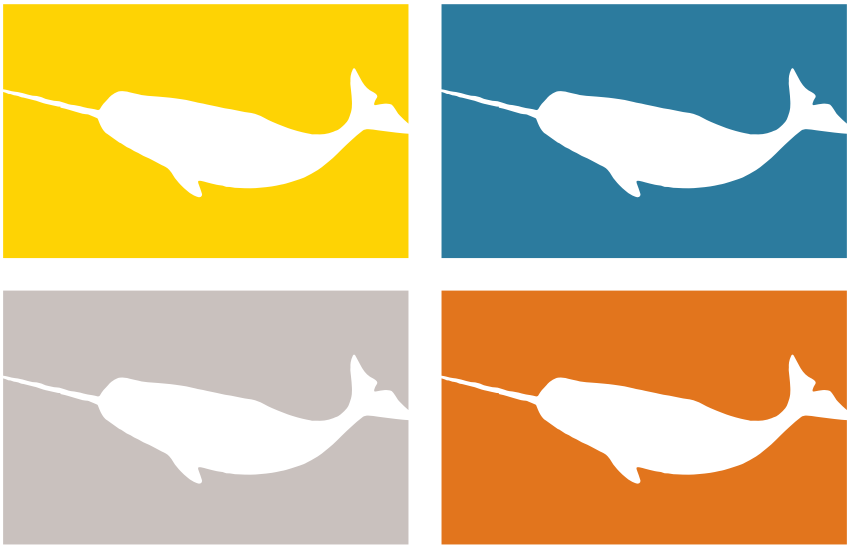
An Impact Brief
June 2019

# The Narwhal Project

## Canada's Challenges in Scaling Technology Companies



IMPACT CENTRE
SCIENCE TO SOCIETY

UNIVERSITY OF TORONTO

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# Canada's Innovation Challenge

"We lack large companies, particularly in the technology sector."

Three years ago, we at the Impact Centre initiated the Narwhal Project to conduct research to discover the root causes of Canada's challenges in creating a world-leading innovation economy. We thought it would be useful at this juncture to summarize our findings. This report highlights some of the issues we have identified.

For fifty years, the federal and provincial governments have been spending billions to improve our innovation economy, but without performance improvements. The usual discussion is centered on Canadian businesses and their lacklustre performance on research and development (R&D) and intellectual property (IP) protection. In addition, our productivity has lagged relative to the US because of insufficient investments into productivity-enhancing technologies, along with the lack of available capital and talented people to grow technology firms.

But we believe that a critical challenge is our inability to scale companies to a world-class size. Larger companies boast several advantages. They have greater revenue per employee, pay better salaries, undertake more R&D, and take out more patents.

We lack large companies, particularly in the technology sector. We have only one Unicorn (with perhaps another one qualifying but not listed as such at the date of this publication) compared with over 150 in the US. Few tech companies in Canada grow large enough to go public. This means less R&D, fewer patents, and, ultimately, lower income per capita and productivity.

Perhaps the solution to our innovation challenge is not more R&D and more patents, but rather scaling and building of companies. But why are we challenged do this in the tech field? What we have found is that:

- Few Canadian companies are founded in large consumer markets capable of generating the desired scale.
- We invest less per company relative to the US.
- Canadian firms spend less on marketing and sales (M&S), activities that are critical to building the customer base.
- We have fewer qualified people in marketing functions.

The underinvestment and underspending result in lower growth rates for Canadian tech firms compared to their US counterparts. Fundamentally then, Canadian firms do not look as attractive as potential investments due to slower growth. Because of this, they do not attract large amounts of late-stage capital and are often sold before they can scale to world-class size.
All of these factors converge to create serious barriers to growth of Canadian companies, thus necessitating smarter and more strategic thinking about how we will overcome these challenges.

## R&D, Productivity, and Income per Capita in Canada

The following Globe and Mail article reported that the Government of Canada was pleased to announce five new programs to spur business expenditures on research and development (R&D), touting it as a "new" beginning: "This is the start of a new trend for Canada. Until now Canadian Industry has lagged behind its foreign competitors in research and development." Although this article was written in 1967, it reflects many points that mark the innovation debate in Canada to the present day.

Exhibit 1
**The Globe and Mail**

REPORT ON BUSINESS — THE GLOBE AND MAIL, FRIDAY, APRIL 7, 1967 B5

# Ottawa hopes to spur research and development through 5 programs

By DAVID SPURGEON

Canadian industry is being wooed into research and development by the federal Government as never before.

With the final passage through the Senate earlier this month of Bill C-262, there are now a total of five federal assistance programs to encourage industry to undertake its own scientific research and development.

This is the start of a new trend for Canada. Until now, Canadian Industry has lagged far behind its foreign competitors in research and development. The Canadian economy has been based on imitation rather than innovation, largely because much of its industry is foreign-owned.

This can be shown in different ways. One way is to compare the proportion of total research and development effort carried out by Canadian industry with that of other countries.

Figures from the Department of Industry for 1961-2 show that, while industry carried out 74 per cent of the total research and development effort of the United States and 63 per cent of Britain's, industry in Canada carried out only 36 per cent of the total.

Another yardstick is what the Industry Department calls "research intensity." This expresses expenditure on research and development as a percentage much relative to industrial output . . . .

"Taken as a whole," Industry Minister C. M. Drury said recently, "Canadian manufacturing industry in 1962 displayed a 'research intensity' of approximately 1 per cent, which was equivalent to a research and development expenditure of about one-half cent per dollar of sales.

"By comparison, British industry spends three times, Sweden four times, and the United States over six times as much relative to industrial output . . . .

"It would appear that a target 're-search intensity' for manufacturing industry of 3 per cent (i.e. almost three times the current figure) is required to bring Canada more nearly into line with comparable industrialized countries. The attainment of this target within a reasonable period of time would require a virtual doubling of the previous long-term growth rate for industrial research and development."

This, then, is the goal of the department — a tripling of innovation activity by the Canadian manufacturing industry. But what kind of activity? Should equal emphasis be placed on fundamental research, applied research and development? Or is one more important than another?

Here again the figures show shortcomings in past performance in Canada, and point the way to future developments. The 1961 data showed that, while the United States and United Kingdom carried out comparable amounts of basic and applied research and development, Canada did proportionately more basic and applied research than either, but much less development.

According to Industry Department figures for 1961, Canada spent 18 per cent of its research and development funds on basic research, 42 per cent on applied research, and 40 per cent on development, compared with 10 per cent, 32 per cent and 58 per cent for the United States and 10, 34 and 62 per cent for Britain.

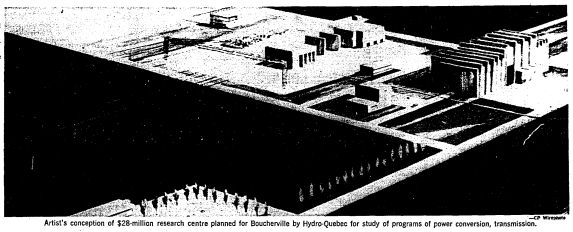
More recent figures, tabulated by the Engineering Institute of Canada, show that in 1963-64 Canada spent 16.1 per cent of its total research and development funds on basic research, compared with 10.2 per cent for the United States and 7.1 per cent for Sweden.

This means that Canada is spending more money to generate new technology than to employ it, the Industry Department says, whereas common experience would indicate that the reverse should be true. The department contends that the most critical sector of Canadian scientific endeavor in the physical sciences lies in the development category, and at least a doubling of effort is required to achieve the necessary balance between research and development.

Why the stress on development? "Technology," Mr. Drury said in Halifax recently, "is changing not only the product lines, but the entire modus operandi of modern industry . . . . Economists now recognize technology as the fourth factor of production along with the classical factors of land, labor and capital . . . .

"Recent studies in this field suggest that about one-half of the spectacular economic growth which has occurred in the United States over the past 50 years has come from increases in labor and capital resources, and the other half from increases in productivity.

"And most of the growth in productivity — about 80 per cent according to some estimates — may be attributed to technological progress."



Artist's conception of $28-million research centre planned for Boucherville by Hydro-Quebec for study of programs of power conversion, transmission. — CP Wirephoto

Technological investment, Mr. Drury said, is the great progenitor of economic growth. Systematic and continuing investment in research and development leading to new products is just as important to competitive survival as capital investment to replace worn-out plant.

". . . In the final analysis, we must look to research and development in large measure to spark the process of industrial expansion and economic growth for the future."

Much of the research and development activity in the larger nations — especially the United States — is in the areas of defense, space and nuclear programs. A major part of these programs has been contracted out to industry, and the general level of industrial technology has been raised as a result.

Defense and space do not loom so large in Canada, so the problem for the Government is to find alternative programs for supporting scientific and technological work in support of economic objectives.

"To this end," Mr. Drury said, "we have chosen the course of supporting research and development in Canadian industry directly for economic purposes. We believe that this approach will prove less costly and at the same time be more effective in meeting the particular needs of Canadians."

The five federal programs designed to encourage research and development include four subsidy-type programs and the new Industrial Research and Development Incentives Act. The four subsidy programs are the Industrial Research Assistance Program, administered by the National Research Council; the Defense Industrial Research Program, administered by the Defense Research Board; and the Defense Development Assistance Program and Program for the Advancement of Industrial Technology, both administered by the Industry Department.

The NRC's program pays the salaries of personnel engaged in research. The Industry Department's PAIT program pays 50 per cent of the non-capital costs of development of processes or products that involve new applications of existing technology, or the development of new technology with industrial applications. The other two apply specifically to defense applications.

In both the PAIT and NRC programs, the aim is to be responsive to the needs of industry, so responsibility for selection of projects and their direction lies with the company involved. In 1965-66, NRC spent about $3.3-million to support 135 industrial research projects under its program, while in the first 15 months of PAIT operation, the program supported a total of 70 industrial projects representing a total development effort of about $37-million, of which about half is paid by the Industry Department.

The new Industrial Research and Development Act replaces a tax incentive program established in 1961. Sections 72 and 72A of the Income Tax Act granted an immediate write-off of current and capital expenditures for research plus an extra 50 per cent of the increase in these expenditures over those in the base year 1961.

The new act provides for grants, payable in retrospect, amounting to 25 per cent of capital expenditures for research and development carried out in Canada during the year, plus 25 per cent of the amount by which eligible current expenditures made in Canada during the year for research and development exceed the average of eligible current expenditures in the previous five years. The grants will not be subject to federal income tax, nor will they reduce capital costs for tax purposes.

This act is meant as a general incentive for increased research and development, freely available to all companies carrying on business in Canada, provided the research is to be carried out in Canada and exploited here.

The Industry Department hopes it will overcome what were felt to be deficiencies of the tax incentive program. It was said to be discriminatory because the eligibility of a company depended on its tax position. Companies that were small or growing and not yet in a profit-making position were excluded from the tax program, but they will not be excluded from the new one.

The tax incentive program also was said to have worked to the disadvantage of companies that had major expenditures in the 1961 base year. In the department's view, all capital expenditures for new facilities or equipment represent prima facie evidence of expansion in research capabilities of a company, and therefore should qualify for the bonus without regard to any base. That is why capital expenditures are being treated separately from operating expenditures in the act.

The incremental feature is being maintained for operating expenditures because the primary objective is to encourage growth in the level of research and development effort.

The department estimates that the maximum cost of the program for the first full year of operation will be about $38-million, and if its expectations are realized, the figure could increase by about 26 per cent a year.

"In other words," Mr. Drury said, "this incentive will amount to about 10 per cent of the total industrial research and development expenditure, so that in effect, the federal Government will be underwriting the additional cost of expanding the growth rate for industrial research and development from 10 per cent to 20 per cent per annum."

Not everyone is as pleased about the new act as the Industry Department appears to be. J. J. Green, director of research for Litton Systems (Canada) Ltd., complained recently that the new act will reduce the advantage that certain companies gained through research and development in previous years. The rewards under the new rulings are only for companies whose yearly expenditures are rising steeply, he said. Those that originally expanded their research and development capabilities under the tax incentive program and are still doing a fair level of research and development, yet did not increase expenditures in any one year, will not benefit under the new act, Dr. Green says.

The department's reply to this is simply to repeat that the new program is designed to encourage growth. "We're booming the increment," J. L. Orr, scientific adviser to the department, says, "rewarding the extra effort, not good behavior."

Dispute has also arisen over whether a tax incentive program, like the old one, or a grant program, like the new one, is best for encouraging research.

The Carter commission approved the use of grants rather than tax concessions, but the Economic Council of Canada would like to have seen the tax incentive program continued, with certain improvements.

The Carter commission had other comments on the new program: it said the extension of the base period would make the scheme less capricious; the allowance of all capital expenditures seemed sensible; and the idea of giving prior approval to all expenditures over $50,000 a year to make sure they would likely benefit Canada was a good one.

But the commission added: "The basic question in our minds is whether the scheme is necessary at all, given the National Research Council program and the Program for the Advancement of Industrial Technology . . . . We doubt whether broad incentives that apply without qualification to something as vague as 'research and development' can be effective. Per dollar of revenue foregone or cost incurred, we have little doubt that the National Research Council program and the new Program for the Advancement of Industrial Technology are a great deal more efficient than general tax incentives."

The commission recommended dropping both the old tax incentive program and the new general incentive program unless careful evaluation showed them to be more efficient than the NRC and PAIT programs.

A report by the advisory committee on industrial research and technology of the Economic Council of Canada criticized several aspects of the new program: the change from a tax incentive to a grant program; the continued use of a base period; the distinction made between capital and current expenditures; and the requirement for prior approval of specific projects.

The use of a base year, the report said, would encourage companies to cycle their research and development expenditures in such a way as to maximize their benefits under the program, rather than planning research on a strictly rational basis. And the use of a moving average base would result in a changing degree of incentive from time to time, when the incentive should remain high for a long period.

The device of giving benefits under the program in the form of credits against present or future taxes is a suitable one through which to accomplish the program's main purpose because it awards success, the report says. In contrast, grants or subsidies are distributed without regard to results.

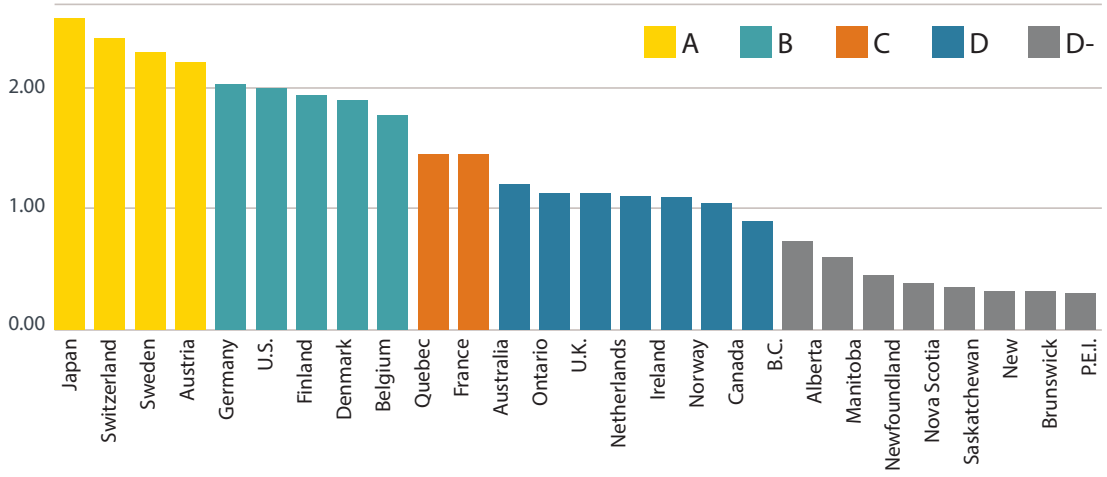
In the last analysis, of course, it remains to be seen how well the new program will do the job of encouraging research and development. But there is another string to the Industry Department's bow: in January it announced support of a new experiment in industry-university co-operation which it hopes will upgrade technology in Canadian manufacturing industries. The experiment involves the establishment of an Industrial Research Institute at the University of Windsor, possibly the first in a series of similar organizations across the country.

The department is providing a grant of $600,000 for an institute to provide a framework within which the university may undertake contract research on behalf of local industry.

For more than five decades, we have seen the proliferation of new government programs at the federal and provincial levels aiming to spur business R&D and the growth of an innovation economy. Yet every year, we also see reports that Canada trails other OECD (Organisation for Economic Co-operation and Development) countries on several indicators gauging our economic and innovation performance, including R&D expenditures and productivity. For example, numerous reports have noted Canada's lack of spending on R&D. While we find ourselves in the middle of the pack in terms of public R&D spending, we still rank near the bottom on business expenditures on research and development or BERD (Exhibit 2). Many studies have also discussed the weak productivity of Canadian industry in relation to other nations. In fact, Canada has slipped to fifth place among G7 countries (Exhibit 3). Our GDP per Capita is also compared with that of the US and found to be wanting and the Governments of Canada and Ontario have both recently announced initiatives to address Canada's challenges in the area of patenting.

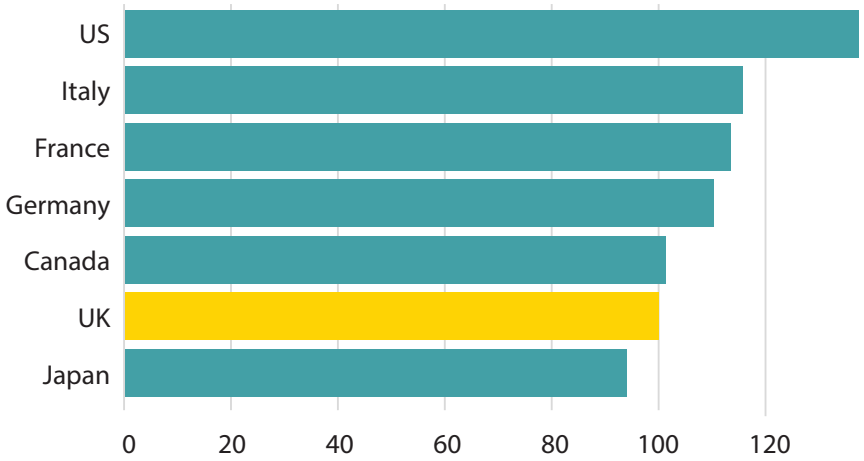
**How can it be that we put so much effort into solving the problems of R&D, patents, productivity and income without making any significant progress on these fronts?**

Exhibit 2
**Business Enterprise R&D, Provinces and International Peers, 2015 or Most Recent Years**
(spending as a percentage of GDP)




Source: The Conference Board of Canada

Exhibit 3
**Current Price GDP per Worker, 2016 (UK = 100)**




Source: Financial Times

## The Large Company Challenge

The reason we continue to face these same challenges is that we are trying to address the symptoms instead of the underlying problem. R&D, patenting, productivity, and income are symptoms of the problem, but not the problem itself. One fundamental, and perhaps often overlooked, issue is that Canada does not have many large companies operating in the innovation economy. Exhibit 5 shows that Canada ranks last in the number of companies with more than 250 employees per million population in selected OECD countries.

Exhibit 4
**Enterprises by business size (250 or more persons)**

| Country | Number of Large Companies | Population (in millions) | Number of Large Companies (per million population) |
|---|---|---|---|
| Germany | 4408 | 82 | 53.8 |
| Japan | 3572 | 127 | 28.1 |
| Australia | 523 | 24 | 21.8 |
| Italy | 1236 | 59 | 20.9 |
| France | 1355 | 65 | 20.8 |
| United Kingdom | 1229 | 66 | 18.6 |
| United States | 5672 | 322 | 17.6 |
| Spain | 802 | 46 | 17.4 |
| Canada | 370 | 36 | 10.3 |

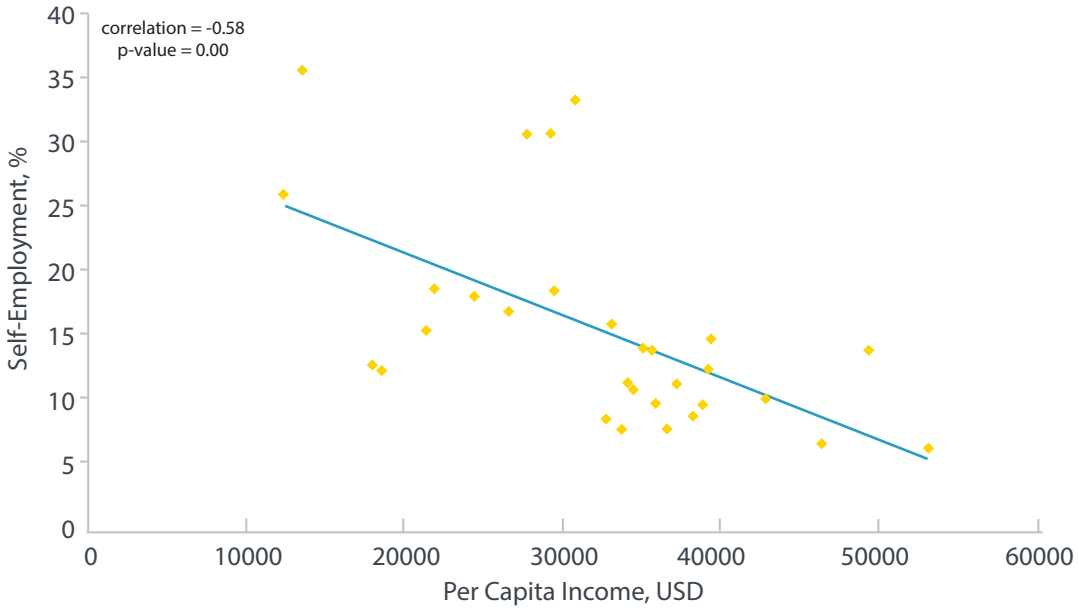
Source: OECD 2017 - Online

## Connection Between Large Businesses and Economic Vigour and Patenting

A large fraction of the Canadian industry consists of small and medium-sized enterprises. But why would this be a problem? Unfortunately, there is a negative correlation between economic vigour and the rate of small business ownership, self-employment, and startups. In fact, countries with a large fraction of small companies are often stagnant in terms of economic vitality as individuals start small businesses when there are fewer other opportunities for employment (Henrekson and Sanandaji, 2014). As a good example of this phenomenon, one can look at entrepreneurship rates in countries such as Mexico, Greece, Italy, South Korea, and Turkey. These countries have the highest rates of self-employment according to the OECD. The US with its economic heft, on the other hand, has the second-lowest rate of self-employment.

Exhibit 5 shows the correlation of self-employment and per-capita income. As self-employment goes down, per-capita income increases, with a correlation of .58 between these factors. Larger firms report higher revenue per employee due to efficiencies and economies of scale (Henrekson and Sanandaji, 2014). While these statistics do not allow us to tie self-employment to per-capita income directly, we can see that larger firms drive a more robust and profitable economy.

Exhibit 5
**S3 Self-Employment and Per Capita Income, OECD Countries**




Source: Henrekson and Sanandaji (2014).

A similar relationship is observed between self-employment and patenting, another metric frequently used to evaluate innovative economic activity. The share of the gross domestic product (GDP) accounted for by large firms is correlated with the number of triadic patents attributed to each country; i.e., the higher the concentration of Global 2000 firms in a particular nation, the larger the number of triadic patents (Plant, May 2017)

Switzerland, which had the highest per-GDP concentration of Global 2000 companies in target technology sectors, was second in triadic patents. Israel, which ranked fifth in the concentration of companies, ranked fourth on patents. Canada, with a significantly smaller number of Global 2000 tech companies, was ranked 15th on the per-GDP concentration of Global 2000 tech companies, and 14th on patents.

Although this approach may have some shortcomings, there is still a correlation of .7 between a country's ranking in the number of Global 2000 companies and its ranking in triadic patents. This means that 70% of the patent results are explained by the heft of the multinational corporations headquartered in a country, a satisfyingly high correlation between these factors.

When put together, all of these studies and data suggest that economic success in countries and in cities goes beyond small business and entrepreneurship rates and is driven through the production of world-class businesses that compete on the global stage. That leads naturally to the question: how good are we at creating world-class companies from smaller ones?

# Canada's Record at Company Creation

In order to determine how effective we are at creating world class companies we developed a funnel of those companies with this potential. Based on our analysis of revenue growth, employee growth, and financing in public and/or private markets, we identified businesses with the potential to grow to world-class size, if they were to maintain their growth trajectories (Plant, March 2018). For inclusion on this list, the company had to have:

- public capital above $10 million and revenue above $1 million with revenue growth rates above 20%, or
- private capital above $10 million, with at least 30 employees and employee growth rates above 30%.

In total, we identified 50 Canadian companies that had met these criteria by the end of 2017. This represents 12% of all of the 423 Canadian companies with more than $10 million in capital (for reference, see Plant, March 2018).

While 50 companies with world-class potential may seem like a good number we must compare that to other countries. To do this we looked at how Canada stacks up against other major regions in the world in terms of starting and scaling companies. (We calculated the rate of Startup and Scaleup per 1 million population. Companies below $10 million in acquired capital are considered to be starting, while those with above $10 million are scaling.) We found some promising as well as weak points for Canada's high-tech industry when using the US, the UK, France, and Germany as comparator jurisdictions (Exhibit 6).

- We have a higher startup rate than Germany and France but trail the UK on the same metric.
- We have a rate of startup and scaleup that is dramatically lower than the US and, in particular, the states of Massachusetts, California, New York, Pennsylvania, Illinois, and Georgia.
- We lead all European jurisdictions in terms of scaling rates. Although Canada dramatically trails the US in the creation and scaling of private companies, we have surpassed major European countries in the number of late-stage or established companies.

Exhibit 6
**Worldwide Startup and Scaleup Rates**

| Stage | Capital | Canada | US | UK | Germany | France |
|---|---|---|---|---|---|---|
| | | | | | | |
| Companies per 1M pop | | 68.62 | 151.83 | 84.01 | 23.46 | 35.52 |
| | | | | | | |
| Scaling | Over $10 M | 9.66% | 15.59% | 5.93% | 6.64% | 6.59% |
| Starting | Under $10 M | 90.34% | 84.41% | 94.07% | 93.36% | 93.41% |

Source: CB Insights

The subject of scaling of technology companies is our current national obsession. The narrative typically involves talking about how Canada is good at creating technology companies but how it often fails to scale its promising businesses to a world-class size. Our research suggests, however, that our challenges go beyond size or scale alone, and also involve market development and the creation of companies that are financially attractive to investors.

# Market Size

The first challenge in creating world-class companies relates to the size of the markets we choose to enter. Research-intensive and globally competitive technology companies are currently found in four major markets: life sciences, automotive, hardware and electronics, and software. For the most part, these companies serve either consumer markets or markets that focus on both consumers and businesses. Leading Canadian technology companies do not have the same focus on consumers (for further details, refer to Plant, March 2017).

While world-class life science companies have been created in many countries through the development and acquisition of novel therapeutics, Canada's focus has not been on therapeutics. Three of Canada's leading life science companies are in generic drug manufacturing with four more operating in the medical marijuana market.

In addition to life sciences companies, leading research-based companies worldwide are often found in automotive markets. While we have an auto industry, we are a "branch plant economy" and do not benefit from a locally developed industry. While many new companies are now being formed worldwide to develop cars and trucks from novel automotive technology, none are located in Canada.

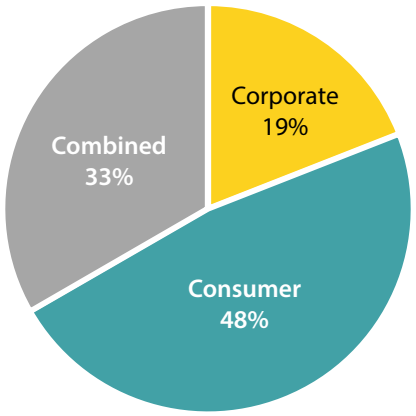
A third area for the development of world-class companies is in electronics and hardware. Companies like Samsung and Apple have developed successful international businesses out of proprietary technology. While Blackberry was a world leader in this market and may emerge again as dominant through the supply to the auto market, we have not created many homegrown businesses focusing on consumer electronics or hardware.

That leaves us with the software market. The markets served by those companies can be broken down into consumer-based, enterprise-based, or a combination of the two. Data from the US and China show the following patterns:

1. The largest new public software companies in the US and China are consumer-oriented, or serve both consumers and enterprise customers.
2. The "best" 21 venture capital (VC) deals worldwide (those with the highest returns) struck in late 2017 have centered largely on consumer-based businesses (Exhibit 7).
3. The top US and Chinese Unicorns are mainly consumer-based companies.

Exhibit 7

**Companies with the Highest Venture Capital Returns by Customer Segment**




Source: CB Insights

While Canada has many locally developed software businesses, we struggle to turn them into world-class contenders. Canadian software companies are typically in enterprise and small- and midsize business markets. However, when it comes to markets, size matters—and the number of consumers that exist as potential buyers means that consumer markets are poised to be larger than enterprise markets. Thus, software companies started in consumer markets are likely to be larger than companies started in enterprise markets.

Overall, our analysis suggests that Canada is not creating research-focused technology businesses that serve large numbers of consumers—and this is observed across the life sciences, automotive, electronics, and software industries. There are several potential explanations for this:

1. We do not start consumer-based businesses.
2. We start them but fail to finance them adequately.
3. We do not do a good job of growing them to world class.

If Canadians wish to create larger companies, they may be well advised to start building companies that serve consumer markets rather than business markets while financing their growth to help them overcome commercialization challenges unique to these markets.

**If we want to create world-class companies, we need to create them in world-class markets.**

This is what Blackberry did exceptionally well. They built a company that served consumers and businesses and gave it enough fuel to become globally competitive. We have done it before, and we will have to devise appropriate strategies to boost our current track record.

# Patents

When blended with other metrics, patents are thought to be an effective measure of a country's ability to convert knowledge into novel inventions that allow it to reap the commercial benefits of the newly protected intellectual property (IP).

## Canadian Patents in the US

Canada's success in obtaining patent grants in the US has improved by 143% over the last ten years. The number of patents with one or more Canadian inventors climbed from 3,661 in 2005 to 8,903 patents in 2015, placing us eighth on a per-GDP basis against competitor countries in 2015 and in terms of our growth rate over 10 years.

However, of the patents granted to Canadian inventors by the US Patent Office (USPTO) in 2016, 58% were assigned to companies domiciled in other countries. This is up from 45% in 2005. This means that Canada earns a return through commercialization for less than half of the patents granted in the US to Canadian inventors. Therefore, Canada's critical issue is not an inability to turn invention into innovation. Our challenge is to ensure that Canada retains some of the economic and social benefits from our innovation activities. (Refer to Plant, May 2017 for the full report discussing this "patent puzzle".)

## Role of Leading Canadian R&D Firms

Of the top 50 R&D spenders in Canada in 2015, 17 were subsidiaries of foreign companies (including Ericsson, IBM, Cisco, and PMC Sierra). The subsidiaries represented 32% of all patents granted in the US to the 50 leading Canadian R&D firms. However, 96% of the patents granted to the foreign subsidiaries were assigned to parent companies in another country.

Subsidiaries of foreign companies conducting R&D in Canada are also eligible for a scientific research and experimental development (SR&ED) tax credit equal to 15% of eligible expenditures (subject to stringent rules). But if the benefits of Canadian R&D are transferred to other countries through patenting practices, are Canadian taxpayers subsidizing research whose long-term impact is felt elsewhere?

Having determined that we are, as a country, filing and maintaining ownership of US patents at the same rate as other major countries we sought to determine whether the lack of patents is reducing our potential to grow world class companies or whether the lack of world class companies is reducing the number of patent filings. This chicken and egg question is critical in the development of sound governmental policy.

To determine an answer, we asked a series of questions:

1. Do Canadian tech companies file fewer patents than US firms?
2. Is patenting a key strategy for Canadian firms?
3. For those filing patents, are Canadian firms as aggressive as their industry peers in other countries?

## Do Canadian Tech Companies File Fewer Patents Than US firms?

One thesis is that Canada's leading tech companies are falling behind in the race to obtain patents. To examine this issue, we used CB Insights' list of 147 US Unicorns and compared their performance in patent activity to Canada's leading tech companies as featured on the Narwhal List. To measure patent activity, we used the USPTO to determine the number of patents where each of these companies is registered as the assignee. US patents are a much better measure than Patent Cooperation Treaty (PCT) filings since it is generally recognized that US patents have the highest jurisdictional value in the world.

The average US Unicorn in our study has raised $759 million while the average Canadian Narwhal has raised $104 million. To make the comparison fair, we calculated the rate of patenting per $100 million of capital raised. This helped ensure comparison of patent filings across companies with comparable capitalization.

The resulting numbers, shown in Exhibit 9, were surprising. In fact, Canada's leading firms receive more patents per $100 million of capital than American firms do. Leading Canadian tech firms do not appear to be lagging US firms at the rate of patenting and are even filing at a 26% higher rate. This would imply that are lack of world class companies is not the result of a failure to patent but that our failure to patent is as a result of too few world class companies.

Exhibit 8
**Patenting Rates**

| | Number of Patents (per $100 million capital) |
|---|---|
| US Unicorns | 3.03 |
| Canadian Narwhals | 3.81 |

Source: USPTO

## Is Patenting a Key Strategy for Canadian Firms?

It is necessary for Canadian tech companies to strategically think through their IP strategy, both from a commercialization viewpoint as well as from the perspective of patent filings. But these are two distinct processes, and many tech companies legitimately decide not to pursue any patents (think WeWork, Bird, and Instacart).

Exhibit 9 lists (by percentage) the substantial number of companies among US Unicorns and Canadian Narwhals that have no patents filed to date.

Exhibit 9
**Patenting Rates**

| | Percentage of companies with no patents |
|---|---|
| US Unicorns | 46% |
| Canadian Narwhals | 70% |

Source: USPTO

Given this statistic, one may assume that patenting is not an important enough strategy as there are more Canadian firms with no patents than there are US ones. But one factor that must considered is also the industrial mix. Some companies like Uber may need patents to protect their IP for driverless cars while others such as DoorDash do not. The difference in no-patent rates may also be due to the mix.

And then there is SpaceX with a single patent. In an interview with Business Insider in 2012, Elon Musk was quoted as saying: ""We have essentially no patents in SpaceX. Our primary long-term competition is in China." He also added that patents publications "would be farcical, because the Chinese would just use them as a recipe book." (Musk)

This statistic would imply that Canada creates fewer world class companies due to a failure to patent but this implication may be erroneous due to the mix variable.

## For Those Filing patents, are Canadian Firms as Aggressive as Their Industry Peers in Other Countries?

Finally, we looked separately at those companies that have actually filed patents, excluding those that do not consider patenting a priority. Among those companies actually filing patents, Canadian Narwhals obtain more than twice as many patents as US Unicorns.

Exhibit 10
**Patenting Rates Among Companies Filing Applications**

| | Percentage of companies with no patents |
|---|---|
| US Unicorns | 5.64 |
| Canadian Narwhals | 12.69 |

Source: USPTO and CB Insight

What comes first: "the chicken or the egg"? Do large companies create more patents, or does creating more patents lead to large companies? The analysis appears to point in the direction of large companies creating more patents. For companies that do file patents to protect IP, Canadians have a much higher rate of patent filings per dollar of capital.

If we have a higher rate of patenting it implies that Canadians are not getting the bang for the buck in patent filing, It also implies that size causes patents and not vice versa. If patent volume was a causation of size, we should not expect to see Canadian firms with a higher rate of patenting than US firms and must conclude that size begets patents, not the other way around.

There must be another factor that is inherent in the mix, causing Canadians not to get "the bang for the buck" out of patenting. For that we shall turn next to marketing and sales.

# Marketing and Sales

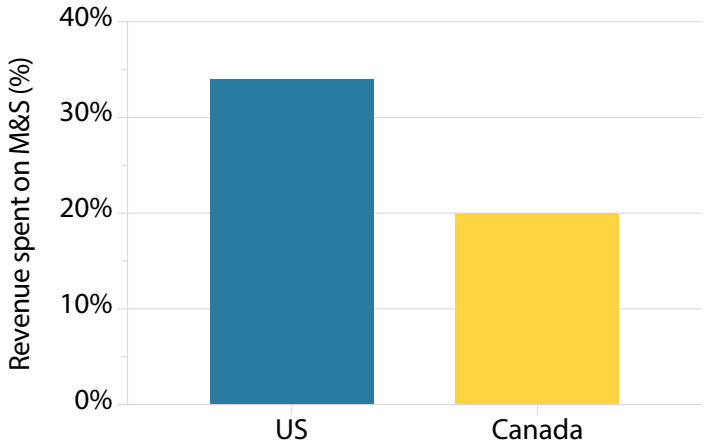
Most definitions of innovation echo a common theme, which suggests that innovation does not stop, as many would believe, at invention, a patent, or product development. For an invention to create value or be implemented in the real world, you need to get that invention accepted in the marketplace and in use by consumers. And the only way to do that is to market and sell the invention so it becomes an innovation. Given this logic, the formula for success in innovation then is as follows:

**Innovation = Invention + Marketing**

Our success as an "Innovation Nation" will depend not only on our ability to come up with novel ideas or inventions but also on our ability to market and sell those ideas. So, how does Canada do in terms of spending on marketing and sales (M&S), particularly when compared to our neighbour to the south?

There is a striking difference in the spending behaviour of Canadian and American firms and their treatment of M&S. While mid-sized US software companies spend, on average, 34% of their revenue on M&S, comparable Canadian firms only allocate 20% of their budgets to those expenditures (Plant, January 2017).

Exhibit 21
**Percentage of Revenue spent on M&S**




Source: Plant 2017

Although marketing and sales are clearly important in getting a technology accepted in the market, the discussion on science and innovation in Canada has paid little to no attention to this part of the innovation formula. Canada also does not have a BERD-like indicator that captures business expenditures on M&S in the technology space.

This neglect of M&S may be one root cause of Canada's laggard innovation performance. We are soft selling innovation and not backing our inventions with appropriate budgets on marketing and sales that are critical to the wider adoption of products and services.

In order for us to become more competitive, Canadian companies must pay more attention to how they market and sell their ideas while policy makers must devise more effective supports that reflect the entire innovation formula—including marketing.

Not only do we spend less money on M&S, many Canadian technology companies wait until their products are completed before raising and spending funds on crucial functions, including M&S (Plant, April 2017). This is disconcerting because early expenditures on M&S may lead to faster market traction, more solid growth, and earlier VC funding. But practitioners in the Canadian technology scene have observed that many businesses underestimate the importance of M&S in their formative years.

To examine this factor, one of our past reports looked at job classifications of employees at over 900 private Canadian technology companies that had received external investments. We could argue that if Canadian firms postponed spending on M&S, we would expect to see no or few employees in M&S roles relative to total employment in the earliest stages of development, followed by a steadily increasing percentage of M&S-related employees as companies grow.

Job classifications were used as proxy to gain insight into how firms allocate money for various functions within the business. We discovered a striking pattern: while Canadian firms with the lowest recorded levels of external funding (our proxy for growth) have only 13% of their employees engaged in M&S activities, this percentage was significantly higher for businesses that had managed to raise funds. Firms with US$50,000–US$2 million of funding have 24% of their employees engaged in M&S. Thus in the early stages of development, Canadian tech firms are likely to have a larger fraction of their workforce dedicated to R&D than to M&S.

A smaller contingent of M&S employees means that less time will be spent on vital startup activities such as market intelligence, product marketing, and business development. Companies that neglect M&S tend to approach the market only when a product is ready, therefore delaying their first revenue and growth.

But how do top technology companies in other countries approach the same issue?

Our analysis of more than 60 tech businesses in the US showed a different recipe for success: firms that scale quickly to US$10 million in revenue spend, on average, 73% more on M&S than on R&D. Leading American firms have 40% of their employees dedicated to M&S.

This is significantly different in Canada where even the highest funded firms only have 31% of their employees in M&S roles. This creates a vicious cycle: fewer M&S employees means less M&S activity, which slows down all the processes needed for customer traction and entry into the market. Such patterns add to the perception that Canadian companies struggle with commercialization and market adoption. They also led us to conclude that, relative to US businesses, there is a striking difference in philosophy about when to approach customers and markets and that perhaps **our technology companies grow more slowly because they do not spend enough on M&S.**

# Financing

The shortage of venture capital (VC) is often cited as a contributing factor to our challenges at growing companies. The reasoning is that since Canada does not have the capital available to fuel late-stage growth, our high-tech companies are sold well before they have a chance to become globally competitive players.

However, statistics show that the claim about too little VC money being available in Canada may not be supported by evidence. To examine this, we looked at Series A Rounds made in Canadian companies during 2018 and used CB Insights' database for our analysis. Their database does not show the amount invested by VC firm by round, but it does show the total dollars invested per round. Their database identifies 265 investor rounds (a round is one investment by one VC firm in one company) and 76 individual companies for whom data could be obtained. The total investment in 2018 was $789 million. The breakdown by the source of funding (i.e. location of VC firm) is shown in Exhibit 13.

Exhibit 13

| VC Firm Location | Number of Rounds |
|---|---|
| Canada | 100 |
| US | 86 |
| Foreign | 36 |
| Angel | 35 |

Source: CB Insights

It was interesting to note that American VC firms invested in almost as many rounds in Canada as did Canadian firms. In fact, there were 22% more investments by US and foreign firms than by Canadian VCs in Canada. In fact, in terms of number of VCs investing, there were more Americans and more than twice as many US and foreign firms investing in Canada than there are Canadian firms.

This data paints a different picture of the Canadian investor landscape than is normally seen. There is funding available in Canada, but the funding is derived from sources beyond our borders.

- Only 18% of the companies financed were exclusively invested in by Canadian VCs.
- About 29% of the companies had no Canadian investors.
- Businesses with no Canadian investors received 2.7 times as much money as those with only Canadian investors.

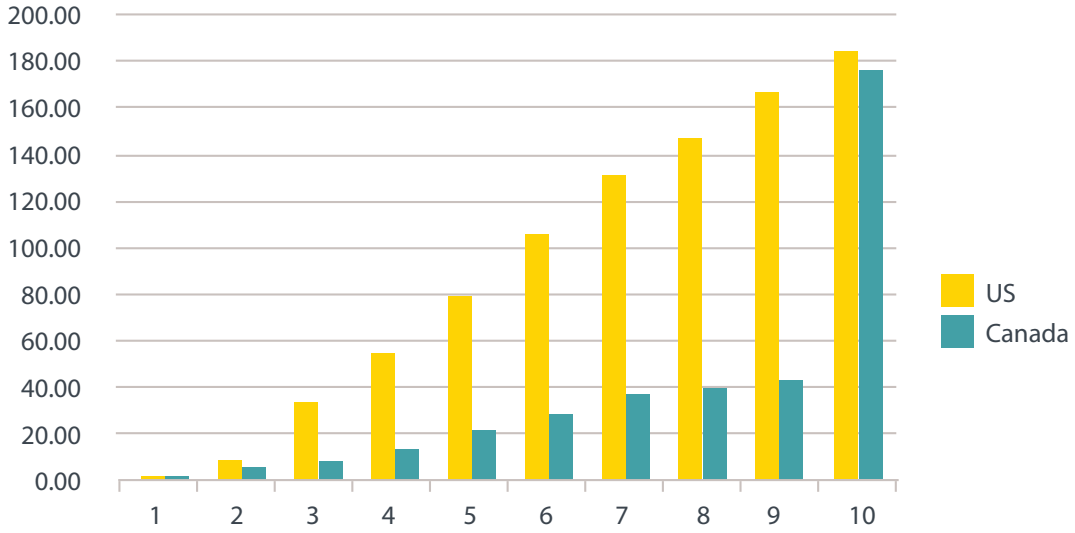
Given this analysis, it is apparent that there is actually money available to Canadian firms, but there may be other competing factors that affect the level of financing here. To start, we looked at the fundraising patterns of Canadian companies.

We looked at 49 private US companies that had received between $100 million and $295 million in VC funds since inception (Plant, February 2017). We compared them to 49 of Canada's largest funded tech companies that had attracted $30 million to $250 million in VC funds per firm. The data revealed three critical issues:

1. Canadian companies wait longer before they start raising funds.
2. They raise funds less often.
3. They raise less money over time.

These fundraising patterns demonstrate remarkable differences between high-tech firms in North America. What US companies raise in four years, Canadian companies take ten years to raise (Exhibit 14). US companies (in this study) had six times the capital on hand to spend in their first five years of existence on critical functions, such as marketing and sales, which contribute to growth and long-term sustainability. The result is that, starved for funds, Canadian companies grow at a 47% compound annual growth rate (CAGR) while US firms grow significantly faster, at a CAGR of 63%.

Exhibit 14
**Cumulative Funding**




Source: CB Insights

When put together, these funding trends create companies that do not look attractive from an investment perspective, lending validity to questions such as "Why would a US VC who is willing to locate offices in Europe, China, or India relocate to Canada to invest in slower-growth companies?" or "Why wouldn't a Canadian VC sell a company that cannot get sufficient capital to compete globally?"

These fundraising and investment patterns over time have given Canada the unflattering label "farm team", a term that clearly suggests we sell our companies to other countries before they reach global status and scale.

But even though innovation centres, accelerators and provincial and federal governments have shifted their focus from starting to growing companies and to programs to support the scaling of startups and small- and medium-sized enterprises, it may be too late. By the time Canadian companies need late-stage capital, their historically slower growth rates have already made them less appealing to investors used to dealing with quickly growing businesses.

The lesson for business advisors, policy experts, and government agencies involved in scaling Canadian firms is that we must encourage smaller companies to start raising money earlier, more often, and in larger amounts. This way firms can spend more money on critical functions such as M&S and R&D and position themselves as attractive investment opportunities to fuel further growth.

# Creating Unicorns

As a tech company matures, it can grow through the acquisition of private funding or undertake an initial public offering (IPO) to access public funds. With the increasing availability of private capital in recent years, firms are staying out of public markets longer. As a result, many of the world-class companies that are created eventually transition to "Unicorn" status (defined as private companies with a market value of above $1 billion).

## Global Ranking

Canada is challenged to create Unicorns. While we might not be able to produce on a pro-rata basis at the same pace as the US, we could use some of the less populous countries as a potential benchmark, putting us closer to a target of 5–10 Canadian Unicorns at any point in time. To keep pace with comparable jurisdictions Canada should be able to produce at least two new Unicorns every year (Plant, January 2019).

What is highly disappointing is that Canada has yet to produce a Unicorn since Kik Interactive became one in August 2015 nearly four years ago. In fact, since Kik became a Unicorn, 19 US companies were founded and became Unicorns.

If the growth of a Canadian tech company to a globally competitive business can be captured as a progression from startup to Narwhal to Unicorn to IPO, then the next question becomes: what would it actually take for our Narwhals to become Unicorns? To answer this, we can perhaps look to the US for some hints.

Although the average US Unicorn is 1.5 years older than the average Narwhal, it has an average financial velocity of $98.9 million per year (meaning that, on average, these firms have raised an astounding $98.9 million per year since inception). Taking out Uber and JUUL Labs as obvious outliers that have amassed substantially larger funds, the average financial velocity for the top 50 Unicorns is still a remarkable $81.6 million per year (compared to the Canadian Narwhal average of $14.6 million per year).

Exhibit 15
**Comparison of Financial Velocities**

| | 2018 (millions of $ per year) | 2017 (millions of $ per year) |
|---|---|---|
| Unicorn | 98.9 | 93.7 |
| Narwhal | 14.6 | 9.4 |

Source: CB Insights

If Canada's objective is to create more world-class companies from the tech sector (as envisioned by the federal government, and particularly Innovation, Science and Economic Development Canada), then one step on the road may consist of creating more Unicorns.

Since the lowest-ranked US Unicorns (the ones with valuation of $1 billion) are closest in size to Canadian Narwhals, they may provide instructive examples on what is actually needed to reach that point.

We took a closer look at 34 US-based Unicorns with a valuation of $1 billion, the minimum amount needed to become a Unicorn.[1] Collectively, these companies have raised an average of $275 million. Of these, there are 21 US Unicorns with a financial velocity of $10–33 million per year.

Canada has 28 Narwhals with a financial velocity in that range. In fact, this is up dramatically from the 18 that were at this level last year and the 10 that were in this range the year before. This means that we are making some progress in our ability to scale companies. Because of the way companies are valued for venture capital purposes, if each of these companies can maintain this rate of capital acquisition, they all have the potential to become Unicorns in the near future.

These results point to a sense of cautious optimism in Canada's technology space. Although we have made significant progress and have continued to leverage our investments in startups and incubation, our analysis suggests that we have significant work ahead of us. For example, while the 28 Canadian firms with a financial velocity of $10-33 million per year have raised, on average, $140 million in 2018 (up from $105 million in 2017), American Unicorns have accumulated nearly double that amount in the same timespan: $275 million per firm in 2018, up from $202 million in 2017.

Based on these numbers, one can argue that to turn 28 Narwhals into Unicorns, they must raise another $135 million (on average) at valuations that would qualify them for entry into the Unicorn Club. The sheer difference in scale between investments available to technology firms here and the US is a stark reminder that we have to be significantly smarter about how we nurture and invest in Canadian technology companies.

Even as Canadian Unicorns continue to grow and eventually go public, the challenge is not to lose sight of the whole pipeline. We have to continue to produce a steady stream of startups that can grow and have all the supports necessary to become members of the exclusive Narwhal List and Unicorn Club.

1 Although there were actually 38 businesses with a valuation of $1 billon, we eliminated four businesses from our analysis as they were considered outliers.

# The Role of VCs

Venture capital is a critical piece of a healthy innovation system. Investments timed correctly can propel a fledgling company to new heights. But VC is inherently risky, and making the right investments in the right company involves carefully considering a number of factors, including growth potential, technology type, and deal sizes.

Canadian VC deal sizes continue to lag those in other countries. Canadian venture capitalists invested $3.2 billion in 530 deals for an average deal size of $4.9 million in 2016. Meanwhile, American VCs invested $69.1 billion in 8,136 deals for an average deal size of $8.5 million (refer to Plant, September 2017 for full details).

Canadian VCs made a strategic decision to invest the way they did as they could just as easily have chosen to invest an average of $12.3 million in 260 companies. But do the smaller deal sizes result in smaller returns?

While deal sizes remain smaller in Canada, our rates of return have always been significantly lower than those in the US. The 10-year internal rate of return for Canadian VCs now averages 4 and, in fact, this return has only been positive for the last several years.

But is there an "ideal" deal size? Is it possible to correlate the amount of investment a firm receives with its growth rate? By investing in smaller deals, are Canadian VCs inadvertently throttling the growth of Canadian companies, limiting their potential returns, and creating an ecosystem where it is difficult to get late-stage financing that is sufficient to create world-class companies?

Was the decision they made to invest in smaller deals correct, or is it possible that by choosing to invest this way, Canadian VCs have become the architects of their own misfortune?

To shed light on the subject, we looked at the investments of over 350 public technology companies, 90 Unicorns, and 147 other US companies that obtained VC financing in July 2017 and compared that to 131 Canadian companies backed by venture capital. We looked specifically at capital funding per employee and growth rates as measured by revenue for public companies and by employee growth for private companies. The data showed us that:

1. Unicorns have the highest funding on a per-employee basis.
2. California-based companies have the next highest rate of funding per employee.
3. US-based companies outside California follow next in the rankings.
4. Canadian companies ranked fourth in funding per employee.
5. Compared to Unicorns and other private companies, public technology firms have the lowest funding per employee and the lowest average growth rates.

These results suggest that the amount of funding provided by the VC industry in Canada is substantially below that provided in the US on a per-capita basis. But does this matter? The results of our research suggest two closely related trends:

1. The more funding a company has, the faster it grows.
2. The faster a company grows, the more funding it can get.

This is why the rich get richer in the VC world. California-based companies that get higher levels of per-employee funding grow faster than companies in the rest of the US. As a result, these companies tend to grow quickly and turn into Unicorns, creating a dynamic where California boasts a disproportionate share of total VC funding. Since the funding leads to growth which leads to more funding formula is deeply embedded and well understood in the Silicon Valley culture, they are significantly more successful.

With funding levels well below that of their US-based competitors and other jurisdictions, Canadian companies tend to get left behind. Consequently, our companies do not grow as fast, do not attract later-stage capital, and are typically sold before they can be turned into world-class companies.

Unless Canadian VCs start funding companies at levels on par with those seen in the US and particularly in California, we will continue to experience lower growth rates, the earlier sale of companies, and lower VC returns.

# Initial Public Offerings

Over the last four years, there have been substantial changes in IPOs in the software world. Firms tend to wait longer to go public, while raising larger late-stage private rounds and eventually experiencing high public market valuations. We wanted to take a closer look at this trend with the objective to gain some insights into current practices. To that end, we looked at the results of 58 software companies that have gone public in the US since 2013 (Plant, March 2019).

The data suggests that the average gestation period for firms pursuing an IPO has increased from just over eight years to about 12 years, resulting in a 50% increase in the time firms stay private before going public. The average revenue of the firms at the time of the IPO has increased from under $100 million to over $300 million. As a result of this change, there has been a dramatic increase in the capitalization of these firms, both before and after going public.

Firms have discovered that incurring high losses through expenditures, especially on activities related to sales and marketing, is driving growth. The emphasis on growth has also driven higher stock valuations and made these capital investments worthwhile for venture capitalists. It remains to be seen whether these high valuation multiples will survive any shocks to the stock market as this dynamic has fuelled increased investment by VCs into private firms.

But what this new dynamic means for Canadian companies more generally is that firms should consider raising money as early as possible and should also develop the habit of raising funds more frequently. Firms should also not be discouraged by losses and should even expect to lose considerable amounts in order to drive growth.

Our report released in March 2019 also attempted to show the economics of scaling software companies. Fundamentally:

- The amount of capital you raise dictates
- how much you can incur in losses which
- fuels spending on marketing and sales in order to
- increase your revenue growth rate which will
- generate a high revenue multiple in order to
- earn a healthy return to the investors that provided the capital.

# Conclusions and Implications

In summary, what we have found from our research is that:

- Canada is challenged at creating large world-class technology companies
- Few Canadian companies are founded in large consumer markets.
- We invest less per company than they do in the US.
- We not derive returns commensurate to our efforts at patenting
- Canadian firms spend less on marketing and sales.
- We have fewer qualified people in marketing functions.
- Canadian firms receive lower levels of financing, later in their development

The ongoing underinvestment and underspending result in lower growth rates for Canadian tech firms relative to their US peers. Fundamentally then, Canadian firms do not look as attractive as potential investments due to slower growth. Because of this they do not attract large amounts of late-stage capital and they get sold before they can grow to world-class size.

We have a choice. We can either agree that Canada has too many structural challenges to contemplate a substantial increase in the number of world-class companies. We can agree that this is a great place to live and that we should not be too concerned about lower productivity, patenting, and income. If that is indeed the case, then perhaps we should not be spending so much on government programs to boost the innovation economy.

However, if we choose to improve R&D, patenting, productivity and income per capita then we need to create faster growing, more attractive tech companies. To do this we must:

- encourage companies to enter larger markets,
- fuel their growth with more capital especially in earlier stages,
- hire M&S personnel in markets they serve, not only stationing them in Canada,
- encourage them to adopt a strategy of large losses to fuel growth,
- and focus an appropriate portion of spending on marketing and sales.

We need government programs and policies that support the creation of faster growing larger tech companies that stay and grow in Canada. Fundamentally, we need a renewed conversation about growth and globally competitive companies, if we are to be successful as a nation in the innovation economy.

# Methodology

This report examines data and conclusions from a series of past Impact Briefs. Details on methodology can be obtained in each of the reports. In many cases, data were obtained from sources such as CB Insights, Crunchbase, OECD, and the US Patent Office

This study was not intended to be academically rigorous, nor was it intended to be all-encompassing about the topic. It was designed only to add to the conversation on innovation and highlight areas worthy of future research by looking at data available from publicly available sources. We plan to complete further research on this subject in the future.

# References


Henrekson, M. and Sanandaji, T. (2014) ***Small Business Activity Does not Measure Entrepreneurship.*** Proceedings of the National Academy of Sciences, 111, 1760–65.

Musk, E. https://www.businessinsider.com/elon-musk-patents-2012-11.

Plant, C. R., ***The Path to IPO: Insights from 58 software IPOs since 2013.*** Impact Centre, University of Toronto, March 2019.

Plant, C. R., ***The Narwhal List 2019: Another Year of Progress in Canada's Tech Community.*** Impact Centre, University of Toronto, January 2019.

Plant, C. R., ***Measuring Canada's Scaleup Potential: A Framework for a National High-Tech Funnel.*** Impact Centre, University of Toronto, March 2018.

Plant, C. R., ***Creating World-Class Companies: Do Canadians Start Businesses in World-Class Markets?*** Impact Centre, University of Toronto, March 2017.

Plant, C. R., ***The Rich Get Richer: Are Canadian VCs Inadvertently Limiting Their Returns?*** Impact Centre, University of Toronto, September 2017.

Plant, C. R., ***Canada's Patent Puzzle: Do we Have a Problem With Securing Patents or With the Commercialization of Them?*** Impact Centre, University of Toronto, May 2017.

Plant, C. R., ***Canadian Tech Tortoises: Is a Lack of Spending on Marketing and Sales Delaying Fundraising?*** Impact Centre, University of Toronto, April 2017.

Plant, C. R., ***A Failure to Scale: Are We Creating Financially Unattractive Companies?*** Impact Centre, University of Toronto, February 2017.

Plant, C. R., ***A Nation of Soft Sellers: Do Canadian Tech Companies Underperform Due to Marketing and Sales?*** The Impact Centre, University of Toronto, January 2017.

# About the Impact Centre

## Science to Society

We generate impact through industry projects and partnerships, entrepreneurial companies, training and research.

We bridge the gap between the university and industry to accelerate the development of new or improved products and services based on physical technologies. We work with graduate students and researchers to help them commercialize their discoveries. We provide undergraduate education and training for students at all levels to ease their transition into future careers.

The Impact Centre conducts research on all aspects of innovation, from ideation and commercialization to government policy and broader themes such as the connection between science and international development. We study how companies of all sizes navigate the complex path between a discovery and its market and how their collective innovations add up to create a larger socioeconomic impact.

Our objective is to understand how we can improve our ability to create world-class technology companies, how governments, companies, and academia can identify and adopt best practices in technology commercialization.

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