Changing the Innovation Conversation: From Research to Global Value Exchange

H. Douglas Barber and Jeffrey Crelinsten

December 2016

THE IMPACT GROUP

Introduction

This white paper builds on research and consulting that we have been engaged in for over 15 years. It started in the year 2000 when the federal government made a commitment to increase Canada's domestic research spending as a percentage of GDP relative to other nations. Within weeks of that announcement, Canada's postsecondary education institutions made a similar commitment.

Since then, despite many initiatives, studies and reports, the effort to increase Canada's GERD/GDP has failed. Canada remains at the same place among nations – even a little lower than we were in 2000 – at 1.6% of GDP vs. the OECD average of 2.3%.

With the federal government re-engaged and committed to crafting a national innovation strategy, in close cooperation with the provinces and the general public, we believe it is important to change the nature of the conversation.

Research intensity – the percentage of GDP a country spends on R&D – is the traditional indicator that policy makers use to assess the vitality of a nation's knowledge-based economy. This is the measure that has dominated innovation policy in Canada for decades.

In our view, the focus on R&D has been a major distraction from the real issue, which is prosperity. The engine of a country's prosperity is export trade, particularly for small countries. In the resource economy, Canada is a big country and one of the biggest players. In the knowledge economy, we're small – we're a 2% player domestically. To succeed, we need to be a 95% plus player in international business.

Currently we run a trade deficit in the knowledge economy. We've lost many companies that were doing well in the 90s and early 2000s. Canadian founders didn't work on succession and preferred to sell. Public firms were undervalued on the TSX and easy targets for foreign buyers looking to grow via acquisition. Small firms now dominate Canada's tech sectors.

Canada has been consistently in the top ten on the Legatum Prosperity Index[1] largely because of our strong resource sector, exemplary health care, education, governance and security. All the other countries in the top 10 or that do better than Canada on the Prosperity Index are small – Norway, Sweden, Switzerland, Finland, New Zealand. Except for Norway, which has rich natural resources like Canada, the other countries rely on and excel in global trade in knowledge-based sectors of the economy.

The real challenge for Canada is not R&D. Prosperity is the right focus for countries with populations under 80 million. Prosperity comes from export trade. Knowledge-

[1] http://www.prosperity.com/rankings

based trade requires knowledgeable people who not only excel in technical fields, but also understand how to create value for others, using their knowledge to identify opportunities to create value competitively.

The key for Canadian entrepreneurs is to identify niche markets that they can dominate globally without being of interest to large multinational players because, for them, the market is too small. For example, Gennum Corporation, a Hamilton-based microchip manufacturer, specialized in microchips for hearing aids and for high-speed digital signal transport for the world's 20,000 television content-creation studios. The percentage of any population with hearing impairments is small as is the number of television content-creation studios. Gennum built a $100M global business in those niches and was the number one player in the world in both. They did it by understanding the needs of their customers and their customers' customers and continually innovating and creating value for them.

We suggest that the focus on research and commercialization has been unproductive. Instead, we propose that by understanding commerce as a value exchange requiring trust, understanding and respect – very human skills – we will better be able to build strong, sustainable and ethical R&D-intensive enterprises that create value for the world. To succeed, Canadian entrepreneurs must learn to engage international customers to co-create value for them. Working continuously with customers and listening to their feedback will develop an ongoing ability to create value even as customer needs evolve and change. We believe that Canada's postsecondary education institutions have a critical role to play in helping young people learn these skills and attitudes toward value creation and that it will require sustained effort and courage to create a supportive culture in these institutions.

In the following pages, we examine the traditional arguments around business expenditure in R&D and show how they obfuscate the real issues and the potential solutions to improve Canada's knowledge-based exports and trade.

Canada's BERD Problem – looking through the wrong end of the telescope

Declining BERD

The three main actors that contribute to national R&D spending are the business sector, higher education and government. In most OECD countries, including Canada, the business sector is the largest R&D performer, followed by higher education and then government. A relatively small portion comes from the not-for-profit sector.[2]

Canada's ranking among OECD nations is mediocre. Using total research intensity (GERD/GDP) as a measure, Canada consistently ranks below the OECD average.

[2] Government's role is actually more prominent than standard figures suggest, since the majority of higher education funding comes from government.

While Canada's higher education research (HERD) intensity is among the top, its business expenditures (BERD) as a percentage of GDP is low.

A number of explanations have dominated the discourse about finding solutions to Canada's low BERD intensity. The most common theory is that while Canada is excellent at discovery research, it is average or worse in commercializing the results of publicly funded research. Government policies based on this view have led to numerous programs, including funding of technology transfer offices in universities; funding of industry-academic collaboration mechanisms such as networks of centres of excellence; sector-specific funding programs[3] and innovation intermediaries[4]; and providing public financing for start-up firms by supporting angel groups and venture capital funds.

Despite all these efforts at both the federal and provincial level, Canada's BERD intensity continues to decline. The Science, Technology and Innovation Council (STIC) reports that Canada's BERD intensity declined from 2006 to 2013, when Canada ranked 26th among international competitors.[5]

Clearly inability to commercialize research results from our publicly funded research institutions is not the core problem underlying Canada's declining BERD. In fact, studies have shown that companies value universities, not for their intellectual property, but rather for their knowledgeable people – faculty, students and graduates. We need to look elsewhere to understand what is going wrong.

STIC has embraced another explanation to Canada's declining BERD intensity. Rather than focusing on commercialization incompetence, this view zeroes in on innovation. STIC's central conclusion is that "Canada's most profound and urgent ST&I challenge lies in increasing the number of firms that embrace and effectively manage innovation as a competitiveness and growth strategy." [6]

There are two problems with this view. First, it assumes that innovation and R&D performance are causally linked. The implication is that innovative firms necessarily do a lot of R&D and therefore the more innovative firms we have the more enterprise R&D we'll have and Canada's BERD will climb. This conflation of research intensity and innovation is problematic. It is true that firms in R&D-intensive sectors of the economy have to innovate to stay ahead. It is not necessarily true, though, that the more innovative firms Canada has, the higher its BERD intensity will be. The beliefs that more R&D will lead to more innovation and that innovation is dependent on R&D are faulty. Policy based on these assumptions will fail. More firms innovate than do R&D – hence voucher schemes, support for apprentices and access to

[3] Genome Canada and its provincial equivalents, Sustainable Development Technology Canada, etc.
[4] research parks, incubators, accelerators
[5] Science, Technology and Innovation Council, State of the Nation 2014: Canada's Science, Technology and Innovation System (2015), p. 2.
[6] Ibid.

mentoring are relevant policy issues for non-R&D performers. They are also relevant to firms doing little R&D

Secondly, if one looks at BERD intensity regionally, Ontario and Quebec are close to the OECD average, suggesting that scale might have something to do with Canada's overall performance. Furthermore, Canada Revenue Agency (CRA) definitions of R&D focus exclusively on early-stage research and exclude most areas of later stage development. Many countries do not have such restrictive criteria. It is possible that if Canada moved to similar measures, we would fare better in international rankings. In fact, tax credits are different in just about every country that uses them.

A clue to the real problem is the fact that Canadian tech sectors are populated with small firms led by entrepreneurs who don't know how to (or don't want to) grow globally competitive businesses. As a consequence, Canada has a knowledge-based prosperity problem. As our resource sectors decline, the negative impact of this weakness will exacerbate.

Company size matters

A critical factor that STIC acknowledges in its report is the matter of scale. "Canada must increase the number of large, innovative firms to enhance future competitiveness and job growth, as larger firms are often more productive and tend to invest and to export more than smaller firms."[7]

This issue was also raised in the Canadian Council of Academies 2013 report on The State of Industrial R&D (IR&D) in Canada. Noting that BERD intensity was low and declining, the expert panel highlighted the relative dearth of large domestic firms in R&D-intensive sectors and the preponderance of small firms in these sectors. "Given the likely economies of scale in IR&D, *a broader balance of firms across size classes performing IR&D*[8] in Canada would likely benefit overall IR&D performance."[9]

The CCA Expert Panel suggested that this skewed firm size distribution puts Canada at a disadvantage in international comparisons. "Overall, fewer large firms undertake IR&D in Canada than in highly IR&D-intensive countries. This could be holding back Canada's overall IR&D performance because economies of scale in IR&D are not available, and larger firms can help take the successes of smaller firms to broader market."[10]

---

[7] Ibid., p. 3

[8] Italics added.

[9] Canadian Council of Academies, The State of Industrial R&D in Canada, p. 152. The Expert Panel suggested other possible causes, including spending reductions by major players; a general shrinking of manufacturing and expansion of services, which tend to be less R&D-intensive; the predominance of resources in Canada's overall industrial structure; and the small number of highly research-intensive industries. Ibid., p. 151.

[10] Ibid., p. 48

The Council suggested that scale is a more important factor than R&D intensity in explaining Canada's lower productivity relative to the US. "The shortfall in Canada's labour productivity growth rates relative to the United States appears to be particularly pronounced in R&D-intensive industries. It is possible that the smaller scale of these industries in Canada, rather than their R&D intensity, accounts for the shortfall."[11]

The dearth of large, high technology firms in Canada poses a significant challenge to growing our knowledge-based economy. Equally challenging is the lack of middle-sized firms that dominate a global market. We lack the "broader balance of firms across size classes doing IR&D" that the CCA Expert Panel identified as important. Relying on start-ups and early-stage firms to compete globally is not a winning strategy.

Unfortunately, current policies focus almost exclusively on start-up and early stage firms, further entrenching a lopsided ecosystem populated primarily by small R&D-intensive firms that do not scale.

In the following section, we examine in more detail Canada's R&D-intensive industry. Using Statistics Canada data on industrial R&D spending, we were able to study the robustness and scale of Canadian firms that perform R&D over a twelve-year period, from 1994 to 2006. [12] Our analysis highlights the fragility of our R&D performing sectors.

R&D-intensive Firms in Canada – few leaders and many small players

We used R&D-intensity to segment Canadian firms into four different groups. We classed firms spending less than 3% of revenue on R&D as **Low Research Intensity** firms. Firms spending more than 50% of revenue on R&D are research-intensive, but must have external financing to sustain such a high level of R&D expenditure: they are typically **Start-ups**. Their contribution to GDP is negligible.

Firms spending between 3% and 50% of revenue on R&D represent the core of Canada's R&D-intensive sectors of the economy. Firms with higher revenue can spend more on R&D, so we divided this group into two subgroups – those spending $3M or more on R&D (**R&D Leaders**) and those spending less than $3M on R&D (**Early Stage**). Exhibit A summarizes the four groups.

[11] Ibid., p. 71

[12] H.D. Barber and J. Crelinsten, The Economic Contribution of Canada's R&D-intensive Firms: 1994-2001 (March 2004); The Economic Contribution of Canada's R&D-intensive Firms:2001-2006 (March 2011).

EXHIBIT A

Low Research Intensity
Firms that spend less than 3% of revenue on R&D.

R&D Leaders
Firms spending between 3-50% of revenue and $3 million or more on R&D. These firms have higher revenues to support their higher R&D spending and are at a later stage of development.

Early Stage
Firms spending 3-50% of revenue and less than $3 million on R&D. These smaller firms are typically at an earlier stage of development.

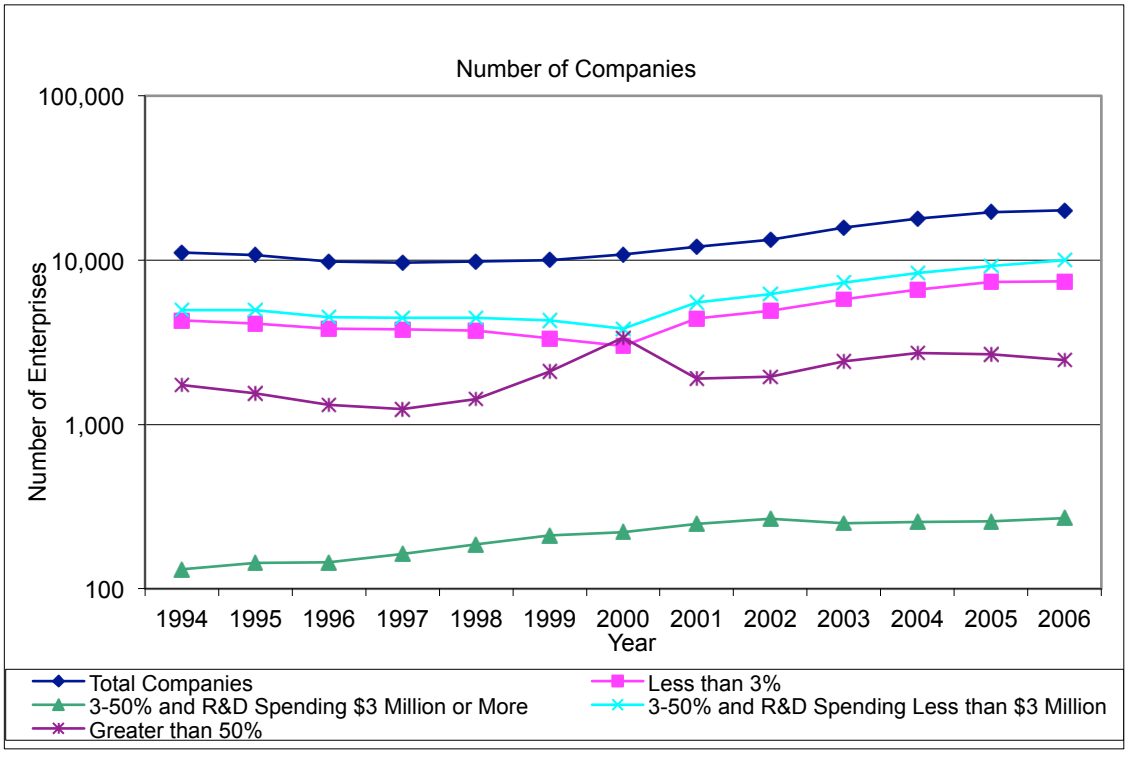
Start-ups
Firms spending more than 50% of revenue on R&D. These are generally start-up companies that are being financed by investors or lenders rather than customers. They have higher levels of risk and uncertainty and are more likely to contribute to Canada's performance in a longer timeframe – if they survive and stay in Canada.

We looked at the growth in the number of firms and revenue for the different groups over thirteen years from 1994-2006.

Number of Companies

Figure 1 charts the total number of R&D-performing firms for the different research intensity groups over the period. (Note: the y-axis – number of firms – is a log scale.)

Figure 1
Total Number of Companies by Research Intensity Group, 1994-2006[13]



[13] H. D. Barber and J. Crelinsten, The Economic Contributuion of Canada's R&D-intensive Firms, 2001-2006 (The Impact Group, 2011), p. 19.

From 1994 to 2001, the total number of firms doing R&D in Canada increased modestly by about 8.6%, from 11,132 in 1994 to 12,087 in 2001. After the dot.com crash in 2001, the total number of firms doing R&D increased by a factor of 1.5 to 20,154 in 2006.

The dramatic increase in numbers was partly a consequence of the "creative destruction" of Nortel and other large firms that led to an increase in the number of smaller firms as laid off employees went to smaller firms or started their own. Government policy also helped: specifically more generous R&D tax credits and a proliferation of SRED consultants assisting firms apply for these credits.[14]

While the number of firms in the R&D Leader group grew at about 8% per year before 2001, growth slowed to less than 2% after 2001. In contrast, the number of firms in the Early Stage group (3-50% and R&D spending Less than $3 million) grew dramatically. Before 2001 this group declined in numbers, whereas it grew at more than 12% annually after the crash.

The Low Research Intensity group also changed from a decline in numbers to an average annual increase of 11%.

As a result, Canada's population of R&D Leader firms has become an increasingly smaller percentage of the country's industrial R&D performers, declining from 2% of Canada's R&D performers in 2001 to 1.33% in 2006.

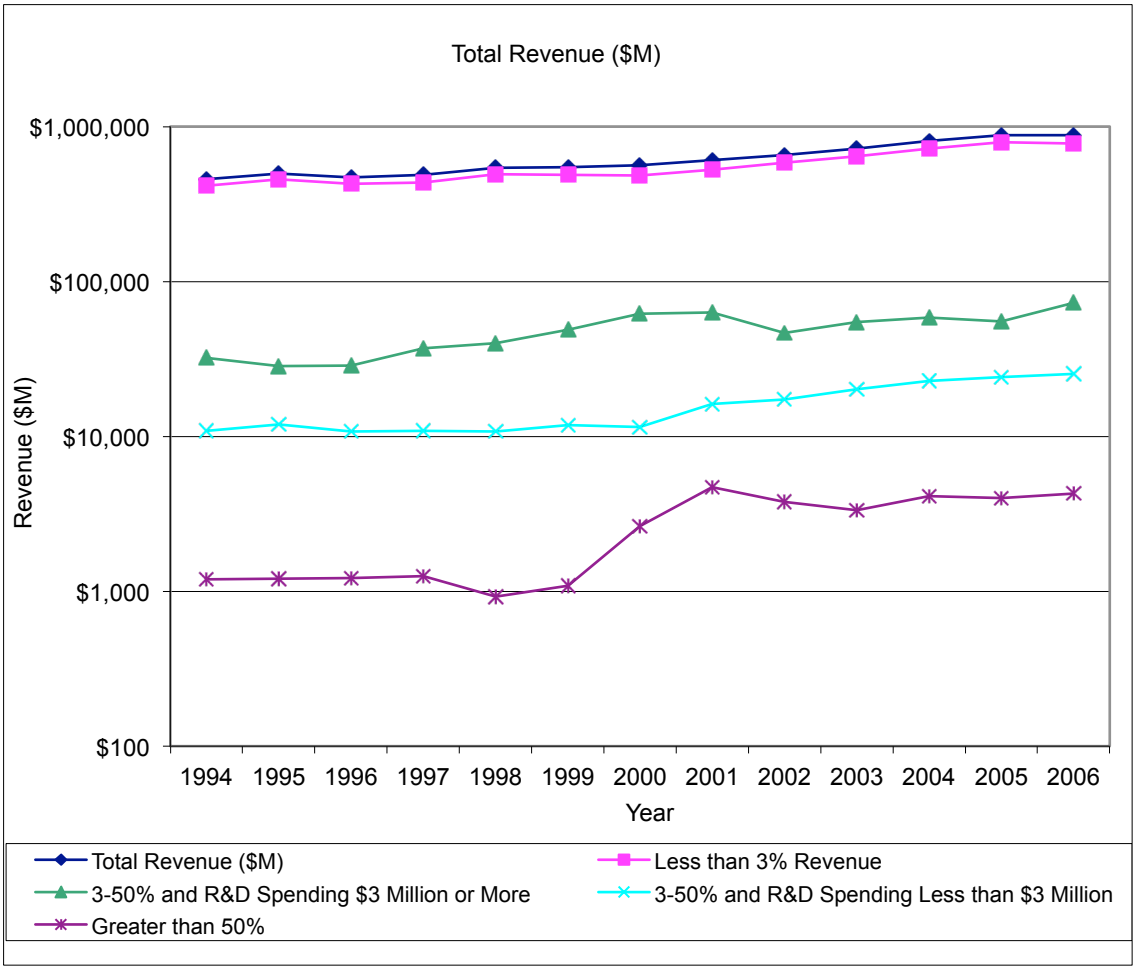
Yet this tiny group of R&D Leader firms accounted for 38% of all industrial R&D spending in both 2001 and 2006.

[14] This trend started in 1998-99 and is reflected in the huge increase in the number of firms in the Startup group (RI > 50%) in the two years before the dot.com crash.

Company Revenue

Figure 2 charts total revenue of Canada's R&D-performing firms during the same period, 1994-2006. (Note: the y-axis – Revenue – is a log scale.)

Figure 2
Total Revenue of Companies by Research Intensity Group, 1994-2006[15]



Total revenue of Canada's industrial R&D performers increased during this period, but due to the significant increase in the total number of firms doing R&D, average per-company revenue performance was stagnant.

This suggests that policies encouraging R&D spending were successful in that more companies performed R&D, but the larger goal of enhanced economic performance was not met, as there was no corresponding increase in business success as measured by average revenue per firm.

[15] Ibid., p. 20.

Declining Contribution of R&D-intensive Firms to Canada's GDP

A better indicator of success in knowledge-based commerce than R&D-intensity is the percentage of GDP that R&D-intensive firms generate in revenue annually.

Table 1 shows that the tiny R&D Leader group accounted for 5.6% of GDP in 1994, growing to 8.6% of GDP by 2001. The dot.com crash abruptly halted revenue growth and by 2006, the R&D Leader group's contribution to GDP had dropped back to 5.5% – a significant decline, largely due to the demise of Nortel.

TABLE 1
TOTAL REVENUE FOR R&D LEADER GROUP (1994-2006)

Year	Revenue ($B)	GDP ($B)	Revenue (% of GDP)
1994	32	576	5.6
1995	28	602	4.7
1996	29	627	4.6
1997	37	651	5.7
1998	40	631	6.3
1999	49	674	7.2
2000	62	739	8.4
2001	63	733	8.6
2002	47	753	6.2
2003	55	888	6.1
2004	59	1,018	5.8
2005	55	1,164	4.8
2006	72	1,311	5.5

The more populous Early Stage group's revenue amounted to about 2% of GDP over the same period, peaking at 2.3% in 2002. The Startup group's revenue was less than 0.5% of GDP, except in 2001, when it peaked at 0.6%.

The Low Research Intensity group contributed the largest percentage to GDP, but dropped from 72% in 1995 to 60% in 2006. Resources sectors fall into this group, which as a whole spends on average only around 0.5% of revenue on R&D. While not contributing significantly to Canada's BERD, the group's decline in GDP contribution does not bode well. If the decline continues, Canada's R&D-intensive sectors' revenues need to grow significantly to make up the difference.

The importance of the R&D Leader group cannot be over-emphasized. These firms operate in R&D-intensive sectors of the economy. They generate significant revenue and employ significant numbers of people, including specialists in R&D. Canada needs to find a way to nurture and support the proliferation and growth of these firms. The data we present here illustrates that we are not succeeding in this important goal.[16]

[16] These results capture only a partial picture of the economic contribution of industrial R&D performers in Canada. To obtain a complete picture, Statistics Canada would have to combine revenue data from tax records with R&D spending data from its industrial R&D data. Some firms did

Did the Post-Dot.com Recovery Make a Difference?

We looked at Canada's Top 100 Corporate R&D Spenders list[17] from 1999-2014 to see if the situation described above improved during the economic boom that came after the economic downturn in the early 2000s. While the list is incomplete, it represents a significant portion of the industrial R&D spending in Canada.

For each year, we identified the firms on the Top 100 Corporate R&D Spenders list that were spending between 3% and 50% of revenue on R&D. Since all firms on the list spent over $3M on R&D, these firms all fall into the R&D Leader group. Firms that did not report revenue were excluded.

Table 2 shows total revenue generated by these R&D Leader firms on the Top 100 list for each year, in $B and as a percentage of GDP.

TABLE 2
TOTAL REVENUE FOR TOP100 R&D LEADER GROUP (1999-2014)

Year	Revenue ($B)	GDP ($B)	Revenue (% of GDP)
1999	53	674	7.9
2000	73	739	9.8
2001	69	733	9.4
2002	48	753	6.3
2003	63	888	7.1
2004	69	1,018	6.8
2005	95	1,164	8.1
2006	75	1,311	5.7
2007	60	1,458	4.1
2008	63	1,543	4.1
2009	85	1,371	6.2
2010	68	1,614	4.2
2011	63	1,779	3.5
2012	51	1,821	2.8
2013	64	1,827	3.5
2014	77	1,785	4.3

In 1999, the total revenue generated by R&D Leader firms on the Top 100 list spending between 3% and 50% of revenue on R&D was $53B, or 7.9% of GDP. By

---

not report revenue, since Statistics Canada does not require firms providing R&D spending data to provide revenue data. Firms that did not report revenue were automatically put into the Startup group (research intensity 50% or more). So some firms that might belong in one of the other three groups have not been included; revenue and R&D spending totals for these three groups could be higher. Since revenue totals for the Startup group were significantly smaller than for the other groups, the potential under-reporting of revenue is likely insignificant. However, R&D spending was comparable among the four groups, so under-reporting of R&D spending might be more significant.

[17] www.researchinfosource.com

2014, the total R&D Leader revenue had risen to $77B, but GDP had more than doubled (x2.6); so these firms' contribution to GDP had fallen by almost half to 4.3%.

Figure 3 charts percentage of GDP for this group over the period, clearly highlighting a gradual decline. This decline, however, was primarily a result of the demise of Nortel. In 2000, Nortel generated $45B in revenue, more than twice the total revenue of all the other R&D Leader firms on the Top 100 list in that year. After 2000, Nortel's revenue tumbled drastically (see Figure 4).

If we take Nortel out of the picture, then the percentage of GDP of the R&D Leader group on the Top 100 list was relatively flat over the period (see Figure 5).

Figure 3
Total Revenue of R&D Leader firms on Top 100 Corporate R&D Spenders List
(% of GDP)
1999-2014

Figure 4
Decline in Nortel Revenue from 2000-2010

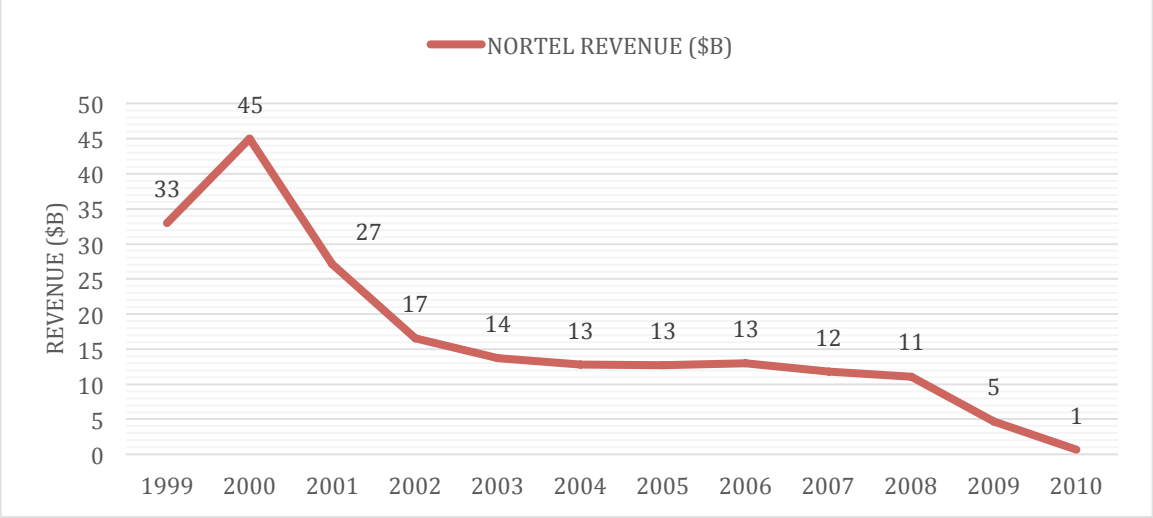
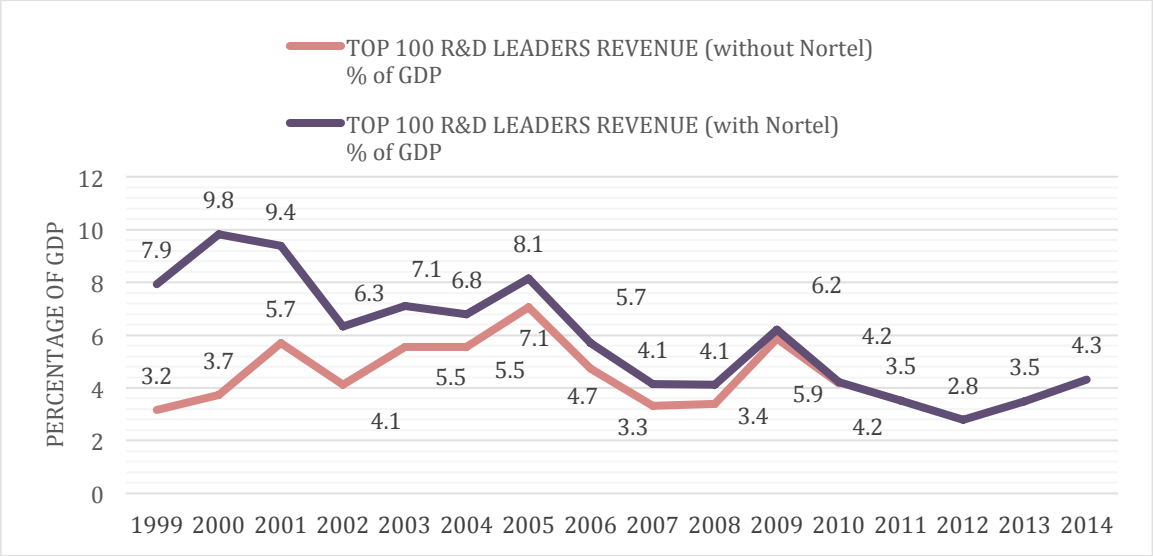


Figure 5
Total Revenue of R&D Leader firms on Top 100 Corporate R&D Spenders List
With and Without Nortel (% of GDP)
1999-2014



The 15-year period between 1999 and 2014 covered two recessions (2001 and 2008) and two recoveries. During this period, the percentage of GDP from Canada's stalwart and tiny group of R&D Leaders has seen a gradual decline. The demise of Nortel made it worse.

If we look at Canada's R&D Leaders in 2001 and project forward we can see clearly that Canada is not succeeding in growing a robust R&D-intensive industry. Despite two vastly different methodologies in Tables 1 and 2, the total revenue for the R&D Leaders in each data set was roughly the same in 2001 – $62B and $69B respectively. Taking the latter figure for the R&D Leaders on the Top 100 corporate R&D spenders list, a growth in sales of 10% per year (a modest growth rate) would have resulted in total revenue of $238B by 2014. Table 2 shows that total revenue had only reached $77B, or a third of that amount – an average annual growth rate of 0.9%.

Canada industrial R&D performers as a group are not generating enough revenue growth to bolster Canada's GDP in any significant way.

Redefining the Problem: Inability to Engage in Global Value Exchange

Canada's inability to generate significant revenue growth from its innovative R&D-intensive firms is clear evidence that we are failing in knowledge-based global commerce. The traditional explanation that Canadian firms do not do enough R&D or innovate enough misses the core problem – an inability to grow and sustain medium and large R&D-intensive firms that successfully dominate global markets.

Most firms stay small; or if they reach significant sales revenues they sell to foreign interests without establishing themselves as global leaders in their market niche. Few Canadian entrepreneurs aspire to global dominance. They lack the skills and experience to understand and meet customers' needs in diverse geographies and cultures. Why is this so?

Root Causes: Talent, Culture and Aspirations

A consistent refrain from business leaders in R&D-intensive firms, both mid-sized and start-ups, as well as from investors in these firms, is a severe talent gap in new Canadian hires. Graduates from Canadian postsecondary education (PSE) institutions lack enterprise experience and skills in sales, marketing, management and communications. They are top-notch in technical knowledge and skills, but lack the enterprise skills and experience they need to help grow and scale companies.

Large multinational firms with strong sales, marketing, management and communications teams can afford to hire, coach and train such employees: and they do, luring Canada's best graduates from computer science, engineering and other technical fields with attractive compensation and living packages. Canadian firms are at a disadvantage, because most of the graduates who stay, while technically competent, have no enterprise-relevant experience to draw on, so Canadian firms struggle to recruit experienced sales, marketing and management people from the US and abroad.

The intention of innovation is to create value for customers. Commerce is a value exchange, and to do it well requires a broad range of experience and skills. Canadian postsecondary institutions focus almost exclusively on technical knowledge and do not provide learning environments that provide these broader experiences and skills. In fact, the dominant research culture in our PSE institutions excludes and marginalizes experiential learning necessary to build and nurture entrepreneurial attitudes, experiences and skills in our young people aged 18-25.

The federal government exerts an enormous influence on Canada's PSE institutions through the billions of dollars it provides to fund research. This research funding largesse has reinforced an environment in our PSE institutions in which faculty and students value research and publishing above anything else. Entrepreneurial attitudes and relevant experiential learning are not rewarded in these institutions. Merit and promotion for faculty rest almost exclusively on research publications and citations. Multinational firms like Thomson Reuters and Elsevier provide detailed metrics and analytics to help PSE institutions quantify their research output. PSE institutions use these metrics for promotion and tenure decisions and granting councils use them for evaluating grant proposals. There is little effort placed on measuring the societal and economic impacts of the research. Relevance is perceived as counter-productive in quality research. The peer review process entrenches the use of these metrics since faculty members that have succeeded in

this research-focused culture populate evaluation committees. This practice represents a large and significant change in research culture that has taken place since the founding of NSERC in 1978.

As a result, Canadian firms find it difficult to find graduates from Canadian PSE institutions that have any experience with entrepreneurship and value creation for society. Company executives consistently report that graduates with domain specific technical skills are world-class, but that they cannot find graduates who understand sales, marketing, customer intelligence, team building, management and other enterprise-relevant skills and approaches. There is little understanding of the human dimension of commerce – a value exchange between two parties that includes mutual trust, respect and understanding (see Box).

Commerce – a Value Exchange

An entrepreneur operates an enterprise (supplier) to create value for someone (customer), to receive value in exchange and to succeed in the exchange – the supplier delivers value to both parties (itself and the customer). In commerce, the supplier typically creates value in the form of a product or service and the value the customer exchanges for the product/service is financial. However, an ideal entrepreneur understands that there are other elements to a successful value exchange.

Trust is the basis for commerce. Trust is built on mutual understanding, respect and responsiveness to each party's needs. An ideal entrepreneur knows that his or her enterprise will be sustainable only if the value exchange is ethical.

Some PSE institutions are addressing the need to develop entrepreneurial attitudes and skills among their students, but these efforts are piecemeal and struggle within the prevalent research culture.

Most graduates that do become entrepreneurs enter business shaped by the dominant research culture from their postsecondary education years. Many Canadian entrepreneurs focus on technology, spending too much time on product development before engaging potential customers. A preoccupation with financing leads many to seek angel and VC financing too early, locking themselves onto a path

to a quick exit for their investors.[18] Selling early at relatively low valuations is the norm in Canada, perpetuating the dearth of medium and large Canadian innovative firms and R&D Leaders. Relatively few Canadian entrepreneurs aspire to build and scale large firms that are sustainable, global leaders in their sector.

Fixing the Problem

Analysis of Canada's "BERD problem" has focused on the wrong end of the telescope – research. If we look through the proper end, the real problem comes into focus – lack of ability and aspiration to build and scale R&D-intensive firms that export knowledge-based goods and services. Canada has excelled in starting and growing firms in low research-intensive sectors such as resources, simply because the world needed our resources and we did not have to go out and convince anyone that we had something that could help them. In the knowledge economy, new solutions emerge all the time. The need to seek intelligence and information about potential customers around the globe, their likes and dislikes, their needs, their culture is ever-present. The skills and experience needed to excel in this kind of intelligence gathering and communication are largely ignored and unsupported in Canada's leading research PSE institutions.

All elements of Canada's innovation ecosystem, including our PSE institutions, need to focus on building our capacity to create value and deliver it sustainably around the world. We must find niches where Canadians can excel and be globally dominant. We must recognize and support our entrepreneurs that are global players, successfully providing value competitively to customers in different countries and cultures. They know how to engage international customers, work with them, listen to them, learn from them and create value for them.

The skills and attitudes needed to excel in this kind of value creation are learned through experience. The culture of Canada's PSE institutions is not conducive to providing relevant experiences to students. These institutions have tremendous influence on young people. PSE graduates spend their formative years (ages 18-25) steeped in the PSE culture. With influence comes responsibility. It is time that Canadian PSE institutions, and the granting agencies that support and fund them, accept their responsibility to provide broader learning experiences to students so that they are better equipped to excel in global knowledge-based value exchange.

There is some recognition of this need. In 2015, the Business Council of Canada launched the Business/Higher Education Roundtable to "support young Canadians as they transition from education to the workplace, strengthen research collaboration between industry and institutions, and help Canadian employers as they adapt to the economy of the future."[19] The Roundtable is focusing on piloting work-

[18] H.D. Barber & J. Crelinsten, Understanding the Disappearance of Early-stage and Start-up R&D Performing Firms (Toronto: The Impact Group, October 2009)

[19] http://bher.ca/about

integrated learning projects in specific industry sectors (e.g. fintech in Toronto) and building trusting relationships between PSEs and the private sector in order to increase the number and quality of research partnerships between PSEs and industry.

In its 2016 budget, the federal government announced a program to support work-integrated learning in Canada's PSEs. The government earmarked $73M over four years, starting in 2016-17, to "support partnerships between employers and willing post-secondary educational institutions to better align what is taught with the needs of employers. The Initiative will also support new co-op placements and work-integrated learning opportunities for young Canadians, with a focus on high-demand fields, such as science, technology, engineering, mathematics and business."[20]

Some provincial governments are addressing the issue as well. For example, the BC government has earmarked 25% of its funding to BC's 24 PSEs for focused training on skills identified by industry. Any new technology program proposed must now include co-op.[21]

While each of these initiatives is important and timely, they risk being diluted by the dominant research culture in Canadian PSE institutions. More academic-industry research collaborations will give students valuable experience, but if the focus is on research then the predominant culture will prevail. Young people need to understand that without global trade, we cannot survive. Export trade is based on a value exchange that requires a broader view of innovation outcomes than simply "bringing ideas to market" or "commercializing research results." To provide solutions to global problems, Canadians will require deep understanding of and respect for other cultures, creativity to develop innovative solutions and effective business models to deliver these solutions globally, ethically and sustainably.

[20] Budget 2016: Growing the Middle Class (March 22, 2016), p. 74

[21] Welcome Remarks by The Honourable Amrik Virk, Minister of Technology, Innovation and Citizens' Services at the National Angel Summit in Vancouver, 5 October 2016.