***P**artnership Group for Science and Engineering (PAGSE)*

***P**artenariat en faveur des sciences et de la technologie (PFST)*

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SUMMARY

The global economic recovery hangs in the balance. Although Canada has so far fared better than others, sustained economic growth in the long term requires a commitment to constructing an innovation pipeline that brings the best ideas and products to market, quickly and effectively. Investing in basic research and the people who do it is crucial to ensuring a steady supply of ideas for the innovation pipeline, and Canada has been improving in this regard. However we continue to struggle to translate ideas into effective solutions and products that create wealth and jobs. In effect, there are leaks in the innovation pipeline that prevent the best ideas from realizing their full economic potential.

This brief presents three ideas for mending the Canadian innovation pipeline. The government can stimulate innovation and shorten the time required for the best ideas and products to get to market through co-localization of education, research and business organizations in innovation clusters, provide jobs and incentivize innovation by rewarding Canadian businesses for hiring highly qualified Canadian graduates, and catalyze productivity by making data, especially that generated through publically funded research, freely available online. These actions are essential for building the knowledge economy on which Canada's future economic growth depends.

The Partnership Group recommends that the Government:

- **Promote the creation of innovation clusters to catalyze the generation and transfer of knowledge between the public and private sectors;**
- **That the Government implement incentives for businesses to hire Canadian advanced research graduates and reduce the level of tax credits for research and experimental development;**
- **That the Government develop a national policy on data accessibility and management that contains a commitment to long-term access and protects intellectual property.**

Introduction

The world economic crisis that began in 2008 appears to be far from over. Recovery is threatened by continued instability of global financial markets and uncertainty over the robustness of the domestic economy. The relative strength of our financial system, and the continued demand for our natural resources, will help to buffer the Canadian economy somewhat against future downturns. But this will not be enough. Long-term economic growth can only be built on a foundation of knowledge creation and innovation – an innovation pipeline that brings the best ideas and products to market, quickly and effectively.

Ideas fuel innovation. Building an innovation pipeline therefore starts with investment in ideas, which means supporting basic research and the people who do it. The Partnership Group for Science and Engineering (PAGSE) – an association of 26 professional and scientific organizations representing over 50,000 members from academia, industry and government sectors – has repeatedly emphasized this point in previous briefs to this committee. Our 2010 submission stressed the need to compete aggressively for global research talent, and we welcome the government's recent commitment to support international training opportunities in this regard. We also commend the announcement of the 10 new Canada Excellence Research Chairs. Both programs will help attract and retain top talent. We also strongly support the government's continued efforts to expand the direct and indirect costs of basic research delivered through the granting councils, as this is the best means of ensuring a continued supply of ideas for the innovation pipeline.

A vigorous research community ensures a steady flow of ideas. There are a number of indicators to suggest that Canada is improving in this regard: our scientific research output grew by 44% between 2002 and 2008[1], and we are among the top tier of countries in international collaboration[2]. However numerous reports have pointed out that we continue to fall short in translating these ideas into deliverable, marketable products and solutions that improve health, the environment, and increase productivity and wealth for Canadians. There is thus a leak in the innovation pipeline: our best ideas are not achieving their full economic potential. This brief presents three ideas for how the government might begin to mend this pipeline.

Innovation clusters

Geography catalyzes creativity. Things happen when people interact on a day-to-day basis, in person. Ideas are hatched, explored, revised, abandoned, and new ones take their place. Shared physical location facilitates mutual understanding, the development of natural partnerships, the exchange of ideas and resources, and the emergence of innovations. Although technology has gone a long way towards shortening the distance between distant geographic points, there still is really nothing like getting together to make something happen.

This is especially true when it comes to innovation. The recent report by the Science, Technology and Innovation Council (STIC)[3] highlighted the importance of clusters – a critical mass of geographically concentrated and intellectually interconnected companies, educational institutions, and government research organizations – as indicators and incubators of knowledge transfer and innovation. The members of a cluster compete and cooperate, providing a place where a more fluid movement of resources and talent allows new ideas to prosper and shortens times to market for new products.

There are plenty of examples where clusters have been successful: Silicon Valley is probably the leading one, followed closely by the private sector campuses of Bell Laboratories, North Carolina's Research Triangle and, closer to home, Research In Motion and the MaRS Discovery District. Germany has led the way in developing national strategies for promoting investment by businesses such as IBM in innovation clusters. All have brought basic scientists, applied scientists, engineers, and industrial operations together in a shared environment to catalyze innovation.

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[1] *Science Report 2010*, United Nations Educational, Scientific, and Cultural Organization (UNESCO)
[2] *State of the Nation 2010*, Science, Technology and Innovation Council (STIC)
[3] *State of the Nation 2010*: page 55

We suggest that the government work with municipalities and provinces to create new environments for innovation partnerships. Capital funds could be provided to universities to build infrastructure that would serve as "Innovation Incubators" embedded in their campuses. These initial investments would be leveraged through public-private partnerships with any companies that wished to be housed within the Innovation Incubator. Innovation Incubators would provide shared office, research, teaching, and development space for university researchers and government agency employees working on specific "theme" areas (e.g., health, energy, agriculture, forestry, environment, water, food security, digital economy, etc.), as well as established private sector enterprises with shared interests.

The benefits are manifold. Innovation clusters provide interfaces for academic, government and private sector researchers to explore new partnerships; they embed the private sector within Canada's centres of learning, to share ideas and experience, and engage in the training of Canada's next generation of thinkers and innovators; they provide a novel training ground for Canadian post-secondary students – enabling them to engage directly with industry at the inception of their careers. Finally, innovation clusters create new business opportunities and an environment to stimulate economic growth.

Recommendation:
That the Government promote the creation of innovation clusters to catalyze the generation and transfer of knowledge between the public and private sectors.

New jobs for Canadian graduates

A highly skilled workforce is an essential component of the innovation pipeline. Canada has done well to improve its capacity to train the next generation of researchers and innovators. Between 2005 and 2008, for example, we experienced the highest percentage increase in doctoral degrees – the highest level of academic achievement – in science among comparator countries[4]. Clearly we are on our way to building the next generation of cutting-edge researchers to supply the innovation pipeline.

Doctoral students and graduates are one of the main agents by which ideas get translated into innovation. They carry the specialized skills and knowledge acquired during their training into an environment where they can be put to commercial use. However employment prospects for highly skilled graduates in industry remain worryingly low[5]. A large part of the problem is that businesses in Canada invest very little in research and development (R&D), so they have little need to hire highly skilled workers. As a result, Canadian graduates who do not pursue the more traditional route of university or college teaching and research often end up leaving the country to take jobs in industry in places like the United States or Australia.

This loss of Canadian talent constitutes a leak in the innovation pipeline. Public investment in education is being squandered because we are training people for jobs that do not exist. The situation is not helped by the fact that the federal government has preferred to use tax incentives to promote business investment in R&D. Tax incentives appeal only to businesses that have actually declared a profit and they tend to foster efforts to "prove" that R&D was performed after a profit is declared, rather than fostering R&D itself. Other countries tend to rely more upon direct support

[4] *State of the Nation 2010*: page 62
[5] *Expectations and labour market outcomes of doctoral graduates from Canadian universities*, Statistics Canada 2011, Catalogue no. 81-595-M.

rather than tax incentives. Improving R&D and business innovation performance in the long run requires an up-front investment in personnel capable of performing these functions.

To do this we need to increase the number of jobs, especially industry R&D jobs, for Canadian graduates. Direct government incentives for business to employ Canadian graduates would be more effective in the long run than tax breaks. Such an incentive program could take several forms, such as post-doctoral fellowships for doctoral graduates tenable in Canadian industry, or grants or salary subsidies to businesses based on new hires of advanced research personnel or even endowments to establish corporate research chairs. The cost of such measures could be covered by equivalent reductions in the level of tax credits for corporate research for a zero-net cost modification of the current incentive system.

Recommendation:
That the Government implement incentives for businesses to hire Canadian advanced research graduates and reduce the level of tax credits for research and experimental development.

Open access data and design

Transforming the ideas generated through basic research into marketable, deliverable solutions and products that create economic opportunity and solve the complex problems facing society is often a complex, multi-dimensional process. Engineering design has always been an essential part of this process. It utilizes the principles of physics, chemistry, mathematics, and increasingly biology, to obtain the best solution to a problem or need. Design is an essential component of the innovation pipeline because it is what makes the difference between a good idea and a successful product or service.

Knowledge sharing is becoming an increasingly important component of this process as well. The complex nature of many of the most pressing problems we face in society – environmental change management and mitigation, the construction of effective information and communication networks, the development of Smart Electrical Grid technologies – require large amounts of scientific and engineering data. Often, the quantity of data required is so large, and the problem so complex, that no one research organization or company can hope to do it on their own. In the pharmaceutical industry, for example, new models for knowledge sharing are emerging because they allow companies to begin to understand the underlying causes of complex diseases without investing large amounts of money in unknown and potentially risky research areas[6].

Making data freely accessible online improves the capacity for research and innovation; it effectively increases the flow of ideas into new products and solutions. Canadian companies will more easily be able to access and use publicly funded data as a "jumping off" point for their own research and development. Engineering design will become more effectively integrated into the innovation process because it will involve more and better information for end-product specifications. Freely accessible online data also helps to bridge regional disparities in access to scientific equipment or research grants. It is essential to completing the innovation pipeline.

Many Canadian organizations supported by the federal government are already adopting a policy of open and free access to their data. For example, NEPTUNE Canada, the world's largest cabled seafloor observatory, is developing a data access policy that places few restrictions on data and allows free online real time and archived data access. This is a welcome first step but more must

[6] Pharmacogenomics Reporter; http://www.genomeweb.com/dxpgx/new-genomic-data-sharing-efforts-aim-bridge-pharmas-revenue-innovation-gap; accessed Aug 06, 2011

be done to keep up with competitor countries such as the United States, United Kingdom, Australia and the European Union, which all have national data access and sharing policies. Canada needs a comparable national policy on data accessibility and management that contains a commitment to long-term access.

The financial investment associated with open access data sharing is small compared to the rewards; for example, in the United Kingdom, the government expects open data to create £6 billion (C$10 billion) in economic value for that country[7]. Canada cannot afford to wait; we have excellent computing capacity, and among the highest levels of government investment in research and development in the world. By unlocking data, we can unlock the potential of those investments.

Recommendation:
That the Government develop a national policy on data accessibility and management that contains a commitment to long-term access and protects intellectual property.

Conclusion

There are signs that recent investments by the Canadian government in building an innovation pipeline are paying off. Canada continues to punch above its weight internationally in many fields of science and engineering, is expanding its output of research and ideas, and is positioning itself as a global player in the competition for talent. But more needs to be done. Canadian investments in building a knowledge economy will be squandered if we cannot translate the ideas generated through basic research into new products and solutions. This brief has emphasized three ways the government could do this: create innovation clusters, provide incentives for industry to hire highly skilled Canadian graduates, and develop a national policy on data accessibility and management. These changes are essential to building an effective innovation pipeline that can create wealth and jobs for Canadians, and will enable us to weather economic uncertainties in the future.

The Partnership Group for Science and Engineering (PAGSE) *is an association of 26 professional and scientific organizations representing 50,000 members from academia, industry and government sectors. It represents the Canadian science and engineering community to the Government and seeks to advance research and innovation for the benefit of Canadians. PAGSE is not a lobby group, but a cooperative partnership that addresses broad issues of science and engineering policy at the national level.*

[7] http://www.conservatives.com/Policy/Where_we_stand/Technology.aspx