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U15 White Paper

Talent, ideas and dynamic regions: Building Blocks for Canada's Innovation Agenda



Group of Canadian Research Universities

Regroupement des universités de recherche du Canada

Supporting Canada's Innovation Agenda: Executive Summary

To achieve our shared vision of Canada as a leading innovation nation, we need to ensure we have the building blocks world-class innovation ecosystems require: Talent, Ideas & Knowledge and Dynamic Regions. Canada's research-intensive universities have a key role to play in fulfilling this vision.

Innovation Building Blocks

Talent		Ideas & Knowledge		Dynamic Regions	
Objective: The most talented and adaptable workforce, through education, training and immigration.		Objective: A research funding system that enables researchers to push the frontiers of knowledge and reduce the time lag between discoveries and innovations.		Objective: A flexible, strategic approach to globally competitive clusters that brings together key stakeholders to design high-impact responses to their unique regional challenges and opportunities.	
Competitive Challenges					
The top talent needed to lead high-performing teams and educate our students is highly mobile and sought after globally. If Canada is to compete and succeed in the global knowledge economy, our efforts to develop, attract and retain highly qualified personnel (HQP) need to surpass the efforts of other leading nations.		A strategy that pulls back from the frontiers of knowledge in favour of addressing near-to-market problems may result in quickly losing ground to global competitors who exploit the latest discoveries. Canada needs to push the frontiers of knowledge while simultaneously enabling our innovators to leverage the leading-edge of discovery.		Not every cluster can be globally competitive. For a cluster strategy to fuel Canadian innovation and competitiveness, we will need to focus on developing those regional clusters that already are, or have realistic prospects of becoming, globally competitive.	
Priority Actions					
Ensure continued diversity in world class educational and training opportunities.	Support immigration reforms that enable businesses and universities to recruit int'l HQP more quickly.	Pursue world-leading research excellence that leads to international and inter-disciplinary collaboration.	Train the next generation of HQP through strategic investments in fundamental science.	Enable collaboration among partners within clusters: businesses, non-profits, post-secondary education institutions, and governments.	Enable investments to target the highest-impact opportunities for each cluster, by making funding flexible, with results-oriented accountability.
Develop a systematic approach to continuous upskilling and professional development.	Increase efforts to attract top int'l students, and streamline pathways to permanent residency.		Better connect Canada's innovators to our leading-edge research, enabling Canadian firms to bring discoveries to market faster than our competitors.		Identify and build on the unique competitive advantages that already exist in each regional cluster.
Develop a robust system to provide timely labour market information.	Improve settlement services to create smooth transitions for immigrants.	Promote internationally Canada's research strengths, to attract R&D investments by leading companies.			

Introduction

In recent months, the federal government has announced its intention of launching an Innovation Agenda. We welcome this renewed focus on innovation, particularly because our competitive environment is changing:

- New industries are rapidly emerging from new discoveries;
- Markets are more global, niches are more accessible, and the global middle-class is growing;
- Global supply chains are evolving due to emerging markets, changing global cost structures, and lower barriers to entry;
- Advanced robotics, 3D printing and other discoveries are transforming manufacturing;
- Resource prices are volatile; and,
- Canada's workforce is aging.

In a world where innovative techniques, technologies and businesses created anywhere disrupt markets everywhere, we can protect and enhance our economy and quality of life only by turning our innovation ecosystem into one of Canada's core competitive advantages. For innovation to be a core competitive advantage, it needs to permeate all aspects of Canada's economy and society. Innovation will need to fuel the creation of new products and services, facilitate cost reductions, increase productivity, and enable social innovations that help our communities with challenges like climate change adaptation. We also need to recognize that innovation is not just about turning a small number of world-changing discoveries into major industries. It is also about encouraging the creation of a large number of smaller innovations and improvements that proliferate and cascade over time.

Innovation Policy as Social Innovation

Successful innovation is inherently messy and chaotic. Innovative products and services are the result of countless inspirations, interactions, experiments, options and decisions. All of these possible decisions and interactions allow us to think about successful innovation policies through the lens of probabilities. The probability of any individual innovation succeeding is the joint probability of the innovator overcoming each of the large number of challenges and barriers that arise in developing, launching, and scaling up new ideas.¹ For example, the probability of an innovative business succeeding if it has both good engineering and sales teams is much higher than if the same business has a weak sales team.

Innovation ecosystems – the people, organizations and interactions that help fuel innovators – are exponentially more messy and chaotic than any single innovation. For governments and others trying to foster an innovation ecosystem, thinking about successful innovation as a function of probabilities suggests two macro policy objectives:

¹ While each innovation is different, these challenges can range from customer awareness, available capital, regulatory environment, quality of management, supply chain, distribution channels, quality of IP, competitor power, proof of concepts, length of sales cycle, the innovator's network, and etc.

increasing the number of high-quality innovative ideas; and increasing the probability of each innovator successfully overcoming the challenges they face.

Increasing the quantity of innovative ideas and their probability of success in such a messy environment is a significant challenge. From the outset, we need to acknowledge that we don't have all of the answers. Some initiatives will not work. Accepting this reality, we need to focus on finding ways to launch promising policy ideas quickly, measure the results and improve or abandon those initiatives that underperform. We also need to scale up those initiatives that do work – quickly. Because much of the activity required to launch ideas and expand them quickly will occur at the local level – everything from immigrant settlement to increasing a cluster's available financing – we have many opportunities to try different ideas, and to share best practices and lessons learned with other regions across the country. Taking this highly iterative approach to innovation policy will require the federal government to work with key innovation partners (e.g. relevant businesses, non-profits, universities, and all levels of government) to co-create the right supports at the right time.

The federal government's consultation on the Innovation Agenda is an important first step in this process. The government's background document proposes a vision that being innovative become a core Canadian value. It also contains objectives, including that Canada become a leader in social enterprise and social innovation and in building large, high-growth companies, as well as a number of more specific goals. Woven throughout these objectives and goals are a number of core building blocks for the Innovation Agenda that are essential to both social and commercial innovation:

Talented People. Without talented people with a wide variety of skills and knowledge, world-class social or commercial innovation is simply impossible.

Ideas and knowledge. Ideas and knowledge provide the raw material for an innovative, knowledge-based economy.

Dynamic regions. By having a critical mass of people and ideas, dynamic regions create the social and professional networks that help innovators build their teams and find the resources they need to launch and scale their innovations.

Digital. Digital technologies are having a profound effect on all aspects of society and our economy. They are both a powerful enabler of, and a channel for, distributing social and commercial innovation.

This paper will focus on the building blocks of the Innovation Agenda where research universities have the largest direct impact: people, ideas and knowledge, and dynamic regions. Although digital infrastructure, as well as broader environmental factors such as regulations, tax policies, trade agreements and countless other provincial, national and international policies are all important aspects of the Innovation Agenda, they are beyond the scope of this paper.

Talent

Building a robust innovative economy and society requires highly talented people with a variety of skillsets and educational backgrounds.² Although innovative businesses provide good jobs for a wide range of Canadians, their ability to compete globally depends upon having world-class leadership³ and talent across the organization. These leaders and talented employees fuel the growth of both the company and of individual teams – creating diverse jobs and professional development opportunities, and launching innovative products and services. Ensuring Canada is able to thrive as an innovation economy requires us to prioritize developing, attracting and retaining top talent. Fortunately, this builds on a number of existing strengths, including our education system and our reputation as a safe, welcoming country.

Role of World-Class Research Universities

World-class research universities contribute to developing the talented workforce a dynamic innovation ecosystem requires by:

Educating students. Students educated at world-class research universities learn on the front edge of science. Universities provide both access to learning from research that may not have been published yet, and an environment that encourages turning ideas into action.

Attracting Top Talent. World-class research universities actively recruit top faculty and students from around the world. Once they arrive, these sought-after individuals represent a brain-gain for Canada.

Developing talent is about ensuring that people who live here are able to perform and innovate at their full potential. This means ensuring that world-class educational programs exist to foster individual strengths and aptitudes. Different people at different stages of their careers will thrive in different types of programs – whether world-class vocational programs at colleges or polytechnics; world-class bachelor, professional or graduate programs at universities; or professional development programs. If we, as a country, are to make developing world-class talent a long-term competitive advantage, we need to move past the false debate about the relative importance of one educational model versus another. All of these programs and institutions have an important place in Canada.

Regardless of which pathway an individual chooses following high school, the speed of technological change in all fields means people will need to learn new skills and concepts more frequently and more rapidly than at any previous time in history. Building a workforce that can thrive in this environment means increasingly integrating work into learning and learning into work. For students this means increasing experiential learning opportunities while for the rest of Canada's workforce, this means continuous upskilling. Workforce upskilling and professional development need to become a norm for careers in all fields and

² A study of clusters in Canada (Spencer, 2014) showed a 2011 employment in the Kitchener-Waterloo ICT cluster to be 48 percent university graduates (compared to 25 percent of the Canadian workforce) and 31 percent colleges and trades graduates (compared to 34 percent of the Canadian workforce). Other clusters in the study exhibited different distributions of educational attainment.

³ A US study (Wadhwa, Freeman, & Rissing, 2008) found that 47 percent of technology company founders had an advanced degree (Masters, PhD, JD or MD) compared to about 10 percent of the US workforce (United States Census Bureau). In Canada, a study found that more than 29% of small and medium sized enterprises in knowledge based industries were led by people with advanced degrees (Statistics Canada, 2015) compared to about 7% of the workforce (Statistics Canada, 2011).

sectors. It is critical that governments, businesses, non-profits and educational institutions work together to create a system that encourages both experiential learning as well as continuous upskilling and professional development.

Building a truly innovative country also requires a concerted effort to attract talented people across all sectors and at all career stages. Recruiting highly qualified international personnel is difficult, time-consuming and expensive – but essential. This brain-gain provides significant benefits to Canada. Businesses build and grow teams around these HQP, creating jobs and rich professional experiences for many other Canadians. When Canadian universities recruit top faculty members, our students gain the opportunity to learn from teachers and researchers who are pushing the frontiers of knowledge. These students in turn go on to share their cutting-edge knowledge and critical thinking skills with Canadian businesses. Recruiting HQP for either businesses or universities requires an immigration system that is able to admit talented people quickly, on either a permanent or a temporary basis. This is an area where Canada needs to make progress.

Another key channel for attracting a talented workforce is through the recruitment of top international students. In addition to promotion and marketing efforts, the federal government can increase the attractiveness of Canada as a study destination by creating easy, clear pathways for international graduates to become permanent residents. This would help Canadian institutions recruit top students and expand the pool of talented workers available to Canadian employers.

Retaining the talent we have attracted and developed requires ensuring that these individuals can have both a good quality of life – already a Canadian strength – and rewarding career opportunities. High-performers value working in environments where they can make an impact and work with other highly talented individuals. A dynamic innovation ecosystem, combined with our quality of life, will make Canada a place that continues to attract and retain talented individuals.

Innovation Agenda Implications

For Canada to attract the talent necessary to build a sustainable competitive advantage based on innovation, the Innovation Agenda will require a HQP strategy that integrates:

- A systematic approach to continuous lifelong upskilling and professional development;
- Immigration reforms that equip businesses and universities to recruit international HQP more successfully;
- Settlement services to create smooth transitions for recent immigrants;
- Increased efforts to attract top international students, in part by creating clear, easy pathways for international students to become permanent residents;
- A robust system of timely labour market information; and
- A diversity of educational and training opportunities.

Ideas and Knowledge

Without new ideas, innovation cannot occur. Innovation is usually either the direct result of, or is enabled by, scientific discovery and research. While many Canadian firms may be focusing on conducting research and development on products and services that are closer to market, Canada's ability to make innovation a long-term economic strategy also requires world-leading, discovery-driven research that helps open new frontiers and create new opportunities (e.g. quantum materials, regenerative medicine, etc.). As former US Federal Reserve Chairman Ben Bernanke noted: "Fundamental research is ultimately the source of most innovation, albeit often with long lags." (Bernanke, 2001)

In addition to the discoveries, knowledge and opportunities our investments in fundamental research creates, these investments are also critically important for developing the HQP and expertise that innovators rely upon.

Training HQP: One of the main training grounds for Masters and PhD students is working on fundamental research. When these students graduate and begin conducting research for innovative firms, they bring state-of-the-art knowledge and techniques that they could only have learned by working at the frontiers of knowledge. It is therefore not surprising that in a survey conducted for the Jenkins panel, about a third of firms that perform in-house R&D indicated that a majority of their R&D performers had a graduate degree or a doctorate (EKOS Research Associates, 2011), despite the fact that fewer than 7 percent of Canadians over 24 have an advanced degree (Statistics Canada, 2011).

Expertise: The world-leading expertise developed through investments in discovery-driven research at Canadian universities is also a critical resource for businesses. The Jenkins panel's survey of businesses performing R&D found that almost a quarter of businesses that contract R&D services, contract with universities (EKOS Research Associates, 2011).

The HQP and expertise created by investments in fundamental research are also critical factors for attracting international R&D investments. According to a recent study, a "growing number of firms have offshored R&D and innovative activities" and key factors for choosing a location for these investments include "(specialized) R&D capabilities, and

Role of World-Class Research Universities
World-class research universities are major producers and mobilizers of new knowledge.

Knowledge Creation: U15 universities alone undertake about \$8.5B in research annually – about a quarter of all research in Canada.

Mobilization – Graduates: The largest channel for mobilizing knowledge is through graduates entering the workforce. U15 institutions alone graduate more than 100,000 people per year.

Mobilization – Partnerships: Another important pathway for mobilization is through research partnerships where researchers and businesses work together on a project. U15 institutions conduct about \$650M in business-funded research annually.

Mobilization – Commercialization: Direct commercialization occurs where a discovery can be distilled into a patent that can be licensed or turned into a stand-alone business. U15 institutions currently maintain a portfolio of about 2900 active technology licences.

the availability and costs of human capital (scientists and engineers and PhD graduates in particular)," (Belderbos, Sleuwaegen, Somers, & Backer, 2016). The study also found that the research strengths of local universities played a role. If Canada wants to attract these high-quality investments, we need to ensure that we have both the world-leading talent and world-leading research capacities.

Debates about how to achieve 'balance' between discovery and market-driven research overlook the fact that we can only be a world-leading innovation nation by raising our ambition in all forms of science and research. To be a leading innovation nation, our strategy cannot pull back from the frontiers of knowledge in favour of addressing near-to-market problems. Such a strategy will result in other countries' innovators quickly overtaking us as we lose the knowledge, expertise and HQP necessary to lead the world. Instead, we need to develop strategies that give our innovators a head start by capitalizing on discoveries that are nearer to the frontiers of knowledge. In practical terms this means a national commitment to world-leading research excellence, while at the same time undertaking efforts to shorten the lag between discovery and when our innovators capitalize on it.

World-leading research excellence. Although it is widely accepted that Canada needs to do better in commercial R&D, the reality is that between 2006 and 2014, the percentage of GDP Canada invests higher education research dropped from third to seventh among OECD countries (OECD, 2016). Ensuring that Canada continues to be a world-leading research nation will require that we increase our investments in higher education research, so that we are among the world-leaders in investment levels. It also requires that we develop our support for researchers, research and infrastructure in ways that are ambitious, strategic, simplified and flexible. Critical to the success of our fundamental science system is its evolution to a system that capitalizes on the global shift towards research that is collaborative across sectors, disciplines and countries. We hope that the work of the federal Fundamental Science Review will help shape such a system.

Shortening the lag between discovery and innovation. Creating increased exchanges among top researchers and leaders from other sectors will be a long-term commitment. Currently, the main ways we mobilize knowledge from our world-leading researchers to our social and commercial innovators is through recent graduates, contract research, IP and publications. However, during interviews with members of the U15's Private Sector Working Group, a number of CEOs noted that a lack of awareness of opportunities and capabilities at institutions posed a major barrier to increased collaboration. Accordingly, finding ways to expand engagement among leading academic researchers and researchers or leaders from other sectors can create new channels to mobilize world-leading research.

Implications for the Innovation Agenda

In order to make Canada a leading innovation nation, the Innovation Agenda should:

- Pursue world-leading research excellence that capitalizes on global trends towards international and inter-disciplinary collaboration. We can leverage investments in research excellence by:
 - Recognizing our investments in fundamental science as a strategic investment that trains the next generation of HQP;
 - Finding ways to better connect Canada's innovators to this leading-edge research, so that Canadian innovation becomes world-leading and firms are able to bring newer discoveries to market faster than innovators in other countries; and
 - Communicating Canada's research strengths more effectively internationally, to attract R&D investments by leading companies.

Dynamic Regions

Making innovation a sustainable competitive advantage in the face of robust global competition requires us to build on and leverage our existing assets and strengths strategically. These assets and strengths – whether the result of our geography, resources, history, culture, institutions or society – create unique opportunities from coast to coast for regions to develop their own competitive advantages and to unleash social innovation. Canada's ability to build regional innovation ecosystems based on unique location-based competitive advantages will be a key determinant of whether our country can become a leading innovation nation.

For many regions, the most effective way to capitalize on these regional opportunities is by building globally competitive innovation clusters. Clusters are a dense, interconnected group of firms and organizations engaged in a related set of business activities within a geographic region (Porter, 1998). A range of location-based competitive advantages,

including the availability of a talented workforce, knowledge exchange, a critical mass of business supports, and a network of peers fuels these clusters. Often, they capitalize on geographic or natural assets such as proximity to markets or natural resources. As a result, Canada cannot simply replicate well-known clusters such as California's Silicon Valley or

Role of World-Class Research Universities

Research universities are at the heart of globally competitive clusters across Canada and around the world. In addition to their primary role developing talent and ideas, research universities provide:

State-of-the-Art Facilities. By having access to nearby state-of-the-art facilities, businesses have an advantage over many of their competitors.

Expertise. Businesses often turn to university faculty for either expertise or contract research. In fact, U15 institutions conduct more than \$650M in research for businesses annually.

Programming. Through entrepreneurship centres, public lectures and cultural facilities, universities provide a range of services that both fuel businesses and improve quality of life.

Brand. Business and opinion leaders recognize that the presence of a world-class university indicates a vibrant community, making it a more attractive investment destination.

Boston's biotech cluster. At the same time, other countries cannot replicate globally competitive Canadian clusters.

Not every cluster is or has the potential to become globally competitive. Many clusters play an important role in their local economy but have limited broader impact. For a cluster strategy to fuel Canadian innovation and competitiveness, we will need to focus on developing those regional clusters that already are, or have realistic prospects of becoming, globally competitive.

Within globally competitive innovation clusters, post-secondary institutions, other levels of government and community organizations have important roles to play. They each have unique assets and capabilities that can help the companies within a cluster⁴ grow and compete. For example, in addition to developing talent and knowledge, research universities contain state-of-the-art facilities that most businesses in the cluster could not afford to build or maintain themselves. Governments often fund entrepreneurship resource centres and supports, which help many of the cluster's early-stage businesses get off the ground. Various community organizations provide professional networking and quality-of-life enhancing programs, which are essential to both the economic and social health of a cluster.

The unique combination of place-based competitive advantages and local innovation partners in globally competitive clusters means that governments need to target their supports strategically, focusing on each cluster's strengths and opportunities. These supports need to be flexible. They should respond to a cluster's actual needs, as identified by those working in the cluster. Some clusters may need better transportation infrastructure; others may require a computer programming boot camp, or the creation of a network with other regions to build capacity. Still others might need to solve a next-generation technology challenge. Importantly, if the goal is to create globally competitive clusters, we must be disciplined in focusing resources on projects that are likely to help Canada achieve that goal.

To meet these needs, The U15 recommended that Budget 2017 build on Budget 2016's cluster commitments by creating three funding streams that a cluster's innovation partners could jointly apply for:

- **Cluster capacity-building fund.** This fund would provide relatively small investments to support the operations of a small cluster coordination office. Applicants would need to demonstrate they are building on regional strengths and are, or have, reasonable prospects of becoming, globally competitive innovation clusters.
- **Cluster project fund.** This fund would invest in projects that respond to a cluster's unique challenges and opportunities. The cluster's innovation partners would develop proposals, which could take a variety of forms (e.g. facility upgrades,

⁴ According to Statistics Canada, 99% of Canadian businesses are single location enterprises (Statistics Canada, 2016). This underscores the potential impact of building place-based competitive advantages and helping businesses capitalize on them.

international trade missions, training or mentorship programs, work-integrated learning initiatives) and the proposals would be assessed competitively.

- **Scientific advancement fund.** This fund would invest in specific research areas that the cluster's innovation partners identify as major, widely-experienced 'next generation' R&D challenges. Proposals would be competitively assessed, would require the cluster's innovation partners to actively contribute to the project, and would require agreement about how to manage project IP.

To facilitate this bottom-up approach and to provide accountability for investments, Canada will need to develop key performance indicators (KPIs), supported by timely data collection and release. Proposals to access cluster support funds should be clear about the challenges and opportunities they will address, and about the ways the project will improve the cluster's key performance indicators. Once the project is complete, those responsible for implementing it should be required to publish a report describing the project's best practices and lessons learned, to help other clusters benefit from their experiences.

In addition to investments in STEM disciplines, dynamic, world-class clusters require investments in the fine arts, humanities, and social sciences in order to fuel their growth. Companies that are scaling up rapidly need HR professionals capable of hiring hundreds of employees per year and marketing professionals who can develop the creative content for their next marketing campaign. Globally mobile talent – people who are desirable to companies in San Francisco, Austin, New York, London, Paris, Shanghai or Tokyo – are attracted to vibrant social and cultural hubs.

Innovation Agenda Implications

To build the location-based competitive advantages that allow innovation clusters to thrive, the Innovation Agenda should:

- Encourage collaboration among the cluster's innovation partners - businesses, non-profit organizations, post-secondary education institutions, and governments;
- Enable investments to target the highest-impact opportunities for each cluster, by making funding flexible, with results-oriented accountability;
- Build on the unique competitive advantages that already exist in each cluster; and
- Focus investments on clusters that are, or are poised to become, globally competitive.

Conclusion

For the last 150 years, we have successfully developed world-class educational, scientific and research capacities, a tremendous quality of life and a leading economy. We have accomplished a great deal. However, in the face of rising global competition, we need to turn our innovation ecosystem into a sustainable competitive advantage by investing strategically in our assets and capitalizing upon them in an integrated way. Put simply, achieving this will require us to develop:

- 1) The most talented, adaptable workforce possible, through a combination of education, training and immigration;
- 2) A research funding system that allows researchers to focus on research, push the envelope with higher-risk nationally and internationally collaborative projects, while building mechanisms for rapidly linking innovators with discoveries; and
- 3) A flexible, strategic approach to supporting globally competitive clusters that brings together each clusters' key stakeholders to design high-impact responses to their unique challenges and opportunities.

By focusing our efforts in these three areas, Canada will ensure that it remains a leading, innovative nation for the next 150 years.

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