TRIUMF

Canada's national laboratory for particle and nuclear physics
Laboratoire national canadien pour la recherche en physique nucléaire
et en physique des particules

# A Canadian View on the Holy Trinity

## Research, Innovation, and Commercialization

Frontiers of Science Symposium | March 2-3, 2011 | Kolkata, India

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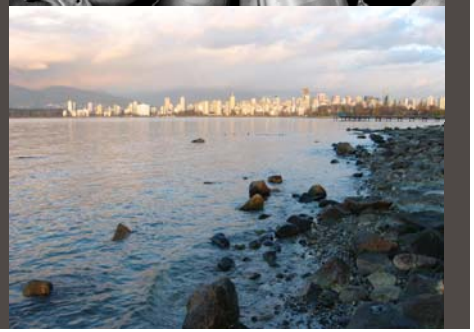
FRONTIERS OF SCIENCE



Accelerating Science for Canada
Un accélérateur de la démarche scientifique canadienne

# Broader context

- People with opinions just go around bothering each other.
  - Buddha
- Perception is not always reality.
  - Mercedes-Benz
- I have become my own version of an optimist. If I can't make it through one door, I'll go through another door - or I'll make a door. Something terrific will come no matter how dark the present.
  - Rabindranath Tagore

# Thesis

- Effective collaboration between science & industry is the breeding ground for breakthroughs in inspiration, invention, and innovation
  - Success always builds on quality person-to-person relationships
  - Each country must develop its own policies and practices to promote effective collaboration

# Motivation

# Public investment in science

- Science receives more public funding than arts & culture
  - Admittedly, we often overlook the cultural/aesthetic components of science
- Assertions (*i.e.*, never fully proven)
  - Science drives benefits in multiple sectors and at multiple scales
  - These benefits are of broad and shared value
  - These benefits take “unusual” time & effort to develop or accrue
- Conclusion
  - It is good public policy to support science with public funds so that the benefits & impacts are optimally generated---and captured---for society

- “Public support for business R&D [R&D conducted *by* or *at* industry] has been justified on the basis that benefits of such activities often extend beyond individual firms, generating positive outcomes for the entire economy.”
  - Canada’s Ministry of Industry: Expert Panel on Federal Support to R&D

# The Holy Grail

- Research & Development or Science & Technology drive innovation, economic growth, and societal progress
  - New products & new jobs
  - Enhanced health & wellness, standard of living
  - The knowledge-based economy
- Governments and their constituent tax payers want to optimize these “returns” on the public investment into science
- Assertion: Encouraging collaboration between science and industry will accelerate this process

# Collaboration

# What is collaboration?

- Wikipedia #1
  - "Collaboration[ism] describes the treason of cooperating with enemy forces occupying one's country. As such it implies criminal deeds…"
- Wikipedia #2:
  - "Collaboration is a recursive process where two or more people or organizations work together in an intersection of common goals—for example, an intellectual endeavor that is creative in nature—by sharing knowledge, learning, and building consensus."

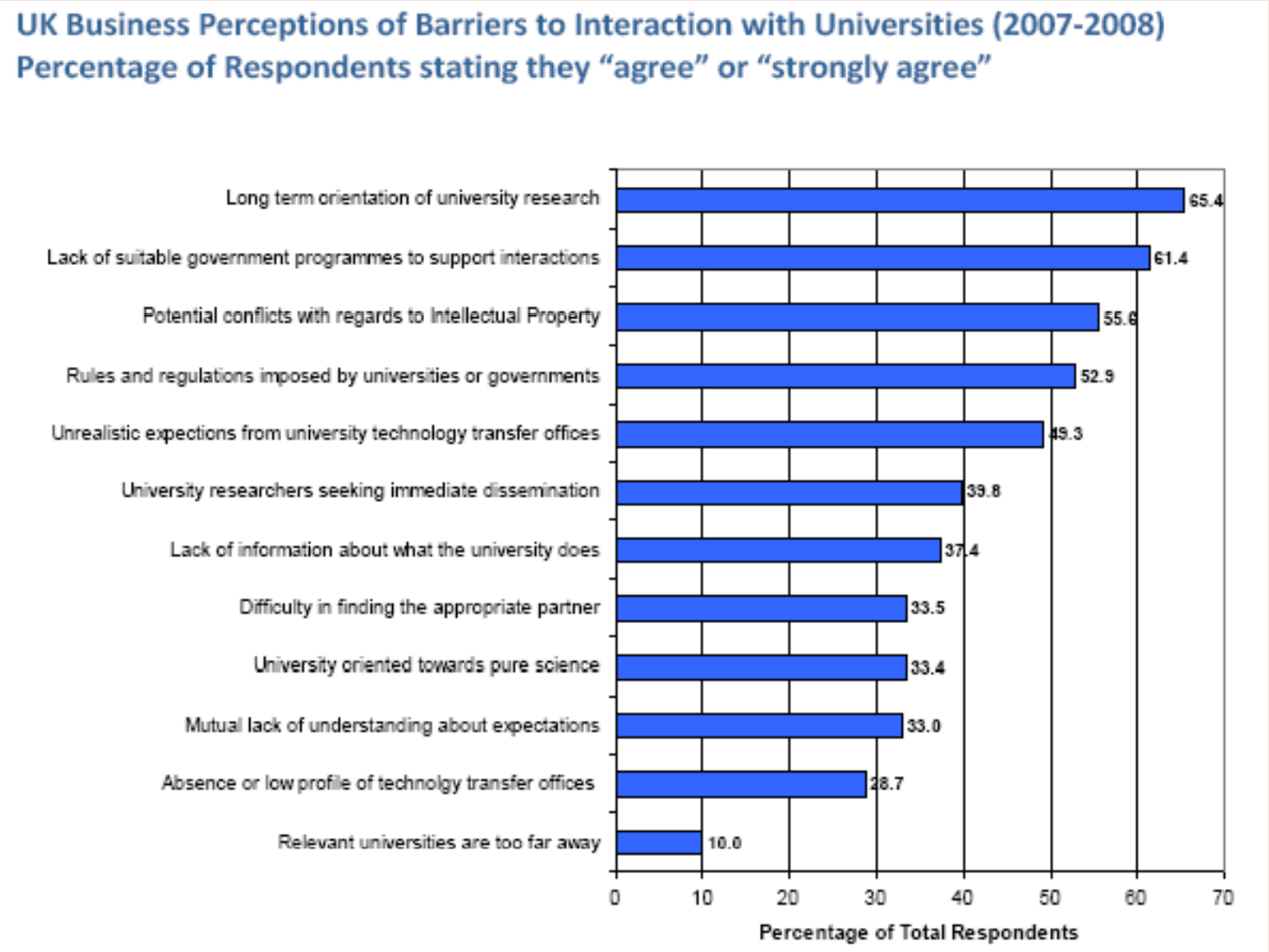
# Why we collaborate

## Business Motivations for Collaborating with Universities, August 2010, Québec.

| Motivation | Companies that have collaborated with a university in the last three years (n=104): | Companies that have not collaborated with a university in the last three years (n=90): |
|---|---|---|
| Access to qualified workers / top-notch talent | 74% | 47% |
| Contribution to the company's development and growth | 52% | 38% |
| Access to advanced expertise | 45% | 37% |
| Access to tax credits offered by the Quebec and Canadian governments / tax incentives | 36% | 23% |
| Raise the company's profile | 30% | 11% |
| Access to a stimulating research environment | 19% | 10% |
| Access to cutting-edge equipment | 8% | 4% |
| Other | 3% | 4% |
| Don't know / Not sure | 5% | 27% |

"Government Policies to Encourage University-Business Research Collaboration In Canada: Lessons From the US, the UK and Australia," Centre for the Study of Living Standards, Feb 2011

# Why we don't collaborate



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# Collaboration between science & industry

- Much has been written about the different “cultures” of research and business
- So, the key to collaboration is the “intersection of common goals...which can take the form of a creative endeavour”
- Three main types of collaboration
  1. We (science) can help you (industry) with your problem
  2. We have a new problem for you to solve
  3. Let’s solve a problem together
- (In a different talk at a different time, I’ll argue that a research lab is the ideal entity for fostering these collaborations)

# 1. We can help you...

- This is the easiest and most popular form of collaboration

- Science offers expert or unique guidance/capability to industry
  - "Fee for service" model or *pro bono*
  - Contracting for technical advice, guidance, or evaluation
  - Cost-recovery access to unique facilities, instrumentation, and tools
  - Ad hoc, but frequent interactions may develop a more robust relationship
  - Typically, IP belongs to the "payer" and is not shared with scientist

- For example, at TRIUMF...
  - Main cyclotron provides variable intensity, energy, and geometry of proton and neutron beam irradiation
  - This capability is sold as a "service" to aerospace and medical-equipment manufacturing industry who want to evaluate performance of their devices at high altitudes or in radiation environments

# 2. Let's work together on a problem...

- Science and industry identify a "golden" opportunity for R or D that would fill a market need
  - Industry brings the opportunity and the market analysis
  - Science brings the possibility of a product solution
  - Work together, side-by-side, in common lab space
  - IP is ideally shared equally
- Requires a deep understanding on both sides
- Often considered the "golden ticket"
- For example, at TRIUMF...
  - Global radiopharmaceutical company Nordion was interested in developing new metallic isotopes for efficient labelling of larger molecules
  - Approached TRIUMF and co-wrote funding proposal to create shared lab space to allow personnel to work side beside
  - Patent on first product already filed

# 3. We have a new problem for you...

- Science identifies a performance requirement or capacity that is not yet available on the market and chooses to approach industry and develop a custom solution
  - Typically work with a vendor/supplier from related or upstream/downstream technology
  - Goal is to prototype workable solution for science AND leave industry with skills & know-how to scale up for generalized sales and marketing
  - Industry may end up with exclusive rights or license
- Often considered the “platinum” ticket

- For example, at TRIUMF...
  - Science selected superconducting RF (SRF) cavities for isotope post-accelerator
  - No Canadian vendor available, so first batch imported
  - One technical step in fabrication is electron-beam welding
  - TRIUMF identified local e-beam welding company that was interested in expanding its prowess by learning to work with SRF cavities
  - After prototyping together, company has sold 20 cavities to TRIUMF
  - Company now stand-alone in this technology and has been qualified to sell product to U.S. labs, and has developed new market reach for primary business of e-beam welding tools

- Sometimes, government as “first customer” makes the difference

# Policy Considerations

# How do we know when it is working?

- There are no clear indicators
  - Of inputs, or outputs
  - Post de facto observation & anecdotes are the primary sources of “data”
- Four categories of commonly cited indicators for measuring and reporting on such collaboration:
  - Research funding indicators
  - Bibliometric indicators (*e.g.*, trends in university-business co-authorship)
  - Technology transfer and commercialization indicators (*e.g.,* patenting, licensing)
  - Creation of university-spin off companies)
  - Other survey and composite indicator results

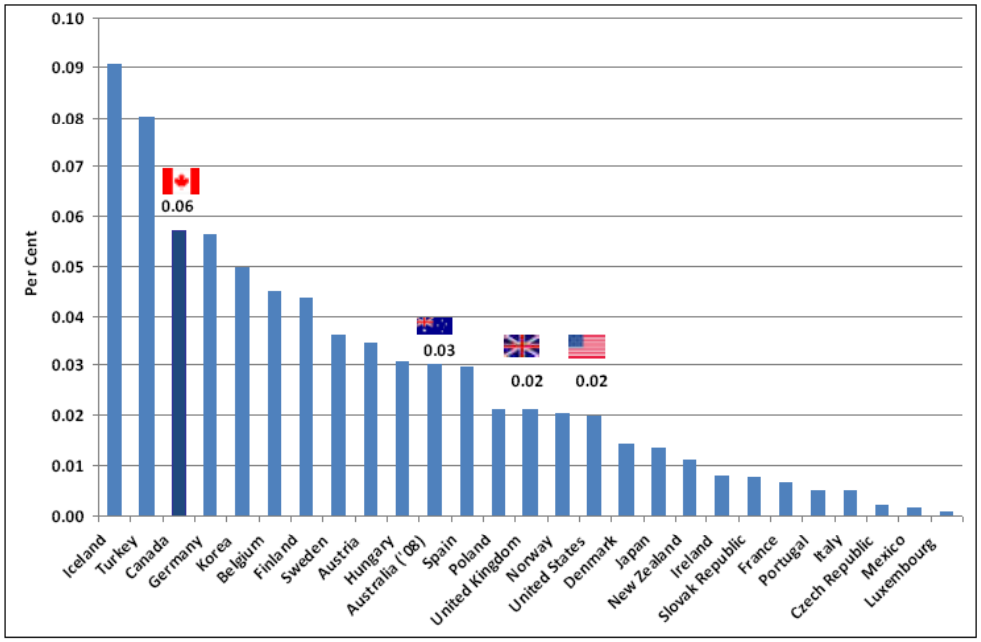
# Metrics (1)

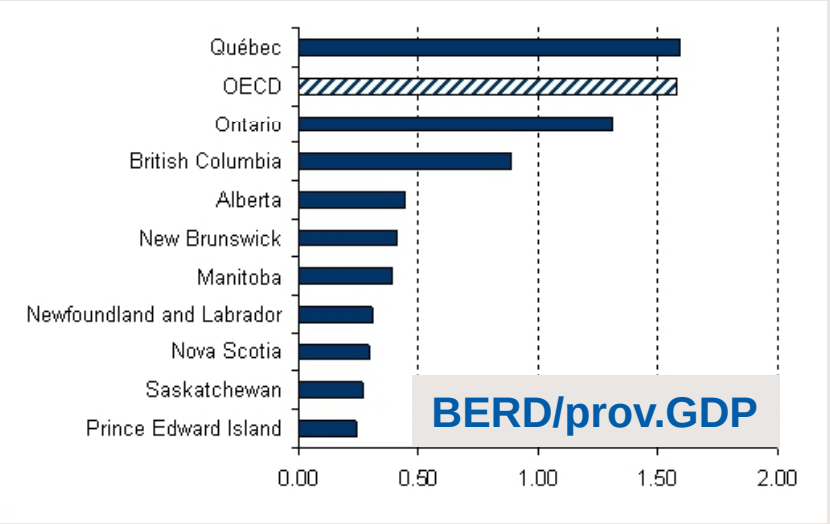
- GERD, HERD, BERD tell some of the story
  - Business spending on university research accounts for 0.06% of GDP in Canada, compared to 0.03% in Australia, and 0.02% in the U.S. and Britain.
  - And Canada leads those same countries in terms of its share of university R&D that's funded by business - 8.5% in 2008 versus 5.7% for the U.S., 4.6% for Britain and 4.9% for Australia

# Metrics (2)

- Canadian businesses spend relatively more on research conducted at universities than do their counterparts across the OECD after taking into account differences in the size of national economies

R&D Funded by the Business Sector and Performed by the Higher Education Sector, 2007, percentage of GDP (2008 for Australia)



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# Canadian business R&D investment by sector

## R&D intensity by Business Sector in Canada 2007

| Business Sector | SHARE OF BERD % | SHARE OF TOTAL GDP % | BERD INTENSITY (%) |
|---|---|---|---|
| **MANUFACTURING** | **52.7** | **15.1** | **3.59** |
| Computer and electronic products | 18.5 | 0.6 | 31.72 |
| Pharmaceutical and medicine | 7.3 | 0.3 | 25.03 |
| Aerospace products and parts | 6.5 | 0.5 | 13.37 |
| Machinery | 3.6 | 1.1 | 3.37 |
| Chemical, plastic and hydrocarbon products | 3.3 | 1.2 | 2.83 |
| Motor vehicles and part | 3.3 | 2.0 | 1.70 |
| Wood products, paper and printing | 2.9 | 2.2 | 1.36 |
| Fabricated metal products | 1.4 | 1.2 | 1.20 |
| Primary metals | 1.3 | 1.0 | 1.34 |
| Electrical equipment, appliances and components | 0.9 | 0.3 | 3.09 |
| Food, beverages and tobacco | 0.9 | 1.9 | 0.49 |
| Non-metallic mineral products | 0.4 | 0.5 | 0.82 |
| All other manufacturing | 2.4 | 2.3 | 1.07 |
| **SERVICES** | **42.3** | **69.2** | **0.63** |
| Information and cultural industries | 10.6 | 3.6 | 3.03 |
| Computer systems design and related services | 8.0 | 1.1 | 7.48 |
| Scientific research and development. | 8.0 | 1.2 | 6.86 |
| Wholesale and retail trade | 5.2 | 11.8 | 0.45 |
| Architectural, engineering and related services | 2.7 | 1.0 | 2.78 |
| Finance, insurance and real estate | 2.3 | 19.9 | 0.12 |
| All other services | 5.5 | 31.8 | 0.18 |
| **ALL OTHER INDUSTRIES** (primary, utilities, construction) | **5.0** | **15.8** | **0.33** |
| **TOTAL ($ BN)** | **$15.8** | **$1,536** | **1.03%** |

# How do we foster these collaborations?

- Assertion based (only) on experience
  - Successful collaboration starts at the level of individuals
  - It cannot be “legislated” from the top
- It is the personal interactions between individuals that develops a “background of relatedness” that allows broader discussion to get started—and lead somewhere
  - On almost any topic, science & industry speak different languages and don’t have “intersection of common goals”
- What’s needed are “mixers” and “cross-training” opportunities to reduce the barriers

# Canadian policy innovation #1

- Canadians are good at looking at themselves critically
  - Canadian Council of Academies spent 2008-09 studying the "innovation gap" in Canada
    - "Canada has a serious productivity growth problem. Since 1984, relative labour productivity in Canada's business sector has fallen from more than 90% of the U.S. level, to about 76% in 2007. Over the 1985-2006 period, Canada's average labour productivity growth ranked 15th out of 18 comparator countries in the OECD group. Canada's relatively poor productivity growth is due mainly to weak growth of multifactor productivity (MFP), which measures broadly the effectiveness with which labour and capital are used in the economy."
    - "The principal factors that influence the business innovation decision can be categorized broadly as (i) particular characteristics of the firm's sector; (ii) the state of competition; (iii) the climate for new ventures; (iv) public policies that encourage or inhibit innovation; and (v) business ambition (e.g., entrepreneurial aggressiveness and growth orientation)."
- Part of federal government response is an Expert Review Panel examining mechanisms for and success of federal support to R&D performed in the business sector
  - Report due this fall.
  - http://rd-review.ca/eic/site/033.nsf/eng/h_00000.html

# Canadian policy innovation #2

- Ministry of Industry launched a Centres of Excellence for Commercialization and Research (CECR) program in 2007 ($285M over 5 years)
  - Competitive proposals are each awarded ~$15M of public funds to be matched by other investments years to “...bring together people, services and research infrastructure to position Canada at the forefront of breakthrough innovations in priority areas.”

- A radical experiment...
  - Public funds into entities distinct from universities & labs
  - Significant discretion given to executive teams
  - Goal of causing more interactions, more innovation, and more results...by any means necessary

# Canadian policy innovation #3

- In response to Canada's medical isotope crisis, Ministry of Natural Resources launched a targeted technology-development program
  - $35M for 15 months to develop and demonstrate deployment of alternative isotope-production technologies

- A radical experiment...
  - Government identified a technology gap and requested a solution and provided public funds to do so
  - Real money, but real deadlines
  - Four teams were selected and they are competing & collaborating with one another
    - Not surprisingly, ¾ have national labs involved
    - All have connections to industry and commercial partners

# Canadian policy innovation #4

- Students are one of the best vehicles for promoting science/industry collaboration
  - Particularly when exposed to both cultures as part of their training
- Canada has a world-class system of undergraduate “co-operative” education
  - Students take “real” jobs for 1-2 terms at a time in industry, research labs, hospitals, and so on
- A dozen other federal programs promote industry/research experiences for students of all ages
  - MITACS, CCIP, Shad Valley, FSWE, and so on

# Personal Comments

# Detour – Science Communications

- Everyone begrudgingly agrees that science communications is important, typically for one or more of the following reasons
  - "To know is to love"
  - "If science is for everyone, we have to share it with them—especially when they are paying for it"
  - "Sense of civic obligation"
  - "Athenian ideals"
  - "Inspiring the next generation"
  - "Corporate affairs, corporate identity"
  - "Looking good" or "spin doctoring"

# Broader context: “Public Relations”

- Research institutions are increasingly responsible for building and maintaining their identity, reputation, and overall strategy
  - No more ivory tower, no more entitlement, no more “its just worth it, so just fund it, and let them do it”
- Akin to *public relations* functions at a corporation
- But what IS public relations?
  - Often confused with science outreach or marketing or spin-doctoring

# Pedagogy

- Public relations people manage communication with top managers and with publics to contribute to the strategic-decision processes of organizations
- They manage communication between management and publics to build relationships with the publics that are most likely to affect the behaviour of the organization or who are most affected by the behaviour of the organization
- Effective organizations are able to achieve their goals because they choose goals that are valued by their strategic constituencies (*i.e.*, publics) both inside and outside the organization and also because they successfully manage programs designed to achieve those goals

# …Say that again?

- Assumptions
  - There is no “one” public.  Multiple interests in multiple groups.
  - An organization has a mission/purpose and can have an impact
  - Effectiveness is best when you don’t operate in a vacuum
- Public relations is about connecting an organization with its stakeholder communities and stewarding those two-way relationships
  - How can you know “what to work on” if you don’t talk to people, in fact, “your” people?
- And now we’ve come full circle
  - Part of public relations is not only communicating & connecting with government & taxpayers, but also the business communities…
  - …To identify, build, and maintain the key relationships that allow for substantive partnership---and science/industry collaboration

# The impact of a flat world

- If science is “globalized,” and its benefits are publicly shared, why should Canada invest at all? Why not have the U.S. and India do all the work and just participate in the rewards?

- Consideration #1: If you can’t run with the big dogs, stay on the porch.
  - If you are not part of the team developing the breakthrough, you won’t know how to use it or deploy it.
  - If you’re not working alongside the leaders, you won’t see the opportunities and risks as they emerge.
- Consideration #2: In the market, timing is everything.
  - If you wait to read about it in the papers, you will be too late to exploit/sell/control it.
- Consideration #3: *Quid pro quo* keeps friends.
  - In the long run, people share and expect others to share. If you never contribute, you will be squeezed out of the club.

- The model of “preferred distributor” or “national importer” is obsolete. Apple can sell iPhones sooner, faster, and better in China than a Chinese broker can.
  - **Each country is on its own, working together.**

# Looking forward

- Effective collaboration between science and industry relies on a mutual understanding and appreciation
- Key is to find opportunities for connecting & relating the key staff at each institution
- Ironically
  - IP is a short-term benefit (don't let it stop the show)
  - True collaboration is a long-term benefit
  - …and the latter is what the public is paying for

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# Merci

# Thank You

# शुक्रिया


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