non-technical skills. The capacity to think scientifically and systematically – “to enquire, investigate and continuously create new methods of discovery”³⁷ – is particularly important.

As noted by the CCA, “the fundamental skills required for STEM literacy, such as problem solving, technological proficiency and numeracy, represent essential components of working smarter ... and are thus vital to all Canadians.”³⁸ A parallel analysis of the benefits of student

engagement in applied research projects within colleges and polytechnics shows that practical engagement in industry-driven projects results in an increase in the soft skills required for a collaborative, creative and curiosity-driven character, on top of technical skills.³⁹

Similarly, many of these skills, such as problem solving and creativity, are developed in undertaking fundamental research. The social sciences and humanities also develop knowledge about human thought, behaviour and experiences, which is fundamentally important for understanding how people adapt to and adopt new technologies. Understanding people, and their different needs, provides the reason behind bringing new innovations to market.

For Canada to be a global innovation nation, it also needs young Canadians to learn from other countries and cultures. Open minds mean open borders for trade, immigration and ideas. Only 3% of Canadian university students (approximately 25,000) go abroad in any given year, despite 97% of universities offering international experiences. Through international student mobility experiences, students can develop greater risk taking, adaptability, flexibility, language and intercultural skills as well as knowledge of global markets before they graduate.

34 OECD 2011, p. 94

35 OECD 2011, p. 95

36 Government of Canada 2011, p. 5-14

37 Cobo 2013, p. 73

38 CCA 2015, p. vi

39 Luke 2013, p. 39

Blending the Hard and the Soft

Interview with Robert Luke, Vice President Research and Innovation at OCAD University (formerly of George Brown College)

Hard skills and soft skills—the well recognized set of skills that are inputs to innovation—can be taught, learned and practised, according to Robert Luke of OCAD University.

“Some say entrepreneurs are born, and entrepreneurship cannot be taught, but that’s not true,” he says, citing Roger Martin’s remark that entrepreneurship isn’t taught in Canada.

All skills can be taught, in Luke’s opinion. Equally important when it comes to innovation, is recognizing that it takes a range of skills. Consider what it takes to launch a rocket.

“One person alone will not get a rocket launched,” says Luke, who explains the process of technology readiness levels used at places like NASA. “The rocket scientist may think of the idea, but it will need people from different backgrounds and disciplines and with different credentials to get it launched. We need to get past the lone inventor concept of innovation and recognize that innovation is a team sport.”

Innovation requires investment in a variety of education and the intentional support to put people together from different disciplines and different types of credentials according to the need of a given product, service, idea or area under development.

“We need to work together better in Canada at linking basic research with applied research and experimental development—the innovation side of the equation,” says Luke, who points to

the Fraunhofer in Germany (Europe’s largest application-oriented research organization) and the Advanced Research Projects Agency (ARPA) in the U.S. Through the Fraunhofer approach, somebody can earn a PhD while working with firms, explains Luke. “There is an automatic receptivity to sponsoring research. There is a clear articulation between industry, research and education.”

The ARPA stands up national grand challenges where people from the public and private sectors are recruited for time limited projects. Teams are assembled to address these grand challenges together, with clear supports and mandates to boost ideas from concept into viability.

“The point of connecting industry with learning is to learn and practise the breadth and depth of skills and competencies to make innovation happen,” says Luke.

A national conversation is also important. “We are the only OECD country without a national minister of education. Like education, health is also an area of provincial jurisdiction, “but we have a national minister of health,” says Luke.

Intentionality will go a long way, he believes. “We need all players to realize this is our time to lead. The status quo has got us into a moribund state. What is our mission as an economy and country? What do we want as an outcome? What are the inputs to get the outcomes?”

“If we can decide what outcomes we want—say a focus on green and clean tech and sustainability—we can proactively pivot our economy from resource extraction to the design of more value added products and services,” Luke says. “By deciding on outcomes, we can better understand the inputs needed for a more resilient economy.”

Lessons Learned and Rewarding Risk

Interview with Dr. Justin Gammage, Industry Liaison Manager, University of Ontario Institute of Technology

When assessing our culture of talent development in innovation, Dr. Justin Gammage at the University of Ontario Institute of Technology's (UOIT) General Motors Automotive Centre of Excellence (ACE) has seen first-hand the benefits of bringing different skills together.

The Automotive Centre of Excellence, located in Oshawa, Ontario, has one of the largest and most sophisticated climatic wind tunnels on the planet. The facility has been used for everything from observing how firefighters perform in extreme weather conditions to seeing how drones cope with all kinds of climatic conditions.

“Most facilities like this are located within large car companies. The drawback is that the only people who get access to this kind of facility are usually engineers and access is fairly restricted. By having ACE located at a university, it gives more exposure to different kinds of expertise and different types of organizations who all bring fresh ideas,” says Dr. Gammage.

An example Dr. Gammage gives is that of health scientists using ACE and coming up with ideas to make passengers more comfortable when they travel. The facility has been used by nine different sectors to test products, all under the inquisitive eyes of UOIT students.

“The facility is available to companies, start-ups and researchers. This really benefits small companies that are able to access this world-class facility to

help test and commercialize their ideas. They can also tap into the expertise available at UOIT. A major benefit for us is that students and professors are engaged and get to work closely on industry projects and develop their skills.”

Beyond business, the facility has also become a focus for partnerships with other academic institutions. The firefighter research was done together with Durham College, for example, and other universities, such as Waterloo and Queen's, are exploring new opportunities for research at ACE.

“Having a facility like this is a catalyst for skills development. It encourages industry and other institutions to partner with us, and our students really feel the benefit. We are passionate supporters of work integrated learning, and for our students to work so closely with these companies as they develop cutting edge technology, is priceless.”

One area that would help further encourage this collaboration is through a more agile government funding system. The pace of technology means that, although funding is available, the complexity of the current system means it is difficult to respond quickly to industry needs. This means opportunities are missed to further encourage partnerships with industry and develop innovation skills.

Encouraging the kind of partnerships we see at ACE by making collaboration as easy as possible and by investing in this kind of facility would go a long way to building world-class innovation talent in Canada.

Cultivating Talent for an Innovation Economy

The cultivation of talent for innovation cannot happen in one silo – innovation, itself, is a spectrum and, therefore, requires a spectrum of talent if it is to grow. Further nurturing talent for innovation requires the collaboration of a range of actors. In Canada, the actors that play the most integral roles for the private sector are:

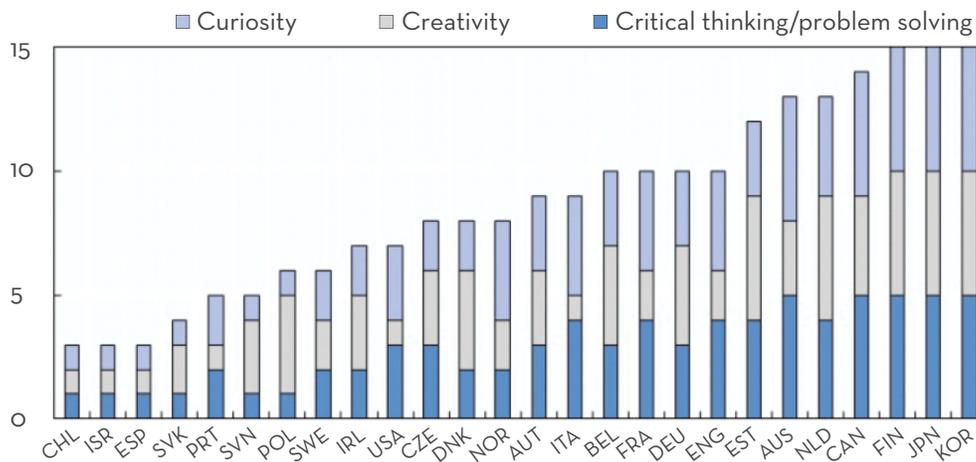
1. **Education:** the suppliers of talent
2. **Business:** the ultimate end user of talent
3. **Government:** the promoter of an economic vision and market regulator of talent supply and demand

An Accelerating Urgency

The magnitude of the disruptive changes of the 21st century economy demands an innovative and competitive Canadian workforce. Ultimately, developing these competencies is not just about workforce development. It is about developing a society with an innovation mindset – an entrepreneurial and creative society with the desire, expertise and competency to innovate in every aspect of life and to proudly lead the world in economic, ecological and social impact.

Canada currently places well in the OECD for integrated soft skills. But a closer look at the data indicates that an increased focus on developing entrepreneurial mindsets within the workforce would increase our effectiveness and leadership role.⁴⁰

Figure 6: Relative Soft Skill Levels in OECD Countries



Notes: The values for each indicator correspond to the quintiles of the skills levels across available OECD countries (1 for countries with the lowest levels, 5 for countries with the highest levels).

Source: WEF (2015)

Cultivating innovation talent requires integrated strategies for the active and coordinated engagement of all the actors in an innovation ecosystem, including educational institutions,

businesses, and government. Each is critical to success and has an individual contribution, but their cumulative effect would lead to better skills and economic outcomes.

40 WEF 2015

THE CONTRIBUTION OF EDUCATION

Education systems form the foundation for the successful development of the 21st century workforce. But the education system itself in Canada is fragmented into 13 different systems, offering over 18,000 programs through almost 250 institutions.⁴¹

Canada's post-secondary education system comprises community colleges, polytechnics and universities that provide apprentice, certificate, diploma and degree-based education. Although they actively incorporate discovery research, applied R&D and "work-integrated learning" activities into their educational processes, Canada's overall post-secondary education system can best be characterized as a patchwork of industry connection programs with little consistency.⁴²

Systems, and the institutions themselves, must adapt in order to evolve into 21st century learning environments.⁴³ In keeping with the global trend, formal education in Canada faces a challenge to keep pace with the new innovation economy due to the rapid pace of societal and technological change.⁴⁴ To incorporate "innovation literacy,"⁴⁵ the Canadian education system must rapidly adapt. Teaching and student assessment should not inhibit risk taking, but promote curiosity-driven inquiry and skills development.⁴⁶

A big opportunity is in leveraging government R&D funding for higher education. Thirty-eight per cent of Canada's R&D spending comes through higher education.⁴⁷ This represents a major opportunity to improve Canada's record around commercialization and provides an incentive to develop skills for innovation, both for students and educators, through partnerships with industry. It is also an opportunity to foster collaboration across different types of post-secondary educational institutions, exposing all involved to different skill sets.

Beyond incorporating industry experience, programs across all post-secondary education systems need to do more to work with business to incorporate in their programs the competencies essential to a 21st century workforce.⁴⁸ In many cases, this will require significant curriculum re-design and strategies for engaging faculty members. A strong model already exists in Canada. Polytechnics and colleges have program advisory committees that are formed with employers to develop curricula.

A report from the Information and Communications Technology Council added that the opportunity to engage youth extended beyond post-secondary education to include elementary and secondary education. K-12 education must

41 EduCanada, 2015

42 Cheung 2012, p. 36

43 ICTC 2016, p. 34

44 Cobo 2013, p. 68, Sulzenko 2016, p. 27

45 Luke 2013, p. 38

46 Cheung 2012, p. 25

47 Conference Board, 2016

48 Cobo 2013, p. 71; ICTC 2016, p. 22; OECD 2011, p. 12

be on the frontline of the workforce development process.⁴⁹ It is in the early years of development that children build or forego many of the essential abilities and competencies that contribute to collaboration, curiosity, discovery and creativity.

Creative, participative, discovery-based and digitally enabled learning techniques must be incorporated in all aspects of K-12 education.⁵⁰ The centrality of these techniques has been recognized for many years, yet studies have shown that few teachers incorporate them in their education processes.⁵¹

What Employers Need: The Example of Coding

As Canada continues to experience a skills gap in innovation, federal and provincial governments have an important role to play in crafting education policy that better reflects the demands of the 21st century. Specifically, Canadian provinces should move forward with ensuring coding is introduced as a mandatory part of the K-12 curriculum. While any efforts are welcome, the importance of making computing and digital skills available early on in the education system is now understood.

To date, British Columbia and Nova Scotia lead the pack in innovative education. Both provinces have committed to introducing coding programs into their classrooms. Federal coordination on

this, including an analysis of international best practices, could go a long way to ensuring the widespread success of our students. Teachers, too, must be able to benefit from these initiatives. For our students to succeed, teachers must have the necessary training to feel confident in executing these programs.

As always, time is of the essence. Without action, Canada risks falling further behind its international competition. Next door, the United States is also paying attention. Through a partnership with Microsoft, the U.S. government has initiated a program that encourages the hiring of teachers trained in technology with STEM degrees. The United Kingdom has introduced the National Computer Curriculum initiative, which forms a core part of the education curriculum. While a government program, it also benefits from strong partnerships with private sector leaders. And France's Great Digital School, a national training initiative aiming to hone digital skills, helps ensure French students and workers remain internationally competitive.

In order to thwart any competitive disadvantages, forward thinking approaches to education require the inclusion of digital skills such as coding. While some provinces have made promising steps, further pan-Canadian progress is required.

49 CCA 2015, p. xiv

50 Cobo 2013, p. 75

51 Cobo 2013, p. 80

Recommendations

With this in mind, we propose Canada's education actors:

1. Support the expansion of research internships and work-integrated learning across the entire post-secondary education sector.
2. Encourage provinces, through benchmarking or funding, to enhance curricula to integrate more experiential learning throughout the K-12 and post-secondary educational systems, focusing on developing underlying competencies and characteristics that foster innovation.
3. Leverage the Strategic Investment Fund to ensure post-secondary education institutions are equipped with cutting-edge facilities and infrastructure to provide platforms for academia to collaborate and attract industry partners and create an environment for innovation.
4. Expand opportunities for researchers and post-secondary students to engage with industry through collaborative projects and work placements.
5. Provide one single point of contact at post-secondary institutions to make it easy for industry to partner on skills development and research.



THE CONTRIBUTION OF BUSINESS

Research by the Conference Board of Canada found that Canadian businesses spent around \$800 million on learning and development in 2014-15, slightly up on the previous year but only two-thirds of what was spent in 1993.⁵² Businesses have a critical role to play in fostering an innovative workplace by investing in talent and providing an environment that promotes new ideas. Here, employees learn the detailed skills and norms to effectively perform and grow.⁵³

Workplace culture and organization are critical enablers of innovation and are critical to the survival and success of many companies. In particular, factors, such as job flexibility, delegation processes and incentives, impact the effectiveness of formal and informal workplace learning and the ability to introduce new ideas.⁵⁴

Specific needs will vary and no “one-size-fits-all” solution exists, but all businesses, regardless of size, maturity or industry, must ensure their culture and organization are designed to drive their employees’ innovation competencies. This alignment increases the “absorptive capacity” of the workforce – “the ability to adopt, adapt and diffuse new or improved products, production processes and organizational innovations.”⁵⁵ High performance work systems are one form of work organization that is particularly suited to building

and enhancing innovation based workforces, however, they are not currently in widespread use.⁵⁶

Business-academic collaborations also present excellent opportunities for the development of workforce innovation skills by providing real-world cultures and work organization practices. Expert panels have identified a need to promote more of these collaborations,⁵⁷ which lie at the heart of key recommendations for innovation and talent enhancement.

Businesses can engage with academic institutions in fundamental and applied research projects, capstone projects, co-ops and internships and other work integrated learning programs. Successful collaborations require a shared understanding of the success drivers and timelines within academia. But not all institutions are the same or have the same motivations for innovation or R&D collaboration.

The speed at which they move and execute projects can vary significantly. The difference between polytechnics applied research projects and university research, for example, is significant. University output is often more fundamental and measured in years, conducted by senior research staff and benefits from

52 Conference Board, 2015

53 OECD 2011, p. 13

54 OECD 2011, p. 13

55 Toner 2011, p. 8

56 Toner 2011, p. 57

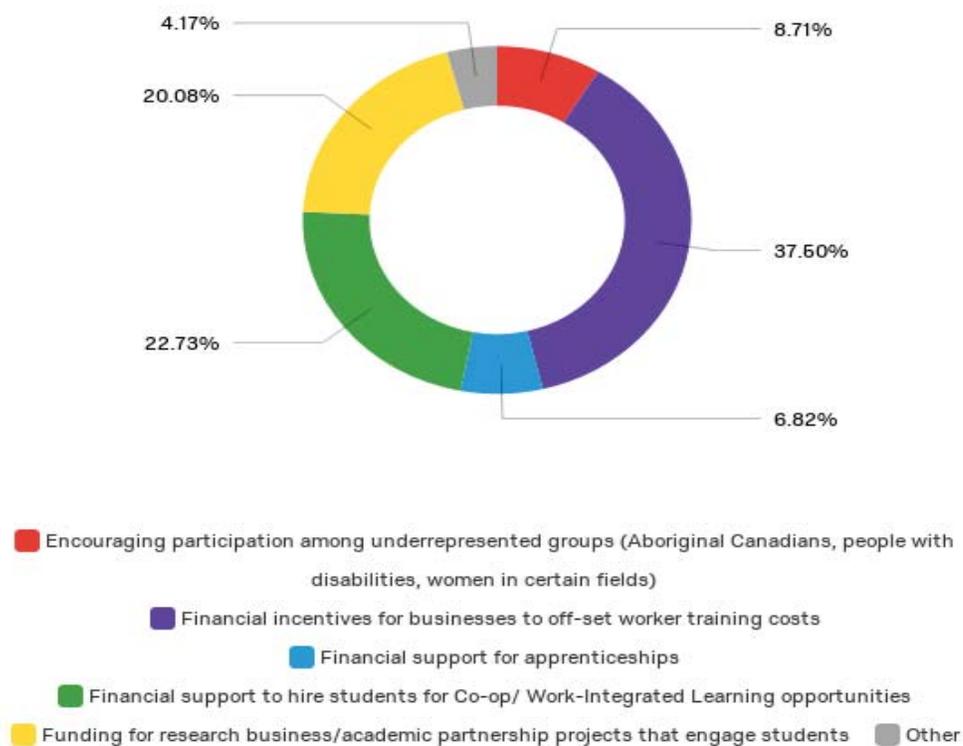
57 Government of Canada 2011, p. 7-1

long-term stable funding. Polytechnics output tends to be measured in months, has students at its heart and is in response to a specific business need.

The scope of expected outcomes must be mapped to the institution's needs, those of the professors and the experience and availability of the

students and researchers. Nevertheless, these collaborations represent a unique opportunity to map student education and innovation skills development more closely to industry and to ensure students, whether they be technicians, graphic artists, engineers or PhD scientists, are truly "work ready" when they graduate.⁵⁸

Figure 7: Best Incentives and Programs to Encourage Talent Development for Innovation



Source: HRP, 2016

How Polytechnics Are Helping to Solve Industry Problems

Interview with Dr. Glenn Feltham, President and CEO, Northern Alberta Institute of Technology

Industry and business partner with the Northern Alberta Institute of Technology (NAIT) in everything it does. Polytechnics are uniquely positioned among post-secondary institutions in Canada to work with industry to help create a more innovative and productive country. They provide hands-on, technology-based education that meets the demands of industry.

With industry advisory boards for each program, NAIT ensures the programs are relevant. But in addition to this, NAIT has a significant and direct impact on innovation. This impact will become even more pronounced with the creation of its new Productivity and Innovation Centre.

“The Centre will be the place industry comes to succeed,” said Dr. Glenn Feltham, President and CEO of NAIT. “It will focus on three of NAIT’s core strengths: productivity enhancement, applied research and an accelerator focused on advanced prototyping and manufacturing. These areas are critical to innovation and competitiveness.”

With over 5,000 registrations for training in productivity enhancement courses last year, NAIT is already having a significant impact on Alberta’s productivity. This will help industry increase productivity by developing in-house expertise, improving their processes and adopting and sustaining new methods and technologies. Learning focuses on the foundations of productivity, including project, quality, lean and operations management.

These programs, which are currently housed in NAIT’s Shell Manufacturing Centre, will move to the new Productivity and Innovation Centre. This will allow NAIT to double the number of seats in its productivity programs.

“As CEO of Fountain Tire and Chair of NAIT’s board of governors, I know first-hand the potential

for the Productivity and Innovation Centre,” said Brent Hesje. “Fountain Tire has worked directly with NAIT to enhance productivity and on applied research projects. This Centre will foster a more diverse and sustainable province and country.”

The Centre will further allow NAIT to expand its number of applied research centres and projects. This is critical for industry. Currently, applied research focuses on a number of areas, and NAIT has three centres, including the Centre for Oil Sands Sustainability, the Centre for Sensors and System Integration and the Boreal Research Institute.

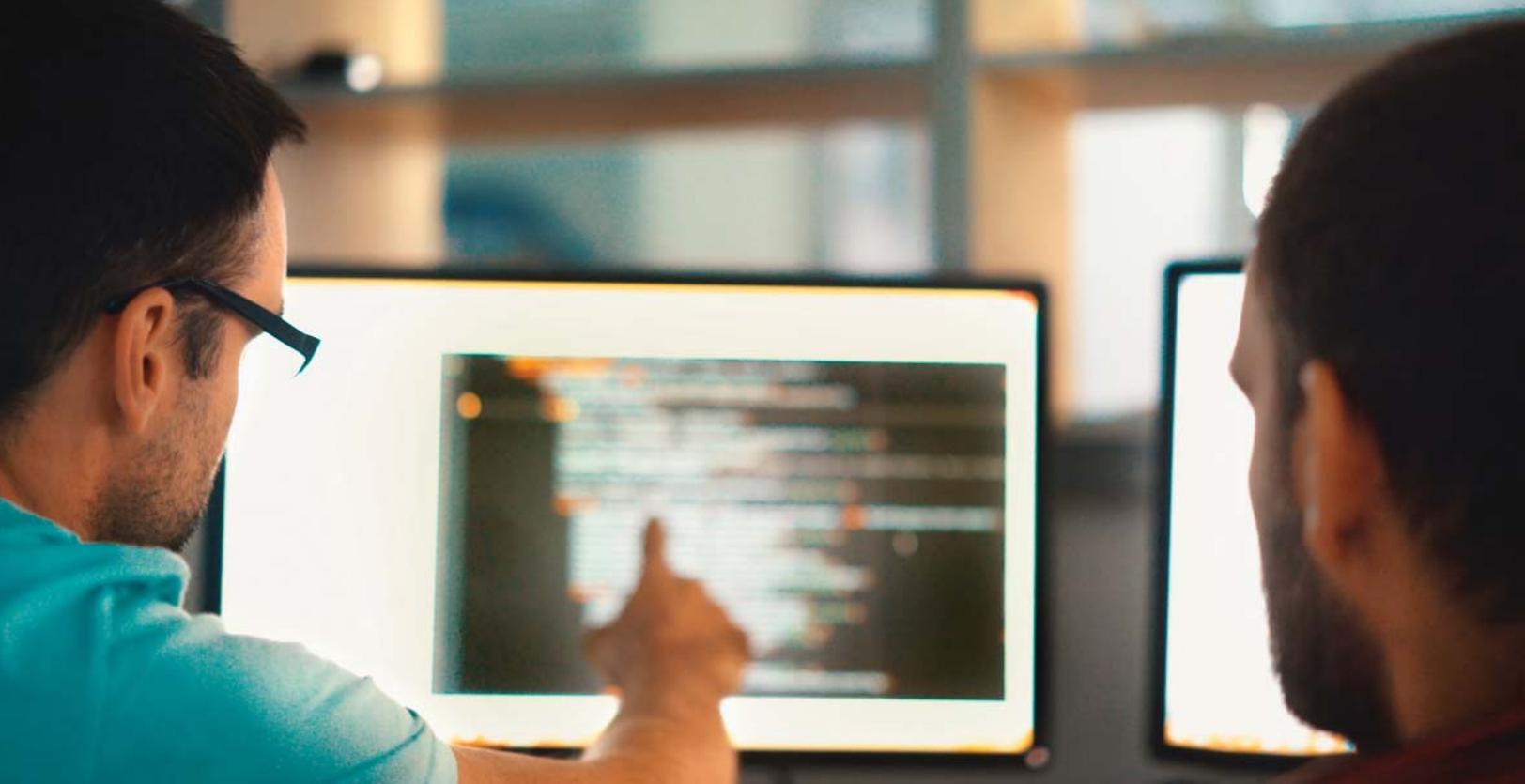
The Centre for Oil Sands Sustainability bridges the gap between existing oil sands environmental research and real-world solutions, taking innovative ideas from concept to commercialization. The Centre for Sensors and System Integration focuses on sensors development and advanced materials and supports small- and medium-sized enterprises in developing new products, often for Alberta’s major resource industries.

“Working with business and industry, we develop technologies that improve the economic and environmental performance of the oil sands industry,” said Dr. Feltham.

The third area, the accelerator, sits between one and two, says Feltham. “Everybody talks about an incubator and then they talk about maker spaces,” he explains. “But, the better term is an accelerator.” There is work on advanced prototyping, including metals and metal prototyping using 3D printing approaches, which will be one of the most rapidly growing manufacturing technologies in the next three to five years, says Feltham.

“The nature of manufacturing is changing,” he says. “You need to prove feasibility.”

A new Productivity and Innovation Centre at NAIT might just be the difference for Alberta’s industries to stay competitive and solve complex problems in challenging times of change.



Recommendations

Moving forward, we believe Canada's businesses should:

1. Provide guidance to government and educational institutions on the cutting-edge and daily skills required to support world-leading innovation in Canada through an annual survey.
2. Invest directly in training and workforce development, with a focus on competency mapping and the soft skills required for innovation.
3. Encourage employees and business units to form collaborations and partnerships with academic institutions for work placements and applied R&D projects and profile success.

THE ROLE OF GOVERNMENT

Government has a critical role in innovation talent development and driving economic growth and global competitiveness. Government's role is to create the conditions for organizations to increase their competitive position and performance for a greater combined total benefit, according to the Porter Diamond model.

According to the Porter Diamond model, the competitive (or comparative) advantage of a nation in the global setting comes from four areas:

1. Business environment strategy and structure
2. Domestic demand conditions
3. Maturity and comprehensiveness of supporting industries
4. Factor conditions, such as labour, natural resources and access to finance

While this view has often been reduced to the simple strategy that government should “do more through spending,” the Porter model emphasizes that the ideal role and impact of government is more nuanced and multi-faceted. Unfortunately, the structure of traditional departmental government bureaucracies is not designed to function well with nuanced and multi-faceted strategies, particularly when those strategies must span departments to be effective.

National innovation strategies demand a challenging integration of seemingly conflicting needs, including:

- Short-term actions and long-term vision and consistency
- Ensuring economic stability through maintenance and support of the existing labour force while creating the conditions for the labour force of the future and the disruption that that may entail
- Balancing policy for demand and supply stimulus

To solve any challenge requires an understanding of the current situation and the impact any changes are having. Without robust labour market information to provide a strong benchmark of where things currently stand, any initiatives introduced will fail to meet their full potential. Access to accurate data is the basis of good policy development.

The Canadian federal-provincial context provides an additional challenge for the consistency and coordination of key areas that impact the development of talent for innovation: education systems and workforce mobility are just two critical areas that must both be aligned at the provincial and federal levels. As education is a provincial jurisdiction, it limits the role the federal government can play.

Existing government programs that support business innovation and academic-industry partnerships are fragmented. Taken individually, they are often funded inadequately. This

condition has driven recommendations for the “rationalization of programs to increase scale, reduce duplication, improve delivery efficiency and create greater awareness.”⁵⁹ This recommendation was combined with calls for the central coordination of the government’s innovation mandate within an Industrial Research and Innovation Council (IRIC),⁶⁰ re-aligning the mix of supports to increase the proportion of direct support versus in-direct tax credit strategies⁶¹ and increasing the extent to which programs support and drive public-private research collaborations at scale.⁶²

While the development of a national talent strategy also formed part of the recommendations for the responsibility of the Industrial Research and Innovation Council,⁶³ innovation talent generation still has not been incorporated as a key performance indicator within the existing structure of government programs. Building this measurement into programs is critical. Specifically identifying and measuring talent generation or improvement is key to achieving and sustaining the broader innovation goal and is a good complement to measuring intermediate outcomes, such as employment, innovations and patents.

While it is possible to identify key initiatives that support the aim of building an entrepreneurial and creative society, with the complexity of the government environment, the challenge is effective coordination and sustained execution. Therein lies one of the most important innovation objectives for government – the internal transformation of the public sector culture to support innovation in order to effectively execute strategies that have impact on the “outside.”⁶⁴

To support innovation, government programs need to be nimble and responsive to demand. Greater coordination is needed between the Ministry of Innovation Science and Economic Development and arms-length entities, such as Natural Sciences and Engineering Research Council of Canada, the Canadian Institutes of Health Research or the National Research Council and its various institutes and innovation programs.

Personnel must also develop a range of soft skills, as must graduating students, academic instructors and the business workforce. This shift requires adjustments to the bureaucratic processes to ensure an innovation culture is fostered and supported, that risk is accepted and that creativity is encouraged.

Without embedding innovation in the fibre of the government workforce, individual policies will be less connected, less visionary, more cautious and less effectively supported. Where to start? Design thinking and a systems view of the innovation workforce challenge facing Canada provides the foundation. Active processes for inter-departmental collaboration, creativity, openness and cooperation provide the means.

In a very practical sense, governments can directly impact the development of talent for an innovation economy. They can use the levers of immigration, direct investment and incentives, purchasing, taxes and the establishment of national priorities, education policy and logically consistent demand and supply side policies. This must build from accurate labour market information.

59 Government of Canada 2011, p. 3-12

60 Ibid, p. 5-9

61 Ibid, p. 6-3

62 Ibid, p. 7-1

63 Jenkins Report 2011, page xii

64 Mazzucato 2014, p. 197

Immigration policy must be clear on the difference between focused actions that address strategic skills gaps and initiatives targeting broad population growth objectives to address longer-term skills shortages. Much of the current Canadian discourse blends and muddies the two objectives. Clarity in strategy definition and execution is critical.

Related to immigration policy are strategies associated with the maintenance and continuous improvement of the workforce. Training, re-skilling, up-skilling and workforce mobility are all components of continuously improving the Canadian talent base and ensuring innovation capacities are matched to current and forecast needs. The government has a leading role in each of these areas, and it is crucial that integrated and consistent programs be developed that promote skills for innovation and are matched to the needs of industry.

Government also has a role to play in conducting strategic R&D, being a customer for innovative products and services, and encouraging industry to play a role in commercialization. While some additional long-term research can be stimulated within academia and business with policies, research areas that should be the responsibility of government will remain.

Defining government research priorities, the process for implementation and the mechanism and incentives for licensing and commercializing the technology to truly develop a national capability is critical. Ideally, these initiatives will involve collaboration with business and across academic institutions for large-scale, demand-driven collaborative R&D and innovation.⁶⁵

By defining strategic research challenges within government-funded labs with consistent long-term support, the Canadian research environment will be increasingly attractive to leading international researchers as well as to Canadian experts faced with attractive alternatives in other countries.

Immigration Policy and International Talent

Canadian innovation will benefit from attracting talent and facilitating the timely entry of foreign talent to meet industry needs. For Canada to be leading in any given area, it needs to be able to access the best available talent, and where innovation is concerned, needs can quickly change. By awarding high points to skilled and qualified candidates who have job offers, the government supports economic growth and innovation. Employers are best placed to identify the skills and talent they need to innovate and grow, and the high points for jobs offers recognizes that fact.

The Express Entry system is a most promising reform of selecting and processing applicants for economic immigration. Modeled after Australia's system, Express Entry is intended to address the relatively poor labour market outcomes of immigrants to Canada by focusing on one of the key causes: a lack of arranged employment on arrival. By requiring job offers to be validated by labour market impact assessments (LMIAs) in order to receive the high points, the government is holding back its potential.⁶⁶

⁶⁵ Government of Canada 2011, p. 7-7

⁶⁶ LMIAs are labour market tests to ensure no Canadian is available to fill a job before it is offered to a foreign national.

The government should continue to allocate high points for job offers, recognizing the role that employers play in identifying the talent and skills Canada needs and complementing the human capital points that are assessed. In terms of attracting the “best and the brightest,” talented people are often only willing to relocate if they have a job offer in the country of destination. On the other side of the process, we know the critical role employers play in recruiting top talent. The attraction of Canada Research Chairs or the Federal Skilled Trades Worker Program are examples of the critical role employers play in identifying talent internationally.

For companies that have identified the talent they need, whether it be to scale up their firm to monetize their innovations or achieve higher growth, the system lacks flexibility to address more urgent needs. A new track in the United Kingdom suggests a way to facilitate specific talent that may support innovation. Its Tech Nation Visa Scheme includes a listing of “technical skills and roles” and “business skills and roles” as one approach to identifying talent separate from an occupations approach.

In Canada, there are at least four categories of candidates where Express Entry and the immigration system should be improved to economic and innovation needs. These are:

1. Highly skilled talent within the information and communications technology (ICT), where the unemployment rate is typically below 3%, reflecting persistent labour shortages in the sector.
2. Senior talent with either specialized skills and/or executive or senior management experience that may be in short supply in Canada, which is an issue for start-up firms or firms that are scaling up.
3. International students who may be prospective entrepreneurs but are precluded from participating in entrepreneurship hubs at post-secondary institutions or are pursuing post-secondary qualifications.
4. Highly skilled talent who are already working Canada through the International Mobility Program or the Temporary Foreign Worker Program but face policy challenges transitioning to permanent residency via Express Entry. For highly skilled workers, both those programs should be seen as pathways to immigration for the foreign talent that Canada needs.

In the face of stiff competition from other countries for highly skilled foreign nationals, timely and efficient processing of applications and the service provided by immigration officers also matters to the success of our system to complement the development of home grown talent.

Talent that Makes a Difference

Ubisoft is a leading video game developer with a team of 3,500 working in its four Canadian studios. While Ubisoft helps train the next generation of game development talent here, it also turns to foreign nationals to overcome the shortage of local senior and intermediate talent. In its sector in Canada, 9% of workers are recruited internationally. For the company’s growth and success here, these international workers make a significant difference. Consider the following two individual cases.

In 2010, Ubisoft hired an Australian creative director who had more than 10 years of experience working on big titles in the video game industry. Since then, he has been a core team member on three big projects at Ubisoft and has

shared his unique expertise with his colleagues. Recently, he contributed to the creation of a new piece of intellectual property, which Ubisoft staff call “a very ambitious project.” His impact on the teams and the company is “phenomenal,” say his colleagues. And he is now a proud permanent resident in Canada.

A couple of years ago, Ubisoft recruited a senior ergonomist from France for the company’s internal User Research Lab in Montreal. The ergonomist holds a masters degree in cognitive ergonomics and has much sought-after experience in the video game industry, mainly at Sony Europe where he had worked on the design of the PlayStation 4 console. His unique expertise enabled Ubisoft to improve the accessibility of its games significantly, making the User Research Lab indispensable in the production process. Several other specialists and researchers from local universities in Montreal recently joined the Lab’s team.

Recommendations

We recommend the federal government take the following steps:

1. Develop an inclusive federal business innovation talent development strategy.
2. Develop more effective labour market information systems that collect, analyze and report data in a manner that is more consistent, more timely and more relevant, reflecting the speed of business and understanding the evolving talent needs of the market.
3. Establish agile, strategic supply-side funding programs with an emphasis on work-integrated learning processes and industry driven collaborations with post-secondary institutions for both applied and fundamental research.
4. Rationalize and harmonize the existing suite of government innovation and R&D supports for academia and industry and incorporate talent development metrics and industry collaboration as key measurement outcomes.
5. Develop immigration policies to address key short-term gaps in innovation expertise while laying the foundation for long-term labour force development needs.

ENCOURAGING COLLABORATION

An innovation culture develops through exposure, curiosity, creativity and collaboration. The sharing of information and experiences by individuals and organizations involved in networks, clusters, incubators and accelerators or through work-integrated learning provides unique opportunities to initiate and develop these characteristics. To be successful, these collaborations must be mutually beneficial.⁶⁷

In the best instances, these innovation environments incorporate multi-actor collaboration (including academia, SMEs, large businesses and government research centres). They enable individuals to more deeply understand each other's contribution to innovation success, whether it be radical or incremental innovation. And they facilitate a continuous life-long learning process for all involved, from individuals to organizations. As a result, the issue is less about the structural form these groups or programs should take, but how to reduce interaction transaction costs between businesses and between business, academia and government.

The Role of Work-integrated Learning

To encourage a more entrepreneurial culture, we are now seeing greater encouragement to blend the inherent benefits of both STEM and non-STEM fields in educational programs.⁶⁸ Experts recommend an increase in applied, industry-driven collaboration through projects, work terms or other forms of work-integrated learning throughout the entirety of formal education. They also advise that a STEM education's curiosity-driven investigation process be built into curricula and learning structures.

Work-integrated learning also presents a major opportunity to develop innovation skills by expanding programs to include things like applied research collaboration with post-secondary institutions. That would afford real-world opportunities to students and graduates around innovation and provide exposure to different skillsets.

⁶⁷ Conference Board of Canada, 2016

⁶⁸ Institute for Competitiveness & Prosperity 2016, p. 41

What Is Work-integrated Learning?

Work-integrated learning (WIL) is the term used to refer to “the process whereby students come to learn from experiences in educational and practice settings.” Seven types of WIL are listed in a report issued by the Higher Education Quality Council of Ontario:⁶⁹

- **Apprenticeship:** Training that combines learning on the job with classroom instruction, leading to a certificate of apprenticeship
- **Field placement:** Practical experience in a real work setting
- **Mandatory professional practice:** Work hours needed to obtain a licence to practise or a professional designation or to register with a regulatory college/professional association
- **Co-op:** Academic study that alternates with paid work experience developed and/or approved by the college/university
- **Internship:** Program-related experience in a professional work environment
- **Applied research projects:** Student projects to address specific business or industry problems
- **Service learning:** Student projects to address identified community needs or global issues

The Role of Networks, Clusters, Incubators and Accelerators

Networks, clusters, incubators and accelerators each serve a similar function in the innovation ecosystem. They increase the depth, breadth and acceleration of knowledge sharing and accumulation and create dynamic opportunities for cross-pollination of ideas, learning and collaboration. Each may focus on a particular industry (e.g. ICT, green tech, natural resources, networking, mobility, gaming, aerospace) that increases the level of synergy and sharing.

While it is important to understand the similarities and differences of each approach, it is more important to recognize their role in the development of the innovation talent base. Each serves to decrease the interaction transaction costs, “naturally leading to more opportunities to share knowledge, form relationships and develop partnerships.”⁷⁰

69 Higher Education Quality Council of Ontario 2013

70 Institute for Competitiveness & Prosperity 2016, p. 10

What Is the Difference between an Incubator and an Accelerator?

Despite some nuances, the primary differentiation across the four categories can be characterized by the level of localization and the intensity of the work integration experience:

- **Networks** are cooperating organizations that are often spread across the country.
- **Clusters** are geographic concentrations of inter-connected firms and related actors (specialized service providers, universities, etc.).⁷¹
- **Incubators** are environments with dedicated and co-working spaces with access to experts and guidance on a structured or ad hoc basis.
- **Accelerators** are (relatively) short duration, immersive, cohort-based experiences with a small number of organizations supported by intensive mentoring.

Partnering for Innovation: Materials Science Research

Housing \$40 million worth of state-of-the-art research equipment and technology, Simon Fraser University's 4D LABS collaborates with industry to generate new products and ideas in a range of fields, including clean energy, information technology, health, nanotechnology and telecommunications. The goal-oriented environment fosters intellectual freedom and creativity, which are critical for breakthrough research. Since beginning operations in 2007, hundreds of academic, industry, medical and government innovators and researchers from across Canada and around the world have

worked in the materials science research facility to develop and test their ideas under real-world conditions, greatly reducing the time to market.

For example, researchers from the 4D LABS developed a new nanotechnology by studying the tiny holes on a butterfly's wings, which can be used to produce images that can't be copied or scanned, making it an ideal anti-counterfeiting security technology. This technology was most recently used as a security feature on tickets for the Union of European Football Associations and has led to the creation of a company that now works with a number of central banks to provide enhanced security to currency.

The Power of Collaboration

There are three Cs that Steve Eccles stresses when he talks about talent development for innovation. Collaboration, connections and clusters are terms sprinkled throughout his animated remarks. As Dean of the School of Computing and Academic Studies and the Learning and Teaching Centre at the British Columbia Institute of Technology (BCIT), Eccles believes innovation comes out of collaborative processes and teams. His goal is to ensure B.C. and Canada have the workforce for collaboration and innovation success.

"It's brilliant to see the federal focus on innovation," says Eccles. "A laser focus on talent development is a needle that we can demonstrably move."

With Vancouver's tech sector 80% weighted towards start-ups and small business, Eccles has ideas on building an innovation talent pipeline. "It is about collaboration and creating connections in clusters," he says.

⁷¹ OECD, 2010

Clusters and networks are where collaboration is already happening and where financial resources are better deployed, says Eccles. He tips his hat to the BC Tech Association for creating connections in the province and to its President, Bill Tam, who points out that tech communities actually work as networks, not as hierarchies. Eccles gets excited mentioning, for example, a firm where collaborations between biologists and engineers (who would have thought it!) have led to success.

Innovation is not just about people with ideas, says Eccles. It is also about taking a firm from early start-up to mid-sized. Twenty years ago, a tech grad would go to work for a large firm. Now, the industry needs a different set of skills. “Now, students have to be ready to work for entrepreneurs or to become an entrepreneur,” he says. Students need the opportunities to develop entrepreneurial skills and develop the risk appetite to work for start-up, he adds.

At BCIT, through the polytechnic model and entrepreneurial programs, students solve industry problems and learn about monetization, commercialization, financing a start-up and growing a team. “Innovative thinking isn’t binary or black and white – it’s about experimentation,” says Eccles.

As a post-secondary institution, BCIT is also reaching back into high schools with a program on applied math skills, where kids can see the value of math and tech skills, working in teams and mentored by SAP employees and entrepreneurs. It offers a supported pathway into tech programs at BCIT.

With three students applying for every seat available in BCIT’s tech and computing programs, including many university graduates, Eccles wants more opportunities for student to learn.

“We could use more seats in tech-related programs and more support for co-op placements, where we have a deficit of spots,” he says. “That is the secret sauce.”

“Are we giving those grads the immersive business experience that they really benefit from?” he asks. “We could do more.”

Collaboration could extend to post-secondary institutions, too. For example, a new blended degree in forensic science is in the works between BCIT and the University of British Columbia. While it is a small initiative, it may also be a sign of what is possible, says Eccles.

CONCLUSION

Developing talent for an innovation economy in the 21st century is a huge challenge that cannot be understated. To be effective, and to ensure Canada realizes a position among global innovation leaders, education, business and government must establish integrated and complementary strategies for talent development. It must also recognize the many ways in which innovation takes place.

In delivering the talent needed, there must be a focus on three key elements:

- 1. Understand what is needed.** The skills that are most required to promote innovation in Canada must be identified and communicated clearly and frequently to individuals, academia and employers.
- 2. Set clear goals.** A clear direction on where Canada sees a potential competitive advantage or a specific need must be provided. The direction will set expectations around delivering a national agenda for skills development for innovation.
- 3. Encourage collaboration.** Collaboration will develop more rounded skills needed for innovation and will generate new ideas. Collaboration should be as easy as possible, inclusive and incentivized, and the most effective approaches should be celebrated.

As technological and market evolution accelerates, any delays or strategic disconnects will exacerbate the need for the development of innovation talent. All our international competitors will not stand still, and Canada already has some catching up to do. We have most of the ingredients; we need to make sure we know which recipe to use and how best to mix everything together.

Sustained innovation comes from a variety of participants bringing a mixture of skills in the innovation process within an organization. Skilled trade workers, engineers, marketing, design, administrative staff, procurement and many others all have a role to play.⁷² We are seeing this type of collaboration become more common in our education system as institutions partner with industry and bring in different skills to work together. To promote innovation, this must become much more common across government, business and academia.

72 Toner 2011, p.24

ANNEX - JENKINS REPORT RECOMMENDATIONS

Recommendation 1: Create an Industrial Research and Innovation Council (IRIC), with a clear business innovation mandate (including the delivery of business-facing innovation programs, the development of a business innovation talent strategy and other duties over time), and enhance the impact of programs through consolidation and improved whole-of-government evaluation.

Recommendation 2: Simplify the Scientific Research and Experimental Development (SR&ED) program by basing the tax credit for small- and medium-sized enterprises (SMEs) on labour-related costs. Redeploy funds from the tax credit to a more complete set of direct support initiatives to help SMEs grow into larger, competitive firms.

Recommendation 3: Make business innovation one of the core objectives of procurement, with the supporting initiatives to achieve this objective.

Recommendation 4: Transform the institutes of the National Research Council (NRC) into a constellation of large scale, sectoral, collaborative R&D centres involving business, the university sector and the provinces, while transferring NRC public policy-related research activities to the appropriate federal agencies.

Recommendation 5: Help high-growth innovative firms access the risk capital they need through the establishment of new funds where gaps exist.

Recommendation 6: Establish a clear federal voice for innovation and engage in a dialogue with the provinces to improve coordination and impact.

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