



# College Applied Research: Innovation, Productivity and the R&D Continuum

Presentation to Expert Panel on  
Review of Federal Business Research  
and Development Programs

29 November 2010

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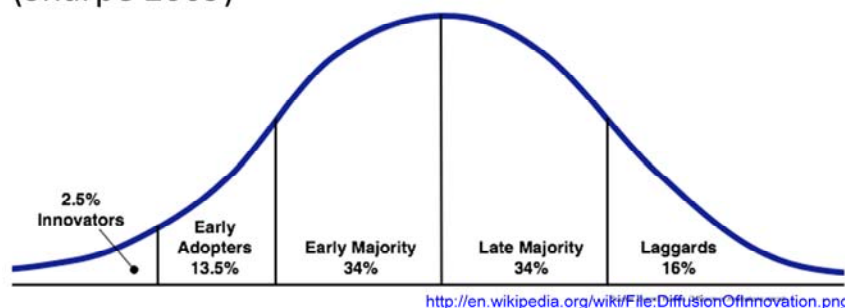


# Outline

- Context
- College applied research
  - Innovation Support Services
  - Focus
  - Indicators
  - Benefits
  - Intellectual Property
- Open Innovation

## Innovation=creating value

- Firms are not making effective use of postsecondary R&D capabilities
  - “We’ve gone too far in subsidizing R&D, and not far enough in subsidizing *diffusion of innovation.*” (Sharpe 2009)



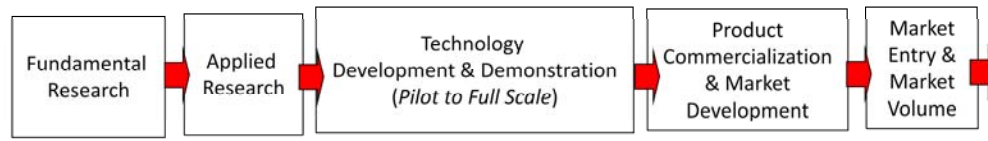
While Canada performs very well at basic research, publications, and inventions, we do not perform well as commercializing inventions. Innovation is about creating value. We have a strong post-secondary system in Canada that performs well internationally, but this system is not set up to serve the needs of industry. Reorienting and modernizing the Canadian post-secondary education system to function as an industry-facing innovation system will encourage firms to make more and better use of the capacity that exists with postsecondary R&D. Not all research need have immediate commercial output/outcome. Nor should commercialization become our only yardstick for measuring return on investment of tax dollars in R&D. Instead, call this a return on innovation. Funding for both basic and applied research that leads to innovation and commercialization is key to improving community economic and social development. We must certainly maintain and improve our commitment to funding basic research, but we must also see the very real benefits that will come from properly funding applied research and the commercialization of innovations.



## College applied research

### “Last Mile” R&D services

- Regional, additive or complementary R&D capacity and *diffusion of innovation*
- Closely linked to industry
  - Market pull vs. idea push
- Move from idea to invoice



Colleges' foray into applied research is a direct by-product of offering undergraduate degrees. Since colleges have started offering more undergraduate credentials we have expanded our mandate to train for industry by offering industry innovation supports through applied research capacity development. College applied research is complementary to the basic research services offered by other R&D facilities (universities, government labs). We are one point of contact in an innovation system that offers value creation for firms as well as basic research ideas seeking to enter the market. Colleges offer industry-facing applied research capabilities that fill gaps in Canada's R&D pipelines. Our focus on applied research, innovation and commercialization supports industry problem-solving in ways that are complementary to established, discovery-based research institutions. Colleges respond to the market – industry pulls expertise and resources from the college applied research sector. This contrasts to basic research which supports pushing ideas from the lab into the market. Both are necessary components of a high functioning innovation system.

The college applied research system is well positioned to play a lead role in strengthening national and regional capacity to innovate, working with research centres and industry partners to enhance competitiveness in the sectors we serve. Firms in Canada are not yet making effective use of the postsecondary research facilities we currently have, but this is changing. College applied research centres offer complementary capacity for R&D that enables industry to make more effective use of publicly funded research facilities. We offer services to industry that are not currently widely available in Canada – the applied research, commercialization-focused “last mile” services that industry needs in order to test market practicality assumptions. Broadening the potential outputs for R&D in a given area by supporting applied research will foster increased productivity, enabling Canada to realign R&D expenditure imbalances, and correct our long-standing poor record on innovation.



## What we do

- **Applied research** is original investigation undertaken in order to acquire new knowledge . . . directed primarily towards a specific practical aim or objective.
- **Experimental development** is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed. (Frascati Manual [2.1.64](#))

The Frascati manual also includes “Basic research [which] is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view.” Basic research is the purview of the university and government labs in the country. Canada is well served in basic research; we are not strong on the commercialization end, which includes applied research and experimental development.

All of us involved in the innovation economy are oriented toward the same goal of increasing social and economic productivity in Canada. The college applied research system can play a lead role in strengthening national and regional capacity to innovate, working with research centres, industry and community partners to enhance competitiveness in the sectors we serve by assisting in the latter stages of R&D into market entry.



## Innovation Support Services

Help industry to

- **Validate** practicality and usability of new technologies/products/processes
- **Simulate** impact of their use
- **Adapt** those technologies for deployment under diverse conditions
- The **intentional** application of applied research and innovation services to industry needs and contexts

College applied research addresses problems faced by industry – industry *pulls* research capacity from the college applied research centres. This is in contrast to basic research ideas that *push* their way into the market. This bifurcation offers us a useful way to understand how applied research is situated.

The key for college applied research is instrumentality, or the intentional application of applied research and innovation services to industry needs and contexts. This means that we are focused on addressing the industry problems faced by firms who are seeking to innovate and create new value in their sectors. We are an explicit instrument for addressing these industry problems, meaning that we respond to what is needed, fitting into the R&D continuum for latter stage innovation support.

Innovation is almost always incremental. It has a history, and builds iteratively from step to step in its value-realization path. The college applied research innovation support services are put into play in a deliberate attempt to assist this incrementality, promoting product commercialization, market development, entry and volume.



## Focus

- Economic and social productivity
- Socializing industry to spend on R&D
  - Incentives to invest via federal funding programs that provide matching funds to engage college faculty and students in industry R&D
- Colleges as catalysts for innovation
- Enabling downstream effects of innovation

Canada needs industry to increase investment in R&D (BERD). College applied research funding programs such as the NSERC College and Community Innovation Program are de facto instruments to socialize industry to spend on R&D, giving our students innovation literacy in the process. This point is made in the recent Conference Board of Canada report on applied research (<http://www.conferenceboard.ca/documents.aspx?did=3853>). "Innovation Catalysts and Accelerators: The Impact of Ontario Colleges' Applied Research" offers important information on the complementary role that colleges play in the Canadian innovation system. This includes encouraging industry to invest in R&D, something Canadian firms do not do on par with our international counterparts. Correcting the imbalance between Canada's high per capita spending on R&D funded through higher education institutions and the lack of spending by the private sector is a key concern. Failure to correct this imbalance so will result in lowered productivity and a continuation of our downward trend on our innovation capacity.



## Innovation indicators

### Downstream effects of

- Increased industry R&D spending and innovation
- New products, processes, practices in industry
- Proxies for future job creation
- Innovation system capacity
- Industry confidence in innovation
- Highly Qualified and Skilled Personnel (HQSP)
- Innovation literacy at all levels of the work force
- Increased student graduation, satisfaction and employer satisfaction (c.f. innovation literacy)

Innovation indicators comprise metrics for measuring the level of success in engaging industry investment in R&D and the proxies for social and economic productivity improvement. These metrics may not be immediate, but we need a “milestone” approach to realizing productivity gains: measuring the steps we take to increasing industry R&D investment and the precursors to eventual job creation and market volume. This includes the specific outputs of innovation support and R&D (new products, processes, practices), but also the proxies and precursors for future job creation (industry outputs) and innovation system capacity (R&D inputs). While increased R&D spending is a solid proxy for industry confidence in the innovation system and innovation generally, we must measure the steps required to get this: industry familiarity with federal funding to support R&D spending, for example. A recent survey by NSERC indicates that only about 7% of firms that do R&D use NSERC programs. Only about 2% of small R&D performers use NSERC; 70% of users said they were not aware of NSERC or the programs available to them. In comparison, about 90% use SR&ED and 17% use IRAP (Statistics Canada).

Of particular importance to colleges and universities is how well we prepare the next generation of talent for entrepreneurial and innovation activities. Typically in Canada we measure the effects of student engagement in R&D by counting Highly Qualified Personnel (HQP), which refers primarily to graduate students. We need to expand this to include undergraduate college students and count Highly Qualified and Skilled Personnel (HQSP) to capture the larger potential of engaging our entire work force in innovation capacity development. Those with graduate degrees represent a small percentage of our population (less than 5%). HQSP embraces the role of advanced skills and education and reinforces a multiplier effect that innovation literacy can have on the wider population. When we expose our students in colleges to applied research problem solving they gain innovation literacy, as noted above. Colleges offer diplomas through to undergraduate degrees. Student so equipped with innovation literacy are more amenable to working with those with advanced degrees on innovation activities. We need innovation literacy at all levels of the work force. Our productivity and innovation challenges demand of us a consolidated approach to improving the innovation capacity of all workers in all sectors of the economy. Doing so will enhance the diffusion of innovation at all levels of the economy.





## The Innovation Equation

- **Public Private Partnership + R&D = P3RD**
  - College applied research is a public R&D subsidy
  - Oriented toward increasing productivity
- **Goal: Fostering diffusion of innovation**
- **College applied research fosters increased productivity, enabling Canada to realign R&D expenditure imbalances, and correct our long-standing poor record on innovation.**

The innovation equation is based on the foundation of our relative standings on Higher Education Expenditures on R&D (HERD) and Business Expenditures on R&D (BERD). Industry-facing applied research and innovation support services exist as a Public Private Partnership (P3) support for R&D, or P3RD. P3RD is a public subsidy for fostering increased industry spending on R&D, and this subsidy is threefold:

1. Colleges are public institutions; equipment and personnel are publicly funded,
2. We receive public money through industry-academic funds (c.f. College and Community Innovation Program) that matches industry contributions, typically dollar for dollar, to engage our students, faculty and equipment in industrial problem solving, and
3. The activities that industry finance themselves are, in most instances, eligible for SR&ED credits or other tax incentives and subsidies.

This is a powerful incentive program that is designed to increase BERD overall, which should have demonstrable and measurable effects on our productivity and innovation capacity overall. The instrumentality of the college applied research layer of the innovation system will foster increased BERD and innovation capacity. Our common goal across the entire postsecondary R&D spectrum is improved productivity and diffusion of innovation.



## Benefits

- **Industry Partners** access timely problem-solving knowledge and facilities
- **Students** gain innovation literacy through real world, practical problem-solving opportunities;
- **Faculty** participate in industry innovation, contributing and refining their expertise

Our focus is not on ourselves as purveyors of innovation support services and applied research capacity. Rather, if we do our job right, it is about industry, who will innovate and improve productivity. Industry thus engaged works with colleges to integrate applied research problem solving in curricula throughout the college system, thereby engaging the next generation of workers and acculturating our graduates to an innovation mindset. Colleges, historically close to industry, are well situated and poised to embrace the innovation challenges we face as a country. We are stepping up to these challenges and working with industry to improve productivity through innovation. Our students graduate with job ready skills and innovation literacy. Our faculty, many of whom come directly from industry, continually refine and update their own skills and expertise. The diffusion of innovation starts with engaging the next generation of workers, all of whom will be agile and adept agents of innovation no matter their work context. We have begun applied research work across the country, and have had strong success with very modest funding available. Increasing the funds for industry to innovate, and finding ways for industry to leverage the innovation system (perhaps through an industry voucher system), will produce longer term benefits throughout the economy.



## Innovation Literacy

- Research, problem solving, leadership and entrepreneurship skills, and the ability to recognize innovation in the product development lifecycle
- Highly Qualified and *Skilled* Personnel
  - flexible innovators in the workforce
- Canada ranks first in tertiary education attainment only when colleges included (8<sup>th</sup> when not)
  - All workers in the economy need to be innovation-ready

The innovation economy is both a driver and an outgrowth of a knowledge- based society that requires us to ensure our graduates are not only content experts in their fields of choice, but also expert learners, able to adapt to our changing world. By directly involving our students in industry-focused applied research we promote innovation literacy, producing graduates who have research, problem solving, leadership and entrepreneurship skills, and the ability to recognize innovation in the product development lifecycle. This is in addition to the job-ready skills our graduates already possess.

Our role in promoting innovation literacy makes us ideal participants in an "ecology of innovation" that promotes partnership, entrepreneurship, and educational pathways for students, industry and community partners alike. Our focus on instilling innovation literacy in all graduates means that we have a work force more adept at realizing value from innovation.



## Intellectual Property

- Colleges offer flexible IP policies
  - We don't take an ownership stake in firms' IP
- Our focus is on the diffusion of innovation and training students to be innovation-ready
- We offer innovation micro-financing
  - Firms are asked to repay investment if successful in the market
  - This is put back into future industry sponsorship

Colleges have a highly flexible approach to intellectual property (IP), precisely because our focus is on downstream economic development. We don't take an ownership stake in IP for two main reasons:

1. It's not our core business to develop, protect and prosecute IP
2. It is much more difficult for firms to obtain venture capital investment when they have encumbered IP.

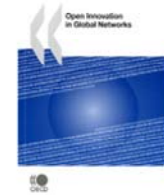
We respond to industry, and thus focus on enhancing and testing industry IP. Where we engage in co-creation of forward IP we reserve the right to receive benefits of this. At George Brown College (as at many colleges), as a matter of principle we do not take an ownership stake in IP, but we do ask that firms repay our investment. For example, if we send public money on to a project, we ask in our collaborative research agreements that the firm, if successful in the market, repay this amount. This money would then be reused to micro-finance the next industry partner's innovation support.

Because we focus on the firms themselves and their downstream capacity to realize market value, we obtain a return on investment via a more macro approach. We measure ROI threefold thus:

1. A Return on Investment through the training of our students: Students with innovation literacy enter the workforce ready to innovate
2. A Return on Innovation through increased industry R&D spending: the capacity to innovate is increased, leading to improved productivity
3. A Return on Interest to provoke thought and ideas, via our focus on innovation literacy.



## Open Innovation



- Using internal and external sources to facilitate innovation and create market value
- The Canadian innovation system requires a complementary approach that articulates universities, government labs and colleges working together with industry toward common goals of national importance.
- Firms require any point of entry into the Canadian innovation system

Canada needs an open innovation system that articulates industry needs to public R&D facilities (P3RD). We need a linked innovation system based on an articulated education system that offers industry a single point of contact on innovation system support services. We also need common indicators across the P3RD system. Open innovation, a term coined by Henry Chesbrough of the Center for Open Innovation at the Haas School of Business at the University of California, Berkeley, refers to the use of internal and external sources to add value to technological development. Open innovation is a way of understanding the transactional flows of knowledge in to and out of organizations and firms as they innovate and create value.

Chesbrough, H. (2003), "*Open Innovation: The New Imperative for Creating and Profiting from Technology*", Harvard Business School Press.

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