10 S&T Strategy Conundrums

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Introduction

Depending on how you count, Canada has had 8 science and technology strategies in the past 50 years. The most recent strategy (2007) is showing its age and a new strategy may be in the offing. Do you fancy yourself to be an astute S&T policy analyst with a good appreciation of the challenges and opportunities facing the country in the realm of research and innovation? Imagine you’ve been asked to craft the next S&T strategy for the country. How would you address 10 key policy and economic conundrums? Many of these are long-standing issues, but others have yet to make their mark on policy thinking.

Conundrum #1: Corporate R&D Performance

Since the retreat of the glaciers (or thereabouts) the biggest knock against Canadian companies is that they don’t spend enough on research and development. (The underlying assumption - as yet unproven by academic research - is that companies and economies that spend more on R&D than their competitors will out-perform them.) That viewpoint has become so established that it has become economic orthodoxy. Some believe that the orthodox viewpoint results from a selective reading of the R&D statistics across countries; statistics which are themselves suspect due to the different data collection methodologies employed by each country’s national statistical authority, and varying local policy and program circumstances that influence firm
behaviour (e.g. R&D tax credit eligibility in different countries). But once scientific ideas have become accepted as true (cf. Karl Popper) it requires a revolution in thinking to overturn them.

Whether one believes the orthodox interpretation of business R&D spending or not - but especially if one does believe it - the conundrum for S&T strategy is that nothing in 50 years of prior strategies - or for that matter, decades of government innovation policies or programs - has remedied the situation. In fact, as Canada’s apparent performance appears to deteriorate with time, it seems past efforts may have made it worse. From that standpoint orthodox analysts are forced to conclude either that previous efforts must be deemed to be failures, or that business R&D spending would have been even worse in the absence of the policies and programs.

So, the conundrum for S&T strategists who believe Canada’s private sector under-performance is both real and worrisome, is how exactly to turn things around. What is your view? Is there really a problem here? And if you believe so, what would you do remedy the situation?

**Conundrum #2: A Casino Investment Strategy**

To what extent would you gamble your salary at a casino? Most of us wouldn’t risk any substantial portion, but governments are eager to do so through their seeming fixation on investing public money in startup and early stage companies.

Small firms with fewer than 100 employees constitute over 97% of Canada’s economy (Table 1, following). Nobody has ever crunched the numbers, but it is a reasonable proposition that something in the order of 80% of government direct funding programs for S&T-based companies is aimed at nurturing small and medium-sized companies, and especially startup and early stage companies. The implicit goal is to spawn as many of these firms as possible in the hope that a few of them will “hit the jackpot” and grow into medium-sized companies, and from there into into large multinational firms. It’s just like plugging your hard-earned loonies into a slot machine in the hope of winning the jackpot, but understanding that your chances are small indeed. And as with slot machines, the startup/early stage investment strategy - the “casino strategy” - is a very risky and inefficient way of producing winners. The chance of failure for an

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3For not, see http://impactg.com/index.php?headline=88

4An alternative view is that perhaps, in the end, we are treating a disease that does not exist, and therefore the supposed symptoms have not disappeared.
individual small firm is tremendous, and extremely few startup or early stage firms will successfully navigate their way to long term growth and financial success.

The experience of the venture capital industry is informative here. A typical venture capital company might review 100 proposals and invest in only 10 companies. Its expectation is that one of the 10 investees will constitute a big win, 2-3 others will deliver reasonable results and the other 6-7 will be failures. Let’s say (using the VC experience) that the overall long term success rate of startup technology companies is in the range of 2-4%; alternately, the failure rate is around 96%. Contrast this with one’s odds of winning at blackjack at a gambling casino, which are approximately 40%.

So, on the surface, it appears that the odds of an “investor” winning at blackjack are at least 10 times better than the odds of a venture capitalist - or any other investor - making a successful investment in a startup firm. The paltry returns to Canadian “smart money” venture capital investors in the heyday of the tech boom in the 1990s was in the order of 3% (and not much better in the US). Investors would have been better off leaving their money in the bank.

And yet even today provincial and federal governments have little hesitation in allocating hundreds of millions of taxpayers’ money to creating investment pools and other vehicles that will support startup and early stage firms, even though the odds of success are predictably small. (Can you imagine a politician standing in the legislature to announce the government intended to invest in a portfolio that has a 96% risk of failure?)

Is that the best way to invest taxpayer money? That’s a conundrum. What, if anything, would you do to support startup and early stage company development?

**Conundrum #3: Medium-Sized Businesses - Growing national champions (or not)**

If investing in startup and small companies is, on balance a guaranteed money-losing proposition, what about investing in medium-sized businesses? Unlike their startup and early stage counterparts, medium-sized companies carry less risk: they have established products/services, supply chains, customers, distribution channels, revenues, earnings, business systems, lines of credit, etc. In other words, they are real entities that have proven themselves capable of withstanding the vicissitudes of the market.

Furthermore, it is axiomatic that Canada’s pool of medium-sized companies will produce the next generation of national champions - winners. The conclusion is simple arithmetic; in order for a (small) firm to become large, it needs to pass through the medium-sized stage. So, by definition, at any point in time tomorrow’s technology stars can be found among the pool of today’s medium-sized companies. So, how many medium-sized S&T-based companies are there in Canada and what are their characteristics? We haven’t a clue.
Table 1. Distribution of Firms by Size

<table>
<thead>
<tr>
<th>Employee Size</th>
<th>No. of Firms</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 4 employees</td>
<td>655,561</td>
<td>55.4</td>
</tr>
<tr>
<td>5 to 9 employees</td>
<td>231,593</td>
<td>19.6</td>
</tr>
<tr>
<td>10 to 19 employees</td>
<td>146,021</td>
<td>12.3</td>
</tr>
<tr>
<td>20 to 49 employees</td>
<td>96,822</td>
<td>8.2</td>
</tr>
<tr>
<td>50 to 99 employees</td>
<td>30,980</td>
<td>2.6</td>
</tr>
<tr>
<td>100 to 199 employees</td>
<td>13,833</td>
<td>1.2</td>
</tr>
<tr>
<td>200 to 499 employees</td>
<td>6,523</td>
<td>0.6</td>
</tr>
<tr>
<td>500+ employees</td>
<td>2,606</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,183,939</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Source: CANSIM 551-0004

According to Statistics Canada there were 1,183,939 companies of all sizes with at least 1 employee registered in Canada in 2013 (Table 1.) The same data tell us that there are about 20,000 firms of all types and across all industry sectors that employ between 100 and 499 personnel. A recent study by the Business Development Bank of Canada\(^5\) found there are only 7,814 medium-sized firms across all industry sectors. Industry Canada estimates there are 18,169 medium-sized businesses as at December 2012\(^6\). So, there is some uncertainty around the actual numbers.

While we have some rudimentary data about the overall population of medium-sized firms as a whole, unbelievably, nobody has crunched the numbers for mid-sized S&T firms\(^7\). We don’t know a single thing about the pool of tomorrow’s tech stars: how many of them there are, in which industry sectors, which parts of the country, how many people they employ, what their R&D spending is, etc., etc.

\(^5\)BDC. What’s Happened to Mid-Sized Firms?. Montreal. 2013


So, an additional conundrum is that we have been fashioning S&T strategies without knowing anything about the critical population of medium-sized firms and their special needs for government support. What is your solution to this conundrum?

**Conundrum #4: Calculating the real cost of corporate R&D**

Ask most analysts about the cost of corporate R&D and they will tell you it consists of labour and material costs and related capital expenses. That answer is true as far as it goes, but ignores the largest single cost to the firm of engaging in research - the opportunity cost. Look at it from the standpoint of a company owner or manager. Relatively few firms have full-time, dedicated R&D departments. So, when deciding to undertake an R&D project, who is the owner/manager going to assign the task to? Obviously, their most talented employees who are already working for the firm.

But why are those people working at the firm in the first place? The reason is the employees are earning money for the company. It’s a simple equation really; employers only hire employees who contribute to revenues. So now, you’ve taken an employee who is already contributing to revenues and put them on to a job (R&D) that won’t contribute to revenues for some time, if ever.

To make the calculation easy, let’s assume you are paying the employee $100,000 a year. To justify this, the employee must earn your company, say, $200,00 a year. Your gross profit is thus $100,000. With the employee now working on the R&D project your company has forgone the $200,000 a year the employee was bringing in, and you still need to pay the employee the $100,000 salary. So your real cost - salary plus forgone earnings - is $300,000.

Government support programs such as SRED might compensate you for a portion of the employee’s salary and overhead - let’s say 30% of the direct cost of labour or $30,000. So, even if you’re fortunate to qualify for a government program, you are still out of pocket $270,000. Oh, and the research project might not pay off. How would you address this conundrum through new strategy, policy or programming?
**Conundrum #5: Analytical data eroding**

As an S&T strategist you will want the most comprehensive and up to date information about trends in the national system of innovation. The problem is, in recent years there’s been no progress in developing new forms of S&T data. In fact, there are fewer data sources available to analysts today than there were a decade ago. While policymakers seem to be happy spending billions on direct and indirect support of research and innovation, there is a reluctance to spend a few million to plan for or evaluate what is going on. Nowadays, Canadian S&T policymaking seems to afflicted with a bad case of wilful ignorance.

What would you do to resolve this conundrum?

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**Conundrum #6: Scientific Research vs. Industrial Research**

Canada’s largest program for supporting research in industry - the Scientific Research and Experimental Development (SRED) program dates back over half a century. SRED provides tax credits (refundable in the case of small firms) to firms that conduct scientific research in support of product or process development. However, in order to qualify, firms are required to perform scientific research on a par with the kind of research that is conducted in universities.

The SRED criteria were designed in another era; one that was dominated by the in-house research laboratories of multinational corporations, such as IBM, Noranda, or Bell Labs. These labs were themselves patterned on an academic research model and essentially mimicked their university counterparts. The SRED eligibility criteria were codified in the OECD’s Frascati Manual. Although the Frascati Manual has been revised many times subsequently in an effort to better reflect the reality of modern industrial research, the SRED program has failed to update its definition of research.

Few companies today actually perform scientific research of the type outlined by the Frascati Manual. Most firms concentrate on translating their own ideas, or results of scientific research conducted in universities and government labs into viable products and services. But SRED actively discriminates against that kind of research - unless it has a demonstrable academic orientation. The result is that thousands of firms bend themselves into pretzels in an attempt to make their market-focussed industrial research appear to be pure “scientific research”, in order to qualify for SRED support.

What would you do to resolve the conundrum between scientific research and industrial research?

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*For example, in 2012 Statistics Canada dropped its Survey of Intellectual Property Commercialization in the Higher Education Sector.*
Conundrum #7: Batting singles - The Importance of $5 million companies

There’s a straightforward but little-understood reason for the apparent shortage of venture capital investment in Canada (and elsewhere), and following a baseball metaphor, it has to do with batting singles versus swinging for home runs. A VC investor who is planning to risk a large sum of money will inevitably look for a big payoff - the home run. Given the high failure rate of VC investments overall, and the hassle of wading through a large number of so-so opportunities to find the “pearl”, large investments can only be justified by large payoffs. In fact, most VC firms have a lower limit - a floor - for their investments⁹. The floor might be, for example, $100 million, meaning that investments that don’t have the potential to grow into companies with revenues of at least $100 million will be rejected out of hand, regardless of their merits.

But we have already seen (Table 1) that few Canadian firms ever reach this lofty objective, which effectively disqualifies most potential investees from receiving VC money. However, from an economic growth and individual quality of life standpoint, why should Canada not be trying for “singles”: building more $5 million dollar companies that employ 50 people, instead of aiming for home runs that will establish $100 million or $1 billion behemoths that will employ 1,000 or 10,000 workers?

Too much private (and public) sector investment activity has the implicit goal of hitting home runs when we should be batting for singles: spawning profitable smaller companies. Would you do anything to re-balance the current emphasis?

Conundrum #8: The Limits to Organic Growth

Although Blackberry (Research in Motion) now seems to be on the ropes, that was not always the case. Only a few years ago RIM was the darling of the Canadian tech scene. In fact, it took Research in Motion 25 years from its founding in 1984 to grow to be a company that in 2009 employed 15,000 people in Canada and around the world. RIM’s experience was not unique; it takes decades for companies to grow organically. Most never do. At the same time there is a fast-track to growth, through acquisitions: acquiring competitors, suppliers, distributors, etc.

Canadians well understand the phenomenon, having experienced the disappearance of so many domestic firms through mergers and acquisitions (though mostly acquisitions). Why then are we so reluctant to turn the tables? Strangely, the acquisition route is virtually ignored by the public sector; government programs are nearly always predicated on organic growth - usually of startup and small companies - rather than an acquisition strategy. Policymakers are happy to direct funds to high-risk startup and early stage companies in the hope they will grow organically

In most instances they also have upper limits.
over time, but offer little or no help to established medium-sized firms that could grow through acquisitions. As an S&T strategist, how would you put growth through acquisition on the policy agenda?

**Conundrum #9: Picking Winning Technologies**

Darned if you do, darned if you don’t. How can a national S&T strategy ensure that a country doesn’t miss out on emerging S&T opportunities? For instance, today the UK government is convinced that graphene technology is the next big thing and has allocated £60 million to a technology development program. For whatever reason Canada has no plans to exploit graphene. Is the UK right? Is Canada?

The conundrum of trying to choose winning technologies is one that confronts governments every day. But when they commit themselves to certain technology pathways they necessarily narrow the window for investment in other promising technologies not on the approved list. As an S&T strategist how do you ensure that a country makes the right investments, in the right technologies, at the right time? Do you invest in foresight exercises? Do you let lobby groups set the agenda? Do you allocate specific sums of seed money for emerging technology development? What is your answer to this conundrum?

**Conundrum #10: Goods vs. services**

Around 69% of Canada’s economy is generated by service sectors of the economy, leaving 31% (a declining figure each year) based on goods production (including commodities). The service sector obtains most of its knowledge inputs from the social sciences and humanities whereas the goods producing sector obtains most of its innovation knowledge from the natural sciences, engineering and life sciences.

While nobody has ever checked the actual numbers, an extremely large portion of our research and innovation policy and programming is aimed at supporting companies and activities in the goods producing sectors of the economy. Also, Canada’s main private sector R&D support program - SRED - explicitly disqualifies social sciences and humanities research from eligibility. Why is our innovation spending largely aimed at goods production when services predominate and are growing, whereas goods production is shrinking? Should we be re-balancing our investment portfolio? How would we do so? How would you address this conundrum?
A Closing Word

If you’ve had the patience to reach the end of this piece, congratulations. Now ask yourself which of these conundrums you were previously aware of and whether you agree or disagree with them. Have you identified additional conundrums? And finally, is it possible to craft an S&T that can address all these conundrums?

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