Research Partnerships: A Discussion Paper for BHER

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Executive Summary

Canadians recognize the need to boost innovation and productivity to retain our position as one of the world's leading economies. While there is much yet to be done, we have a solid foundation of strong, globally competitive firms, world-class post-secondary institutions, and a history of research collaboration between them.

This discussion paper explores opportunities to build on this strong foundation. Distinguishing between different mechanisms and motivations for engaging in partnership is essential to understanding how best to move forward. The *push-pull* dynamic of research partnership, while valuable for **transactional, short-term partnerships**, misses the important dynamic of collaborative relationship building that binds **strategic, long-term relationships** that can boost the innovation capacity of entire sectors and regions.

This discussion paper makes four recommendations BHER can pursue to advance the impact of research partnerships in Canada. The first and second recommendations focus on improving the practice of establishing effective research partnerships for both short-term and long-term impact. The third and fourth recommendations focus on understanding the current research partnership ecosystem and ensuring its effectiveness.

BHER is uniquely positioned to deliver game-changing impact on research partnerships in Canada. Building from a strong foundation, BHER's leadership can establish a new era of collaboration along a distinctly Canadian model, boosting innovation and ensuring that Canada leads the way in tomorrow's innovation economy.

Recommendation 1: Collect, promote and implement best practices to connect industry and post-secondary institutions along the idea to invoice chain - particularly at the intersection of separate institutions - and share across BHER through the development of a toolkit.

Recommendation 2: Establish high-profile industry-led research collaborations with BHER members as foundational leads. Each BHER industry member should commit to leading or co-leading a collaborative research project with PSE members. These could be organized as ambitious "Grand Challenges" around common themes or sectors.

Recommendation 3: BHER should work to establish a performance measurement framework for tracking partnership activity and evaluating outcomes. BHER can produce an annual report on Business-Higher Education research partnerships that will highlight successes and impacts, identify policy gaps, highlight strategic opportunities and promote Canada as a rich source of research and innovation.

Recommendation 4: Advocate for an update of Jenkins Report data on current programs to support business innovation, with a particular emphasis on research partnerships. Include program outcome tracking as part of the performance measurement framework in Recommendation 3. Advocate for a streamlining of programs. Evaluate whether current programs are sufficient and appropriate to support multilateral research partnerships between universities, colleges, polytechnics and industry.

Introduction

The Canadian economy is evolving amidst global change and uncertainty. Rapid technological change and automation combined with slowing economic growth and increased competitiveness of emerging economies make it essential to create opportunities for Canadian businesses to thrive, increase productivity and compete globally.

Boosting business innovation is critical for enhancing Canada's economic performance: innovation makes businesses more productive, increases global markets, and promotes highly-skilled jobs. Research partnerships between Canadian businesses and institutions of post-secondary education (hereafter referred to collectively as PSE) are powerful drivers of business innovation. These partnerships increase business capacity to adopt cutting-edge research and development and provide PSE a pathway from discovery to commercial application. Canada has a rich ecosystem of research partnerships - among the world's best. But there remain significant opportunities to build on this strong foundation with targeted action and a clear vision to ensure Canada's innovation-based economy can thrive.

This discussion paper provides a high-level overview of the current status of research partnerships in Canada and then looks ahead to how industry, universities, colleges and polytechnics can build on a strong foundation to increase Canada's economic performance. It builds on an earlier paper - *Research and Innovation for the 21st Century*[1] - by summarizing main themes and then providing recommendations for actions.

Background and Context

Research and Innovation for the 21st Century provided a foundation for this work by examining drivers of research partnerships between industry and institutions of higher education. It found that the factors shaping participation in research partnership are broad and varied and that the landscape is highly complex. It also summarized key success factors for business-university collaborations as well as key challenges. Helpfully, it raised questions meant to address some of these key challenges. This discussion paper is designed to build on this foundation by providing suggested actions for the Roundtable to advance Canadian research partnerships even further.

While outside the scope of this discussion paper, BHER has also committed to significant action on work-integrated-learning (WIL). WIL provides significant student benefits, including skills development, training, and experience. In cases where the work-integrated learning is research-based, these programs can also be significant drivers of successful research partnerships (and vice versa – strong research partnerships can provide a foundation on which to establish successful WIL partnerships). While WIL will not be a focus of this discussion paper, it is important to be cognizant of the interplay between these two BHER themes and opportunities for coordination and leveraging.

[1] Business/Higher Education Roundtable, 2016. *Research and Innovation for the 21st Century: Building Industry and Post-Secondary Partnerships.*

Categories of Research Partnership Activity

Research partnerships can include a wide variety of activities and arrangements between industry partners and PSE. These may include consulting, fee-for-service contracts, industrial chairs, industrial training programs, collaborative research projects, secondments, internships and more. While many of these partnerships are formal, there are also innumerable informal partnership arrangements based on personal relationships, professional networks, and so on.

In recent years, it has become standard to distinguish between two broad categories of research partnership. ***Technology-push*** partnerships generally originate with research already occurring at the post-secondary institution. Here an invention or process developed by researchers at the institution is presented to industrial partners who can incorporate it into their commercial or business activities.

Market-pull partnerships (also called *demand-driven* partnerships) work in reverse - industry describes a need which is then addressed by research at a post-secondary institution. These are often - though not always - associated with incremental innovation as businesses look to build on existing business or adapt from other sources. In recent years, demand-driven partnerships have been increasingly favoured since they begin with a recognized market need and are therefore expected to have greater commercial potential.

The push-pull model of research partnership is important, but both categories share an important – and sometimes limiting - feature. They each describe **transactional, short-term relationships** - in both cases, PSE is the producer of research and industry is the consumer and in each case there is a “transfer” of technology/knowledge from the former to the latter. The distinction between push and pull rests solely on who initiates the transaction, who defines the research need. These types of partnerships are capable of addressing needs at any number of points along the spectrum from “idea to invoice”, but tend to be targeted on short to medium-term, specific deliverables.

Contrast this with the synergistic relationship observed in successful research clusters and consortia, where industry and PSE collaborate on the identification of research opportunities and objectives, cooperate on the execution of the necessary research - whether it occurs at a campus lab or in an industrial setting - and develop long-term relationships to support each other’s growth and development. These **strategic, long-term relationships** align around a shared research vision, build trust and develop shared benefits that support the long-term objectives of all partners. Importantly, they also have considerably stronger potential to draw in a broader ecosystem to support the vision, including venture capital, intellectual property management, incubators and accelerators and more.

Transactional research partnerships are important and valuable for firms seeking to fulfill particular business needs or for academic researchers seeking to commercialize specific inventions. But the tools and mechanisms for supporting these partnerships will look different than those designed to foster research clusters or consortia designed to promote innovation across an entire sector or region. This paper will examine both in turn.

Objectives and Facilitation of Research Partnerships

As already noted, the objectives of participants in research partnerships can vary widely. However, the distinction between transactional research partnerships and cooperative research partnerships address two broadly different objectives for collaboration between industry and post-secondary institutions. On the one hand, research partnerships are designed to offer specific solutions to particular problems, and may be appropriate at various points along the path from idea to invoice. On the other hand, research partnerships offer the potential for industry and institutional partners to work together to define and address broad challenges or opportunities across a whole sector, technology, or region. While these aren't mutually exclusive, treating them separately helps identify gaps and opportunities for action.

From Idea to Invoice

Canadian PSE offers knowledge, technology and skills to support Canadian businesses along the commercial spectrum, from idea to invoice. These activities may include:

- Basic research
- Applied research
- Proof of concept
- Prototyping
- Simulation
- Testing and analysis
- Clinical or field trials
- Design
- Market analysis
- Skills training and development

Research partnerships designed to help a company move along the path from idea to invoice tend to be transactional and bilateral, involving a single company (or perhaps a main/lead company) and a researcher at a single PSE. In some cases, these relationships may draw in additional researchers as a project grows or expands, but the project remains focused on specific deliverables.

These partnerships are important and valuable to all parties involved: companies access external expertise and facilities that allow them to innovate and grow their business in ways they couldn't if they relied on in-house capabilities. PSE benefits through development of potential new research avenues, experience and opportunities for students and external support for research activities. Partnerships occur as needed, providing business with the opportunity to rapidly respond to opportunities for growth and new directions.

To facilitate these partnerships, many institutions have developed technology transfer offices (existing under many names). These offices are designed to serve as a single point of contact for businesses seeking partnerships, but are challenged by the complexity and diversity of their institutions and by the breadth of potential industry partners. Nonetheless, post-secondary institutions have developed a variety of successful, effective mechanisms to work with industry. Identifying and adopting these best practices should improve performance across the network.

One inherent challenge to the tech transfer approach arises from the affiliation of tech transfer offices and staff with single institutions, and in some cases even single faculties or de-

partments. This poses a challenge to smaller institutions who may not offer a full spectrum of activities to prospective partners and can inhibit effective collaboration between and among universities and colleges or polytechnics who may be best suited to supporting partnerships at different stages of the idea to invoice pathway. Mechanisms to encourage collaboration between and among institutions would increase the flexibility and suitability of research partnerships and should foster a simplified and more straightforward process for industry to engage with the post-secondary research sector.

Recommendation 1: Collect, promote and implement best practices to connect industry and post-secondary institutions along the idea to invoice chain - particularly at the intersection of separate institutions - and share across BHER through the development of a toolkit or through the establishment of a common framework.

Strategic Research Partnerships

Long-term, strategic research partnerships are based less on a specific commercial opportunity and more on a shared long-term vision for research and innovation. These partnerships may last a decade or more, and are based on common objectives, mutual trust, and shared benefits between all partners. Generally multilateral, these complex partnerships can deliver significant benefits to all parties - long-term, stable funding for faculty researchers, industry-relevant skills development and training, and innovative new products and processes. Most of all, these partnerships develop the strong human capital necessary to strengthen partnerships and to drive the development of innovation in a sector.

Strategic research partnerships are the engine for **innovation clusters and consortia**. Combining the commercial vision of industry with the knowledge and human capital in PSE can drive the innovation performance of entire regions. They serve as powerful incubators of start-ups and small and medium-sized companies (SMEs) who can form the developing innovation supply chains for global firms. They create global competitive advantages by concentrating talent and infrastructure in pursuit of common objectives, both on the commercial and on the research sides.

Given their success in driving economic growth around the world, much recent attention has been paid to supporting **regional innovation clusters**: geographically-linked concentrations of firms, PSE institutions and coordinating organizations working on a common platform, sector or challenge. Strategic research partnerships form the backbone of these innovation clusters. Where pre-existing relationships between firms and institutions exist, they can serve as a foundation for initiatives to build and grow the cluster through new and expanded partnerships.

It is widely accepted that establishing innovation clusters from scratch is difficult to impossible[2]. However, **research consortia** and other broad types of research collaboration also confer significant benefits on partipating firms and institutions[3]. Given their scale and complexity, strategic research consortia are generally administered via a platform responsible for

[2] Katz, B and M Muro. 2010. *The New "Cluster Moment": How Regional Innovation Clusters Can Foster the Next Economy.* Brookings.
[3] Brainstetter, LG and M Sakakibara. 2002. *When do Reseach Consortia Work Well and Why? Evidence from Japanese Panel Data.* The American Economic Review 92 (1).

planning, coordination and administration and provide an effective mechanism to work across institutional boundaries. For instance, consortium-focused business development staff work across members, proactively recruiting participants and building research teams appropriate to needs and opportunities. Consortia can establish common objectives and performance measurement metrics to track progress and attract funding. And by having clear industry leadership by Canada's largest companies, they can support Canadian economic development in a global marketplace by building strong, home-grown support systems for talent and supply chains.

Canada has numerous examples of strong, successful research and innovation consortia, as described in a previous BHER paper[4]. These clusters, including the Southern Ontario Smart Computing Innovation Platform (SOSCIP), the Structural Genomics Consortium (SGC), the Consortium de recherche et d'innovation en aérospatiale au Québec (CRIAQ) and the Canadian Oil Sands Innovation Alliance (COSIA), can serve as models for new clusters led by BHER members focused on building capacity and driving innovation in selected sectors. In order to promote and highlight the ambitious nature of these new partnerships and to attract additional participants, they could be presented as outcome-oriented "Grand Challenges". These industry-led projects will serve as focal points for ongoing research partnership, support the development of innovation ecosystems, and highlight Canada's cutting-edge research capacity.

Recommendation 2: Establish high-profile, industry-led research collaborations with BHER members as foundational leads. Each BHER industry member should commit to leading or co-leading a collaborative research project with member universities and colleges. These could be organized as ambitious "Grand Challenges" around common themes or sectors.

Measuring Research Partnership Activity and Outcomes

Canada has a strong track record of research partnership between industry and PSE. Canadian business spent $930 million on research in PSE last year[5], representing approximately 3% of spending on higher education research and development (HERD). This is roughly three times the OECD average and second only to Germany in the G7[6]. However, there are reasons for concern, most notably Canada's falling rate of business expenditure on R&D (BERD). Canada's BERD as a percentage of GDP (0.83%) is roughly half the OECD average (1.6%) and well behind innovation leaders Israel (3.45%), Korea (3.26%) and Japan (2.65%)[7].

Unfortunately, detailed statistics on Canadian research partnership activity are difficult to find. Even data on simple inputs and outputs - types and durations of partnerships, number

[4] BHER 2016.
[5] Statistics Canada CANSIM 358-0001. *Gross domestic expenditures on research and development, by science type and by funder and performer sector, annual.*
[6] Council of Canadian Academies, 2013. *The State of Industrial R&D in Canada*. p.142.
[7] OECD. Main Science and Technology Indicators. Data extracted on 13 Jan 2017 from OECD.Stat. All numbers 2013.

and types of participants, papers and patents produced - are sparse and distributed among numerous sources that may use different and incompatible definitions and metrics. PSE institutions track internal activity, but do not define research partnerships according to common standards, making aggregation difficult. Associations (Universities Canada, U15, Colleges and Institutes Canada, Polytechnics Canada) track and describe activities, but are understandably focused on their respective membership rather than the system as a whole. Granting councils track program activity, but these data are not compiled across all programs and only capture government supported projects.

Tracking outcomes is even more challenging. There is currently no general effort to evaluate outcomes and impacts of research partnerships, to measure activities against broader objectives, nor an effort to determine which partnership approaches are better than others. The effective evaluation of impacts have numerous potential benefits including: determining best practices, identifying policy gaps, communicating with governments and other stakeholders the value of research partnerships and opportunities for support, promoting the value of participation, and increasing the visibility and reputation of Canada as a dynamic, innovative economy.

Recommendation 3: BHER should establish a performance measurement framework for tracking partnership activity and evaluating outcomes. BHER can produce an annual report on Business-Higher Education research partnership that will highlight successes and impacts, identify policy gaps, highlight strategic opportunities and promote Canada as a rich source of research and innovation.

Existing Government Research Partnership Programs

Government encourages and supports research partnerships between industry and institutions of higher education for well-justified policy reasons. Research partnerships generate significant public spillover benefits through knowledge production, talent development and more. With exceptions, government programs incent industry investment with matching government funds, generally via some intermediary or program. Accordingly, research partnerships in Canada have access to support from a wide variety of programs at the federal, provincial and regional level.

In 2010, the federal government convened an expert panel to evaluate federal support to industrial research and development - the so-called Jenkins Panel[8]. As part of their work, the Panel reviewed 60 federal programs delivered by 17 federal entities, totaling nearly $5 billion annually. Of this, roughly 70% was accounted for by the Scientific Research & Experimental Development (SR&ED) tax credit, with the $1.5 billion balance coming from 59 different direct expenditure programs. The Panel noted that the distribution of spending across these programs is highly skewed, with the largest five accounting for about 40% of direct expenditures while more than 50% of the programs spent less than 1% of the total direct expenditure.

[8] Government of Canada, 2011. *Innovation Canada: A Call to Action, Review of Federal Support to Research and Development - Expert Panel Report.*

The largest of the direct expenditure programs, the National Research Council's Industrial Research Assistance Program (IRAP), supports small business R&D in a variety of ways, including via collaboration with post-secondary institutions. Many of the other programs support broad regional (e.g. ACOA, FedDev, FedNor) or sectoral (e.g. Strategic Aerospace Defence Initiative (SADI), FPInnovations, Sustainable Development Technology Canada (SDTC)) initiatives that may include some research partnerships as part of their funding allocation. Additionally, numerous initiatives are administered via the granting councils to support research partnerships explicitly, including NSERC's Collaborative Research and Development Grants, Strategic Network Grants, Industrial Research Chairs and College and Community Innovation programs, and the tri-council's Networks of Centres of Excellence programs. The Panel estimated that in 2007, 27% of direct federal support (about $400 million) for industrial R&D was allocated to the academic sector (including students)[9]. It is unclear how much of the support allocated to large business (11%) or small business (26%) was also used to support collaboration with PSE (the remaining support is allocated to NRC institutes and other federally performed R&D (21%), Canadian non-profits (12%) and others (3%)).

Determining overall levels of support is therefore difficult based on the large number of different programs, all of which allocate their funds according to different criteria, making global analysis difficult. Nonetheless, there is reason to believe that the large number of sub-scale programs may not be an ideal policy approach to supporting research partnerships. The OECD pointed out this risk in a general review of business innovation policies in 2011:

> *The trade-off involved here is on the one hand to have a set of instruments that is sufficiently differentiated to meet the needs of complex innovation systems. On the other hand, the policy mix needs to avoid inefficiencies arising from operating too many schemes at too small a scale. This is a real concern, since instruments can develop constituencies of support and a degree of autonomy, making them less amenable to change or cancellation, even where this would be sensible. In some cases, there may be ways to streamline the range of instruments and programmes, reduce complexity, enhance transparency, and lower administrative costs[10].*

This thinking motivated a major recommendation of the Jenkins Panel to "*consolidate business innovation programs focused on similar outcome areas into a smaller number of larger, more flexible programs open to a broader range of applicants and approaches".* This recommendation remains unimplemented and warrants renewed attention.

Recommendation 4: Advocate for an update of Jenkins Report data on current programs to support business innovation, with a particular emphasis on research partnerships. Include program outcome tracking as part of the performance measurement framework in Recommendation 3. Advocate for a streamlining of programs. Evaluate whether current programs are sufficient and appropriate to support multilateral research partnerships between universities, colleges, polytechnics and industry.

[9] Government of Canada, 2011. P. 3-9.
[10] OECD, 2011. Business Innovation Policies: Selected Country Comparisons. P. 22

Recommendations

Recommendation 1: Collect, promote, and implement best practices to connect industry and post-secondary institutions along the idea to invoice chain - particularly at the intersection of separate institutions - and share across BHER through the development of a toolkit.

This recommendation involves the collection promotion and implementation of best practices from BHER members across the country into a report on how PSE currently supports industry on the commercialization path from idea to invoice. This effort will highlight current successes and share best practices across BHER members and beyond. A particular emphasis should be placed on how PSE institutions' technology transfer teams are able to build linkages with other institutions in their regions or across regions to support research partnerships with industry partners. The report can then be used to generate a toolkit of best practices that would be shared with technology transfer offices or others involved in the interface between industry and PSE institutions. Alternatively (or additionally), BHER could serve as a platform for implementing this toolkit among member institutions and businesses.

Recommendation 2: Establish high-profile industry-led research collaborations with BHER members as foundational leads. Each BHER industry member should commit to leading or co-leading a collaborative research project with PSE members. These could be organized as ambitious "Grand Challenges" around common themes or sectors.

Each BHER industry member should commit to leading or co-leading a collaborative research initiative in partnership (and perhaps co-leadership) with BHER PSE members to establish and support long-term, strategic research partnerships in a given sector. These can be established according to a "Grand Challenge" model in some emerging technology or platform in order to promote and highlight the ambitious nature of these partnerships and to attract additional participants. These projects would be designed to attract SME partners and additional academic participants to support innovation ecosystems around specific themes. The structure of a given cluster could be modeled after existing consortia such as CRIAQ, SOSCIP, SGC or COSIA, and financial support for the cluster would come from a combination of industry funds, existing institutional resources, current partnership programs and dedicated government funding. Grand Challenge Clusters would focus on research and development of next generation products or services, development of skills and talent for future jobs, and establishment of a strong supply chain of regional SMEs to support global competitiveness of our big companies.

Recommendation 3: BHER should work to establish a performance measurement framework for tracking partnership activity and evaluating outcomes. BHER can produce an annual report on Business-Higher Education research partnerships that will highlight successes, identify policy gaps, highlight strategic opportunities and promote Canada as a rich source of research and innovation.

BHER would define desired long-term outcomes for research partnerships and then develop a common performance measurement framework which would be used to gather data on

key metrics. These metrics would inform BHER's ongoing discussion about the state of industry-higher education cooperation and collaboration and could support the production of a public annual report highlighting successes, impact, and opportunities to develop or expand partnerships. Outcome data linked to program activity would also be collected to enable ongoing evaluation of existing government support mechanisms. The performance measurement framework should also include key metrics on work-integrated learning, and may align with (and inform) additional evaluation projects as these initiatives develop.

Recommendation 4: Advocate for an update of Jenkins Report data on current government programs to support business innovation with a particular emphasis on research partnerships. Include program outcome tracking as part of the performance measurement framework in Recommendation 3. Advocate for a streamlining of programs. Evaluate whether current programs are sufficient and appropriate to support multilateral research partnerships between universities, colleges, polytechnics and industry.

The Jenkins Panel data is more than five years old and should be updated to include new programs and changes to funding. Given the reviews occurring at Innovation, Science and Economic Development (ISED) and the assessment on the state of science and technology and industrial research and development underway at the Council of Canadian Academies (expected in late 2017), BHER should determine whether such a review is planned or underway. BHER should support such a review or advocate for one. Notwithstanding the results of such a review, the recommendation of the Jenkins Panel remains relevant - streamlining and/or consolidation of industry research programs would simplify participation for both industry and academic members,would help achieve economies of scale in delivery and administration, and would simplify evaluation and evolution of programs. As part of this process, the suitability of existing programs to support collaboration involving both universities and colleges or polytechnics should be evaluated and taken into account.

Appendix: List of Acronyms

ACOA	Atlantic Canada Opportunities Agency
BERD	business expenditure on research and development
BHER	Business Higher Education Roundtable
COSIA	Canada's Oil Sands Innovation Alliance
CRIAQ	Consortium de recherche et d'innovation en aérospatiale au Québec
FedDev	The Federal Economic Development Agency for Southern Ontario
HERD	higher education expenditure on research and development
IRAP	Industrial Research Assistance Program
ISED	Innovation, Science and Economic Development
NSERC	Natural Sciences and Engineering Research Council
OECD	Organisation for Economic Co-operation and Development
PSE	post-secondary education
SADI	Strategic Aerospace and Defence Initiative
SDTC	Sustainable Development Technology Canada
SGC	Structural Genomics Consortium
SME	small and medium-sized enterprise
SOSCIP	Southern Ontario Smart Computing Innovation Platform
SR&ED	Scientific Research & Experimental Development tax credit
WIL	work-integrated learning