An Impact Brief
March 2018

Measuring Canada's Scaleup Potential

A Framework for a National High-Tech Funnel

IMPACT CENTRE
SCIENCE TO SOCIETY

UNIVERSITY OF TORONTO

Contents

Measuring Canada's Scaleup Potential

"We have made significant progress in the last 10 years but the data show clearly that we have further work to do."

The purpose of this report is to provide a data-driven approach to gauge Canada's progress in developing a successful technology industry, one that is marked ideally by a high rate of startup creation, company growth, and ability to compete in global markets.

To understand how Canada fares, we used the notion of a 'funnel' in our analysis to 'measure' where companies are situated in Canada's innovation pipeline, from the startup to world-class stage. We established a funnel with five stages and later combined these into two stages for the purposes of comparison with other jurisdictions. We define an 'earlier-stage' company as one with cumulative financing of less than $10 M and a 'later-stage' company as one that had received more than $10 M in funding.

We looked at the performance of over 2,600 technology companies in Canada, paying particular attention to 423 businesses with over $10 M of capital. We measured the companies' relative position in the funnel to get a sense of how Canadian firms are progressing.

Based on additional analysis of revenue and employee growth and financing in public or private markets, we identified businesses with the potential to grow to world-class size, but only if they maintain current growth trajectories. For inclusion on this list, the company had to have:

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

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 above $10 M in capital.

Our analysis also looked at how Canada stacks up against other major regions in the world (the US, the UK, France, and Germany). We found some promising as well as weak points for Canada's high-tech industry.

- We have a higher startup rate than Germany and France but trail the UK on the same metric.
- We lead all European jurisdictions in terms of scaling rates.
- We report a rate of startup and scaleup that is dramatically lower than the US and, in particular, Massachusetts, California and New York.
- We have lower rates of both startup and scaleup than Pennsylvania, Illinois, and Georgia.

While the emphasis of this report is on our ability as a jurisdiction to scale companies, we must note that there is a tremendous opportunity to improve the number of startups we generate. Although we have made significant progress in the last 10 years, the data clearly show that we have further work to do. While we tend to look to California as the 'gold standard', it may perhaps be more instructive to compare ourselves with New York and particularly Massachusetts, which has one of the best track records for company creation and scaling.

A Framework for a National High-Tech Funnel

This Impact Brief promotes the development of an evidence-based approach to gauging our success at starting and scaling companies. The purpose of this research is to measure the rate of startup and scaleup in Canada and compare that to jurisdictions worldwide. Our work is based on publicly available data that any government, business or individual can access at low cost. We intend to replicate this study annually as part of a long-term benchmarking exercise.

One of the objectives of this report was to develop metrics that could show at any point in time not only how a business performs in terms of its ability to scale but also how Canada as a whole is faring. In order to show where a company is situated relative to its peers, we made use of the concept of a 'high-tech funnel'. The notion of a sales funnel is typically encountered in discussions at the company level; it can show the management and sales teams where prospective or existing customers are currently in terms of engagement. Thus, companies can track customers as they proceed through the stages of the sales funnel, from awareness to purchase to after-sales servicing.

Similarly, we should be able to track companies as they move through Canada's technology funnel, from inception and scaleup to globally competitive markets. We should also be able to measure the funnel and therefore gauge not only the progress of each company, but also the general system for innovation in Canada. Such a data-driven framework would help innovators and the wider innovation ecosystem identify areas of the funnel on which efforts should be concentrated to build a more effective technology pipeline.

In order to develop such a funnel for Canada, we divided more than 2,400 Canadian companies into stages of the funnel according to the amount of capital acquired. Categories that range from inception/startup to world-class status proved particularly useful (refer to Table 1).

Funnel Classifications

Table 1

Stage	Capital Raised
World Class	Over $1 B
Scaling	$100 M – $1 B
Growth	$10 M – $100 M
Emergence	$1 M – $10 M
Startup	Under $1 M

To construct Canada's technology funnel, we used statistics available from CB Insights for private companies and individual financial statements for public companies (all obtained at the end of December 2017). Statistics were recorded for all companies that are currently active (i.e. not sold or out of business) across a range of industries (internet, healthcare, software, mobile and telecommunications, computer hardware and services, and electronics). Table 2 shows the number of companies that had received financing divided along the various stages of the funnel.

Canada's Technology Funnel

Table 2

Stage	Capital raised	Number of Public Companies	Number of Private Companies	Total Companies
World Class	Over $1 B	11	0	11
Scaling	$100 M – $1 B	47	15	62
Growth	$10 M – $100 M	132	218	350
Emergence	$1 M – $10 M	44	510	554
Startup	Under $1 M	3	1,669	1,672
		237	**2,412**	**2,649**

Two caveats regarding these numbers should be explained. First, the data are probably more accurate for larger companies than smaller ones because CB Insights may be more likely to miss recording funds from smaller companies that are not as widely reported. Second, the failure of firms is not generally reported; so CB Insights may include firms that are no longer in business. This could lead to over-reporting across categories. But since these data gaps would affect numbers for all jurisdictions, the numbers can be used as good general guides when doing cross-country comparisons.

We have further divided the number of private companies by province to see the funnel in selected regions in Canada (Table 3).

Private Company Capitalization

Table 3

Stage	Capital	Canada	Ontario	Quebec	BC	Alberta
World Class	Over $1 B	0	0	0	0	0
Scale	$100 M – $1 B	15	9	2	3	0
Growth	$10 M – $100 M	218	113	38	39	7
Emergence	$1 M – $10 M	510	237	90	94	28
Startup	Under $1 M	1,669	685	259	283	97
		2,412	**1,044**	**389**	**419**	**132**

One can also compare leading provinces on a per-population basis as in Table 4.

Private Company Capitalization Per Population

Table 4

Stage	Capital	Canada	Ontario	Quebec	BC	Alberta
Population (in thousands)		35,151	13,448	8,164	4,648	4,067
World Class	Over $1 B	0	0	0	0	0
Scale	$100 M – $1 B	0.43	0.67	0.24	0.65	0.00
Growth	$10 M – $100 M	6.20	8.40	4.65	8.39	1.72
Emergence	$1 M – $10 M	14.51	17.62	11.02	20.22	6.88
Startup	Under $1 M	47.48	50.94	31.72	60.89	23.85
		68.62	**77.63**	**47.65**	**90.15**	**32.46**

Identifying High-Potential Firms

Equipped with the general funnel classifications described in the last section, we then used two growth rates that could be used to identify high-potential companies.

1. Revenue Growth

   Metrics like revenue growth are popular as they can produce stunningly high numbers such as those seen in the Deloitte's Technology Fast 50 and Inc. Magazine's annual reports on growth. Such measures tend to favour small companies. In fact, the larger a company, the harder it is to maintain high growth rates. Revenue growth is the best metric to use for evaluating public companies.

2. Employment Growth

   As firms grow, they hire employees to develop or sell products, to create a customer base, and to fulfill a myriad of other critical functions. The faster a firm hires employees, the faster it can grow. This close connection between revenue and employment makes the rate of growth in employment another potential proxy for revenue growth.

   The only issue in using employment numbers as a metric is that the only available source is LinkedIn. We have done tests to determine the accuracy of these employee-reported numbers and found that they report numbers in the correct range for most companies and thus can be a useful indicator of scale and potential.

In evaluating our choices for metrics, we concluded that revenue growth is an effective way to measure company potential for public companies and employee growth is a good proxy for private companies.

We paid close attention to the top three levels of the funnel, which may represent the fastest growing firms based on revenue for public firms and employment for private firms. Based on this, we identified businesses with the potential to grow to world-class size, if they maintain current growth rates. For inclusion on this list, the company had to have:

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

The OECD defines high growth as 20%, so this was the base hurdle we chose. Anecdotal evidence though implies that to achieve world-class status, a firm will need to grow at a rate of in excess of 60%.

Number of High-Potential Companies

Table 5

Stage	Capital	20% - 30% Growth	30% - 50% Growth	Above 50% Growth	Total Number of High-Growth Companies	Total Number of Companies per Stage	High-Growth Companies (% of total)
World Class	Over $1 B	1	0	2	3	11	27%
Scale	$100 M – $1 B	3	3	9	15	62	24%
Growth	$10 M – $100 M	8	7	17	32	350	9%
Total		**12**	**10**	**28**	**50**	**423**	**12%**

Comparative Analysis of Private Company Creation

In order to examine and compare Canada's rate of company creation to other jurisdictions, we split the funnel into two parts. We have arbitrarily classified companies with below $10 M of capital as 'earlier-stage' and companies with over $10 M of capital as 'later-stage'. The following analysis was done only on private companies as obtaining all public company records for such a study was not feasible.

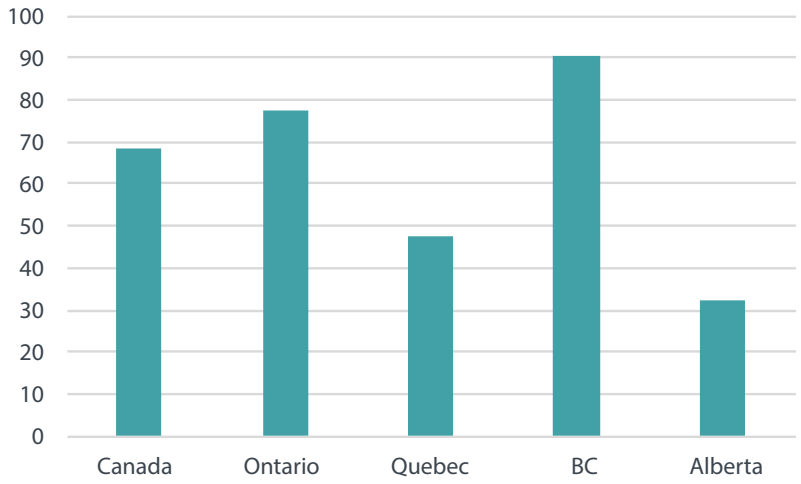
Provincial Comparison

Figures 1 and 2 highlight the number of companies per 1M population and the percentage of late-stage private companies operating in Canada's most populous provinces. While Ontario leads the country in the rate of later-stage businesses, it trails British Columbia in terms of the number of earlier-stage startups created on a per-capita basis. The following charts show how Canada's system is skewed towards earlier-stage companies.

Companies per 1M population – Canada

Figure 1

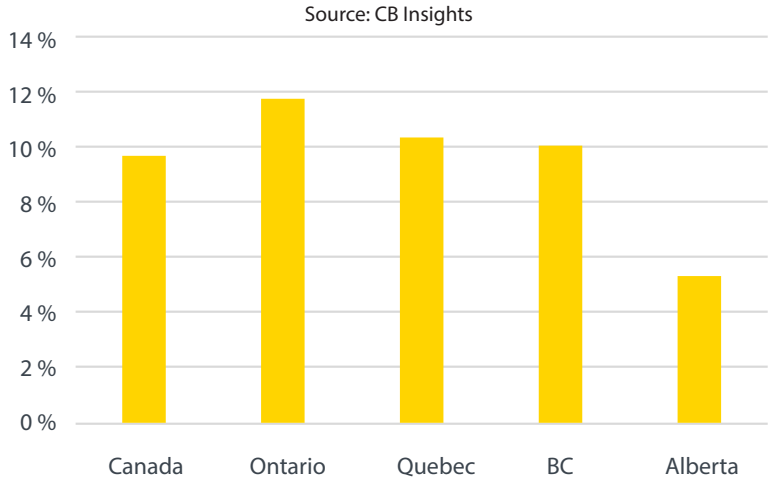
Source: CB Insights



% of Later Stage Companies – Canada

Figure 2

Source: CB Insights



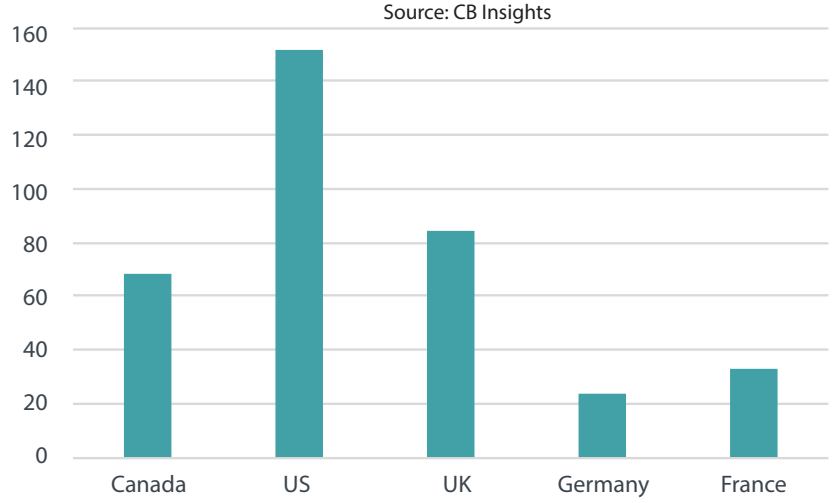
Worldwide Comparison

We can also create a similar funnel for major startup countries in the world (Figures 3 and 4). There may be issues in Europe with data availability due to language of reporting, but the trends in numbers are instructive nonetheless and may prove valuable over time.

Companies per 1M population – Major Countries

Figure 3

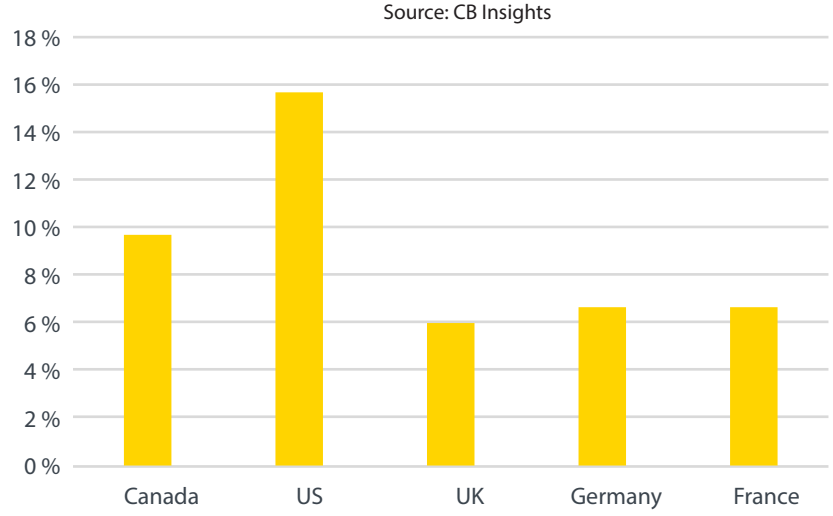
Source: CB Insights



% of Later Stage Companies – Major Countries

Figure 4

Source: CB Insights



Although Canada dramatically trails the US in the creation and scaling of private companies, we lead major European countries in late-stage or established companies. We also trail the UK in early-stage firms.

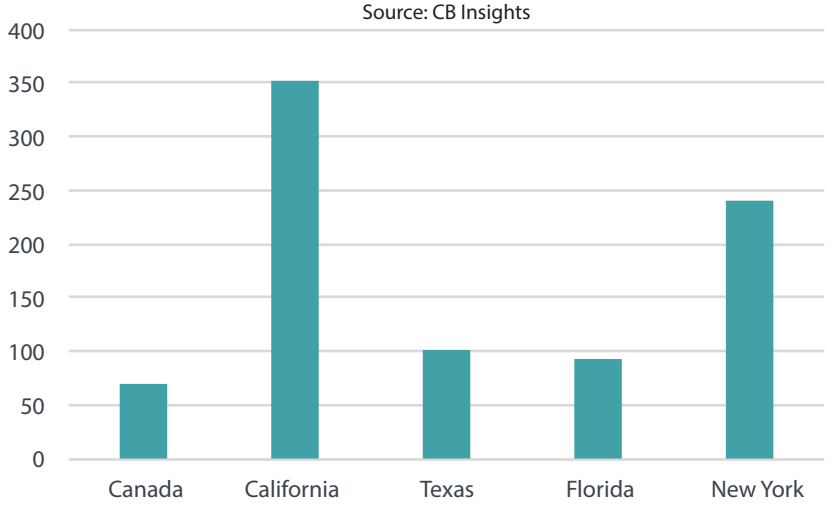
Comparison to Most Populous US States

Comparing Canada to major US population centres shows just how far we need to go to foster world-class companies (Figures 5 and 6). We trail all major US regions in our ability to create private technology companies and trail all but Florida in our ability to turn those companies into firms that can scale.

Companies per 1M population – Canada and Major US States

Figure 5

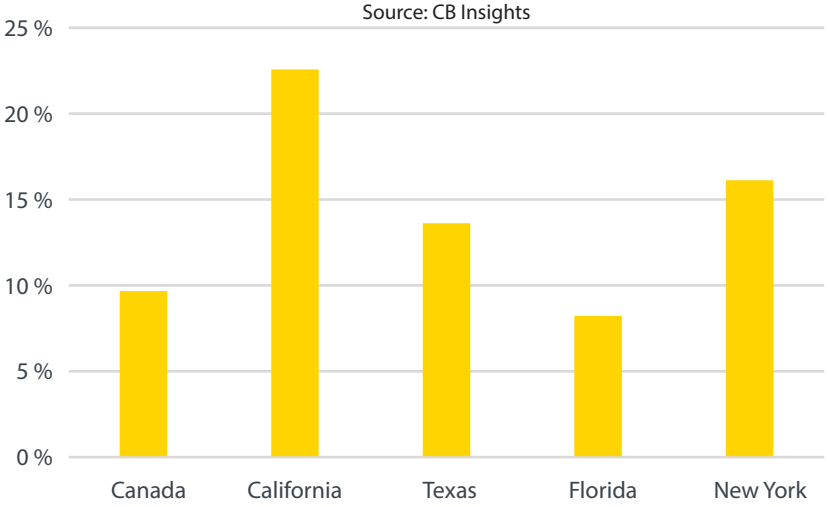
Source: CB Insights



% of Later Stage Companies – Canada and Major US States

Figure 6

Source: CB Insights



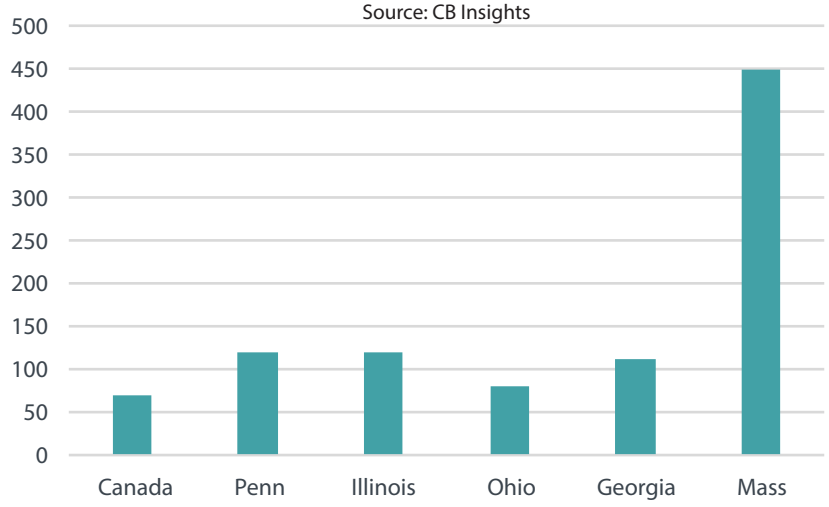
Comparison to Smaller Population States

Finally, we can compare Canada to smaller US states, some with capitals and other cities that are on par with Toronto in terms of population and size (Figures 7 and 8). The numbers clearly show that Canada has both a startup and a scaleup challenge as it trails even mid-size US states in its rate of company creation and only exceeds Ohio in its rate of scaleups.

Companies per 1M population – Canada and Minor US States

Figure 7

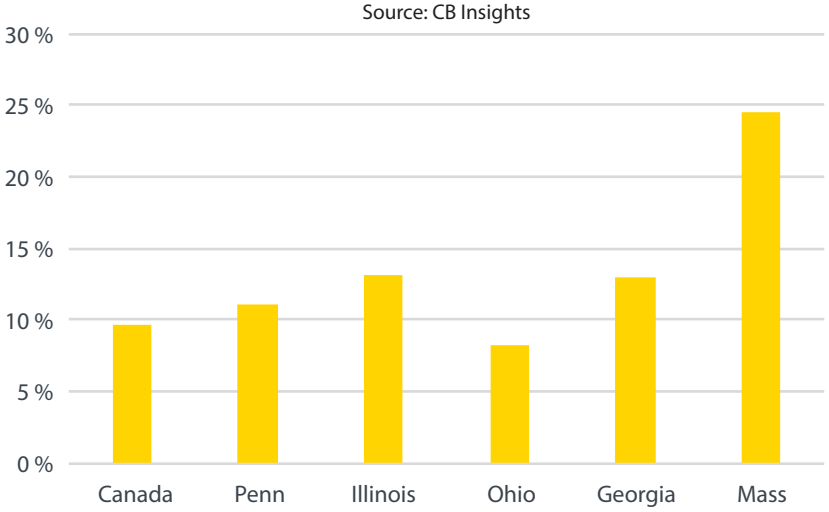
Source: CB Insights



% of Later Stage Companies – Canada and Minor US States

Figure 8

Source: CB Insights



What Have We Learned?

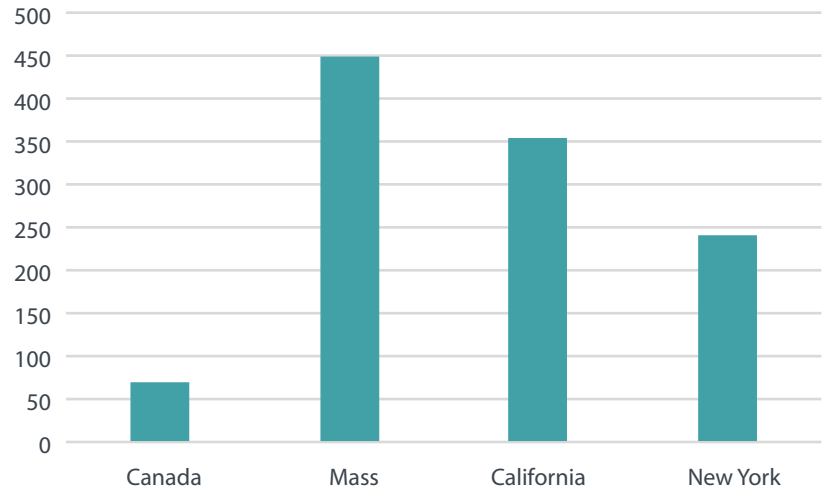
While the emphasis of this report is on our ability as a jurisdiction to scale companies, the analysis points out a tremendous opportunity to improve the number of startups we generate. We have made significant progress in the last 10 years, but we have further work to do.

While we tend to compare ourselves with California, it may actually be just as instructive to compare ourselves with New York and particularly Massachusetts, which has the best record around for company creation and scaling.

Companies per 1M population – Key Competitors

Figure 9

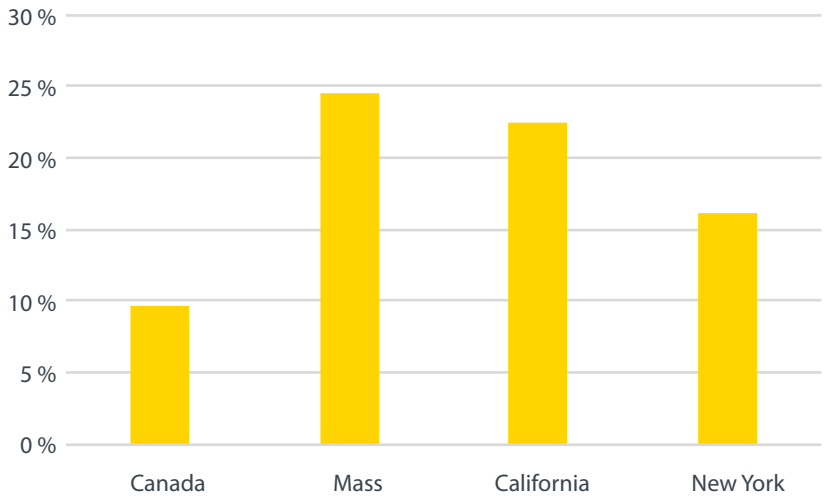
Source: CB Insights



% of Later Stage Companies – Key Competitors

Figure 10

Source: CB Insights



Evidence-based Approach to Innovation Systems

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."

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-252, 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 1963 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, Swedes four times, and the United States over six times as much relative to industrial output . . . .

"It would appear that a target 'research 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, 22 per cent and 68 per cent for the United States and 10, 24 and 82 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

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

ty — about 90 per cent according to some estimates — may be attributed to technological progress."

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, to 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 $27-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 $30-million, and if its expectations are realized, the figure could increase by about 20 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 bonusing 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 re-

This article was written in 1967.

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 the rest of the OECD countries on R&D metrics (e.g. OECD Science, Technology and Innovation Outlook 2016 – Canada Country Profile).

While Canada still struggles with business expenditures on R&D more broadly, our current national obsession relates to scaling technology companies. The narrative on this subject is typically centred on: Canada is good at creating technology companies but often fails to scale them to a world-class size. As a result, both federal and provincial governments have been launching programs and funding mechanisms to grow tech companies. But what we lack is a way to define success and measure progress along the way.

One way to further our understanding of the challenges we face in commercializing technology and deciding what best practices to adopt is to employ an evidence-based approach. We have the opportunity to use data-driven strategies to better understand and improve our ability to scale companies to a world-class level; or to use an example from popular culture: just like the Oakland A's team whose data analysis approach to beat teams with significantly higher payrolls was popularized in the movie Moneyball.

Using data effectively will help in several ways. It will assist CEOs and founders of startups and growing companies answer questions such as:

- How fast should I be trying to grow?
- How much capital should I raise?
- How should I allocate my expenditures to optimize growth?
- How many people do I need to hire?
- What skill sets should they have?

A data-driven approach will also help policy makers:

- debunk myths about scaling, patenting, growth, etc.,
- better understand the issues companies face,
- develop more effective policy tools and frameworks,
- track changes in performance, and
- evaluate policies.

The Impact Centre at the University of Toronto is developing a data-driven approach to determine the root causes of the successes and failures of technology companies in Canada. We are actively using the findings from our research to promote best practices in technology commercialization as well as company creation and growth.

Our research suggests that our challenges are not, as previously thought, only in the areas of patenting, R&D capacity, commercialization, and later-stage financing. Our challenges also involve market development and the creation of companies that are financially attractive to investors.

Our research is discovering new ways of examining activities in the technology industry and discovering new solutions to challenges that have plagued Canada for years. This work is practitioner-oriented and aligns well with policy and economics approaches to understanding innovation such as those that were developed by the Brookfield Institute for Innovation + Entrepreneurship, Startup Genome, and the University of Toronto's Munk School of Global Affairs. It is also complementary to the work done by the Lazaridis Institute for the Management of Enterprises and its use of a survey methodology to understand firm behaviour.

We hope that the analysis presented in this Impact Brief is the foundation for an evidence-based strategy. We hope that we can continue to use this approach to evaluate our progress as a nation in developing a burgeoning technology industry and assess the effectiveness of the many programs created to foster growth.

Methodology

This study looked at the fundraising patterns of technology companies in Canada and the US. Public company data were obtained from Google Finance, and private company data were obtained from CB Insights and LinkedIn. All numbers were collected in December 2017. All amounts are in US dollars.

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.

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.

Impact Briefs

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