An Impact Brief
November 2017

Physical Technologies

Challenges in Obtaining Government Support for Commercialization

IMPACT CENTRE
VENTURE ANALYTICS

UNIVERSITY OF
TORONTO

Contents

Executive Summary

"Whereas in IT and biotechnology, the market can be identified very early in the path to commercialization, in physical technologies one must reduce the technological risk to some extent by the creation of a prototype before testing for market acceptance."

There are many factors that are contributing to Canada's challenge of creating world-class companies. But one of the greatest and most commonly cited challenges is Canada's weakness in the commercialization of inventions.

This Impact Brief examined how the lack of appropriate government programs contributes to this problem. Using scientific research as a starting point, we embarked on a theoretical exercise to examine what support would be available if we chose to pursue the commercialization of specific university technologies.

The first problem we identified is that the way governments classify innovative technologies. Government agencies and strategies typically focus their investments on four main areas: information technology (IT), biotechnology, cleantech and advanced manufacturing. But they omit the classification for physical technologies, which we define as technologies arising from academic research in faculties of engineering and departments of chemistry, physics, earth sciences, and space sciences.

But physical technologies have a much greater impact on the economy of Canada than other sectors:

- They contribute almost eight times as much to Canada's GDP as does the combined effort of the Information communications technology (ICT) and biotechnology industries.
- Industries employing physical technologies substantially outspend traditional ICT and pharma sectors when it comes to R&D.
- Worldwide, leading physical technology companies spend more in total on R&D than either ICT or life sciences, and are granted a significantly larger number of patents.

Physical technologies are distinct from other types of technology because of their commercialization path. Information technologies have a simple and well-known commercialization path without significant technological risk. The risk in IT is usually in market acceptance, and it is possible to obtain private capital to fund development as soon as some market traction is shown.

Life science commercialization is lengthy and costly. There are high technological risks that require substantial testing both of efficacy and potential for harm to get to market. But there is a system in place to support the path from research to market, albeit a complex system that requires companies to go through hoops to access federal and provincial funding, each of which require some matching. In biotechnology, there is often a known market which can easily be assessed prior to commercialization. Thus, much of the risk is technological.

In the physical technologies, there is another long and complex path to commercialization, understood best by the process to take a scientific discovery through the nine different Technology Readiness Levels before market readiness. Whereas in IT and biotechnology, the market can be identified very early in the path to commercialization, in physical technologies one must reduce the technological risk to some extent by the creation of a prototype before testing for market acceptance.

With such a path ahead, there are no government programs that support the early-stage physical technology commercialization without requiring some external matching of funding. And yet, due to the risks associated with physical technologies, the probability of securing external funding is very low, particularly without the ability to obtain market validation until product development has reached a stage where customers can understand its potential applicability. Without market validation, venture capitalists and other investors will not support a company. However, without their support, no matching funds are available so it is easier just to license the technology to a third party who can afford the investment.

Included in the realm of innovative physical technologies are advanced in medical devices and assistive devices, the development of which can be severely impeded by the requirements for matching funds. There should be a system that ensures that findings from basic or applied research are not left without further support as attempts are made to commercialize discoveries.

In particular, the process of requiring matching funds for each program needs to be reevaluated. Companies in biotechnology and in physical technologies have to go to tremendous lengths to secure funds when matching funds are introduced as a criterion for program eligibility.

Given the contributions of physical technologies to the Canadian economy, governments at all levels should examine whether this is an area that should be supported more broadly. If so, they should seek to establish programs that fully support commercialization efforts in that domain.

Physical Technologies

Long-time followers of Canada's innovation narrative will attest to the multiplicity of factors that may be contributing to our inability to create world-class companies. But one of the greatest and most commonly cited challenges is the persistent failure to commercialize inventions arising in Canada.

Our previous Impact Brief found that the benefits associated with promising Canadian technologies may be lost frequently through little-known channels: 58% of patents granted to Canadian inventors by the US Patent Office in 2016 were assigned to companies domiciled in other countries. If these foreign businesses choose to take on the risk and pursue the path of commercialization, they will also eventually reap the financial rewards of these inventions. (Refer to our report entitled *Canada's Patent Puzzle*, May 2017 for more information.)

This triggers an important and more fundamental question as to why Canadians are not commercializing our own inventions. This Impact Brief examined whether part of the challenge results from a paucity of government support during the commercialization process.

To begin our analysis, we went back to basics, starting with university research that is believed to be the foundation for the type of innovations government agencies have embraced in their economic growth strategies. Using broad research areas as a starting point, we embarked on a hypothetical commercialization exercise for each chosen area to examine what support would be available.

When government agencies speak about the world of technology, they generally refer to a number of sectors, some of which are focused on technology and others on applications of that technology.

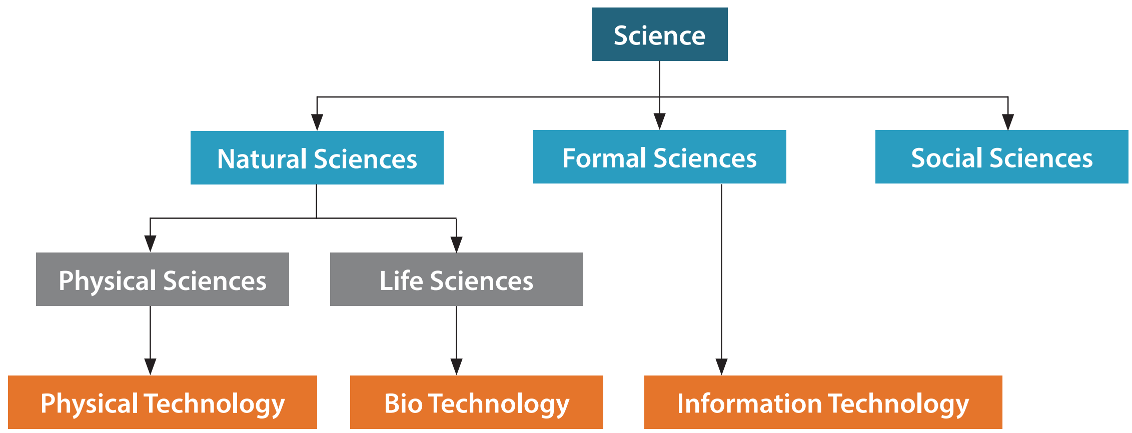
- At the federal level, the Government of Canada's 2017 budget targets six specific technology sectors in its Innovation and Skills Plan. These sectors are advanced manufacturing, agri-food, cleantech, digital industries, health/bio-sciences and clean resources. BDC's venture capital arm, which is federally supported, has three venture funds that invest in IT, healthcare, and industrial, clean, and energy technologies.

- At the provincial level, the Ontario government's Innovation Agenda has focused on bio-economy and cleantech, advanced health technologies, pharmaceutical research and manufacturing and digital media and information and communications technology. MaRS Investment Accelerator Fund (IAF), which is the provincially funded investment arm, invests in IT, health, and cleantech.

Unfortunately, the application of such frameworks to classify all possible Canadian companies leaves several gaps in the market. This often means that little attention is paid to technologies that do not conform to this classification scheme.

Given the diversity of scientific research, the result is that discoveries in other spaces have a difficult time reaching the market as there are few programs that have been developed to meet their needs.

One way of classifying the world of science is to break it down into three areas; natural sciences and engineering (the study of natural phenomena), formal sciences (mathematics and logic) and social and human sciences (human behavior and societies). The natural sciences in turn are broken down into branches that include; physical sciences (study of non-living systems) and life sciences (study of living organisms.)



Science becomes technology when it is applied to problems and solutions are developed that are accepted in the marketplace. The formal sciences (logic, mathematics, etc.) primarily turn into information technologies in the market. Discoveries in the life sciences are the basis for biotechnologies, and the physical sciences are converted into physical technologies (a term that is not often used). These three main fields of technology include the following applications:

Information Technology	Biotechnology	Physical Technology
The use of systems for storing, retrieving and sending information	The use of biological systems to develop commercial products	The use of materials in the development of products
Application software Data and databases Media and content	Pharmaceuticals Biologics and genetics Industrial biotechnologies	Sensors and instruments Devices Materials and nano-materials

If government agencies were to apply this classification scheme, they would have no trouble identifying information technologies and biotech initiatives. However, cleantech is a broad term that encompasses technologies that could fall under any of the three categories (i.e. information, bio- or physical technologies intended to reduce environmental impacts). Similarly, health technologies and advanced manufacturing could include applications of all three types of technologies to improve health or the manufacturing process.

The problem with the existing classifications of technology used by governments is that they do not separately classify or recognize the importance of physical technologies. We define physical technologies as technologies arising from academic research conducted in faculties of engineering and departments of chemistry, physics, earth sciences, and space sciences and include the sub-disciplines of chemistry, physics, earth sciences, and space sciences. This category also covers important advances in medical devices and assistive devices. While advances in Clean Tech or Advanced Manufacturing generally fall under the physical technology classification, they are essentially applications of technology to solve a specific problem rather than technologies themselves.

We stress classifications by governments as important because they influence how programs, technologies, and scientific research are funded.

Government funding that is applied the level of scientific research is significantly broader and is applied in a way that conforms to the primary classifications of the sciences. The three major funding areas for scientific research in Canada include the natural sciences and engineering, social sciences and humanities and health-related research (Table 1). While the federal government does not separately identify physical technologies in their methods of classification, funding for this area would fall under the jurisdiction of the Natural Sciences and Engineering Research Council of Canada (NSERC) whose expenditures are broken down by area in Table 2.

Government Funding for Scientific Research

Table 1

Granting Body	2015-2016 funding ($ billion)
Natural Sciences and Engineering Research Council of Canada (NSERC)	$1,100
Canadian Institutes of Health Research (CIHR)	1,000
Social Sciences and Humanities Research Council (SSHRC)	380

Source: Government of Canada

NSERC Funding for Scientific Research
Table 2

Research Priority Areas	2015-2016 funding ($ million)
Aerospace	$25.9
Automotive	24.4
Environmental science and agriculture	266.7
Forestry and wood products	21.5
Health and related life sciences	184.4
Information and communications technologies	179.2
Natural resources and energy	158.4
Northern research	49.6
Manufacturing	159.4
Oil sands and heavy oil	14.1
Water related research	72.9

Source: Government of Canada

Significance of Physical Technologies

Physical sciences contribute to the research and development (R&D) of products in a variety of areas, many of which are in the manufacturing sector. Table 3 shows the contribution of the various manufacturing subsectors to the Canadian economy. The data show that the physical technologies as a whole contribute almost eight times as much to Canada's GDP as does the combined effort of the information and communication technologies (ICT) and life sciences industries. And yet as an industry or discipline, ICT and health and related sciences receive over 2.2 times as much research funding from NSERC as manufacturing-related efforts.

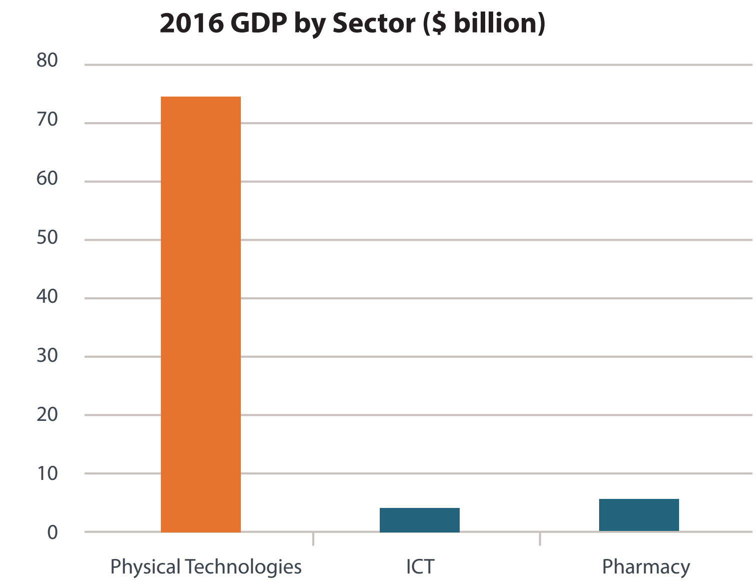
Another perspective on this relates to industrial spending on R&D. The data also clearly show that industries in the physical technologies substantially outspend traditional ICT and pharma sectors in terms of R&D in Canada.

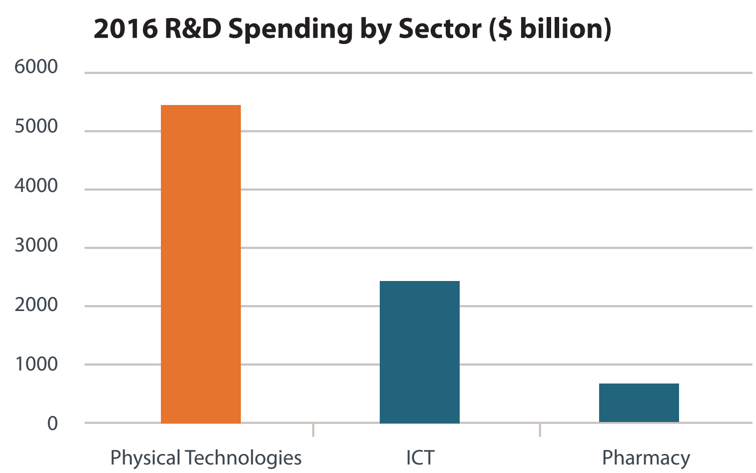
GDP for Selected Subsectors of the Canadian Economy

Table 3

Manufacturing Subsector	2016 GDP ($ billion)	2016 R&D Spending by Industry in Canada ($ billion)
Chemical	$14.7	$283
Plastics and rubber products	10.0	136
Machinery	13.1	591
Computer and electronic products	5.8	2,440
Electrical equipment, appliance and components	3.5	167
Transportation equipment	27.6	1,772
Total Physical	**74.7**	**5,389**
Information and communication technology manufacturing	3.7	2,539
Pharmaceutical and medicine manufacturing	5.9	643

Source: Statistics Canada





This trend also holds globally. Table 4 is a listing of the 20 companies worldwide with the highest spending on R&D. Table 4 shows that world-leading physical technology companies clearly have greater spending on R&D than firms in ICT or life sciences. A further perspective on this relates to patents taken out by top companies in the US in 2016. Table 4 shows the volume of patents taken out by firms in the physical technology industries.

Leading International Corporate R&D Spenders and Patents

Table 4

Company		2016 R&D Spending (US$ billion)			2016 US Patent Granted		
		ICT	Pharma	Physical Tech	ICT	Pharma	Physical Tech
1	Volkswagen			13.2			98
2	Samsung			12.7			9,638
3	Amazon	12.5			1,160		
4	Alphabet	12.3			3,326		
5	Intel			12.1			2,281
6	Microsoft	12.0			2,733		
7	Roche		10.0			308	
8	Novartis		9.5			246	
9	Johnson & Johnson		9.0			575	
10	Toyota			8.8			1,997
11	Apple (split estimated)	4.0		4.1	1,135		1,000
12	Pfizer		7.7			73	
13	General Motors			7.5			61
14	Merck		6.7			373	
15	Ford			6.7			1,365
16	Daimler			6.6			160
17	Cisco			6.2			980
18	AstraZeneca		6.0			46	
20	Bristol Myers Squibb		5.9			101	
21	Oracle	5.8			697		
Total		**46.6**	**53.8**	**77.9**	**9,051**	**1,722**	**17,580**

Source: The Statistics Portal, US Patent Office

As a final point, Table 5 shows the percentage of R&D reported by public companies in the US in a variety of industries. (We have reported US figures as there are not enough Canadian companies to complete this analysis.) While these industries do not correspond directly to North American Industry Classification System (NAICS) codes, the implications are clear: physical technology-related industries do matter in terms of their contributions to GDP and overall intellectual property. Thus, it is not clear why these technologies may not be getting the attention they deserve. One factor may be that sectors with a higher percentage of revenue allocated to R&D (e.g. see software, pharma, and biotech in Table 5) are perceived as more innovative and more amenable to R&D. They may therefore be awarded a larger share of the pie when commercialization programs are developed. While these sectors have more companies in terms of numbers, they are certainly not larger in total revenue.

R&D Expenditures by Industry
Table 5

Industry	Number of Public Companies Headquartered in the US	R&D as a % of Revenue	Total Revenue (US$ billion)
Computer Hardware	22	9.37%	$199
Software and IT	312	11.81%	448
Medical Equipment	25	7.15%	75
Pharma	57	14.65%	714
Bio Tech	53	19.96%	102
Industrial	96	3.58%	593
Automotive	23	4.69%	320
Chemical	37	2.8%	178

Source: Google Finance

Although one could argue that there is a substantial amount of crossover from ICT to other sectors with a lot of ICT research carried out in physical technology companies, our data suggest that physical technologies industries as a whole deserve greater attention. Why this is particularly important is that the path to commercialization for physical technologies is often longer and more complex than the commercialization path in more traditional technology industries.

Commercialization Process

Part of the difficulty in funding early product development in information technology, biotechnology and physical technologies stems from the way each one of them is commercialized. Because the commercialization paths for these technologies are substantially different, each requires a radically different set of supports.

1. Information Technology

Application software, data and databases, and media and content have a fairly well known and relatively risk-free path to product creation. As technologies, they have been around for a considerable time and the complexities of product development are accepted. Most of what is called research and development in this domain is not research but a known process for product development. The risk is not in the ability to develop a solution but the marketing of that solution. Therefore, substantial risk is related to market acceptance.

It is possible for a number of people without resources, working part-time with a computer in a coffee shop to produce a minimally viable product (MVP) that can be tested for market acceptance. As a result of this development path, very little is needed in the way of resources or expenditures at initial stages. It is possible to deploy the MVP and get market reaction quickly. An entrepreneur can raise money from angels investors or venture capitalists without ever having to have expended much other than time.

As a result, government support in this area does not have to be extensive or expensive. Some education, advice and perhaps small facilities will suffice.

2. Biotechnology

Compared to the commercialization path for information technologies, the commercialization path for biotechnology is complex, time-consuming and expensive. Let us look at therapeutics as an illustrative example of a commercialization path and the various stages that a medical drug goes through.

The government has set up the Canadian Institutes of Health Research (CIHR), which is composed of 13 individual institutes funding research at the university level in areas such as cancer genetics and ageing. Funding is competitive but covers all costs related to a research project. The end result of this research is expected to be the discovery of a new drug or a molecule, or elucidation of a mechanism, etc.

Drug Discovery Stages
Table 6

Stage	Activity	Funding
Discovery	Laboratory research	CIHR
Investigational New Drug	Testing on animal models	Multiple granting agencies
Phase 1	Test safety and dosage Sample: 20 – 100 people	Risk capital and established companies funding contract research organizations
Phase 2	Efficacy and side effects Sample: up to several hundred people	
Phase 3	Efficacy and monitoring of adverse reactions Sample: 300 – 3000 people	
Phase 4	Safety and efficacy Sample: several thousand people	

Once the discovery level is completed, research moves into a stage where the objective is to identify an investigational new drug. According to the US Food and Drug Administration (FDA): "During a new drug's early preclinical development, the sponsor's primary goal is to determine if the product is reasonably safe for initial use in humans, and if the compound exhibits pharmacological activity that justifies commercial development."

Funding for this activity in Canada is complex. Provincial and federal governments have established organizations whose role it is to oversee the preclinical phase. Federal organizations such as MaRS Innovation, Centre for the Commercialization of Regenerative Medicine (CCRM), Centre for the Commercialization of Antibodies and Biologics (CCAB), Triphase Accelerator and others exist to provide funding in various forms. Ontario has set up organizations such as the Ontario Institute for Cancer Research (OICR), Ontario Genomics, and the Ontario Brain Institute (OBI).

Each of these organizations requires some form of matching funding. Numerous individuals we contacted for the purpose of our analysis have commented that while money is available and can be obtained, it is often complex and time-consuming to navigate through a plethora of organizations, each with different requirements, funding envelopes and approval processes.

The complexity of obtaining funding for the commercialization of the life Sciences may be a factor that contributes to the transfer of rights of so many discoveries in the field to companies in other countries. It may be easier to assign patents than to try to commercialize them. This subject will be investigated in a future Impact Brief.

3. Physical Technology

The physical technologies have a completely different path to commercialization. The path from the lab to the market for a new product goes through nine different stages, each of these identified as a technology readiness level (TRL) (refer to Table 7). These levels apply to sensors and instruments as well as devices while not to materials and nano-materials which have different commercialization paths and are not analyzed in this report.

Technology Readiness Levels
Table 7

Level	Result
1	Basic principles observed and reported
2	Technology concept formulated
3	Proof of concept
4	Validation in a laboratory environment
5	Validation in a simulated environment
6	Prototype demonstration in a simulated environment
7	Prototype demonstration in an operational environment
8	Technology completed through tests and demonstrations
9	Technology successfully deployed in an operational setting

While the commercialization path for information technologies can be short and inexpensive, the path for physical technologies is long and very complex. Not only must one navigate a continued series of experiments to produce an end product that works, the development of physical technologies requires significantly more than time, a computer and a table. Companies need developmental facilities, equipment and supplies. Even when successfully deployed in the market, such businesses have one investment that no other technology needs—and that is expensive inventory.

While there are funding sources for life sciences projects, such funding sources do not exist in abundance for physical technologies. It is not easy to get external private funding at low TRLs. Since it is almost impossible to prove market traction at these levels, most investors will shy away from making an investment. In fact, most investors want to see some evidence of revenue in Canada; but one cannot get that in the physical sciences until after the product is ready, manufacturing is in place, and a first product run is complete—and all these activities are very costly.

Given this state of affairs, entrepreneurs in the physical technologies space spend years finding interesting new ways to get funding and to meet the requirements of relatively few funding sources.

Availability of Funds

According to some estimates, there are over 4,000 government grants and other non-dilutive funding programs available in Canada. These are offered through federal, provincial, or territorial government agencies, cities, regions, and a myriad of not-for-profits that have obtained funding from governmental and private sources. In fact, there are so many funding programs available in Canada that the government has developed a Concierge Service to help applicants navigate the increasingly complex system of supports.

According to the Concierge website, "Concierge is a single access point to funding, expertise, facilities, and global opportunities for small- and medium-sized enterprises (SMEs) seeking to grow through innovation. The only service of its kind in Canada, it offers free, one-on-one assistance from expert advisors who provide customized guidance in selecting the most relevant programs and services to help you grow your business" (*https://concierge.innovation.gc.ca/*)

Concierge provides access to funding, facilities, programs, and experts depending on the province. This website does not include any city or regional funding programs. Table 8 shows a breakdown of the number of programs listed on the Concierge website by area:

Federal and Provincial Programs
Table 8

Topic Area	Number of Programs
Funding, loans, financing and tax credits	101
Facilities to conduct R&D	71
Industry-focused advisory services	52
Industry experts for research and technical services	54

Source: Government of Canada Concierge Service

We examined all of the programs available in Ontario to determine how a low-TRL physical technology would be able to access funding programs. Specifically we looked for the following program characteristics:

1. Does it apply to physical technology companies?

Since our analysis focuses on physical technologies program funding, any program for which physical technologies are not eligible do not qualify.

2. Does it cover low-TRL developments?

As discussed previously, before the creation of a prototype, developments in the physical sciences must determine whether it is possible to scale the scientific discovery into a useable technology capable of being integrated with other components of the solution effectively.

3. Does it provide a grant instead of a refund?

A startup physical technology company would not have the resources to spend money that would be reimbursed in the future and instead would require a grant to undertake low-TRL technology development.

4. Does it require matching funds from the business?

Low-TRL physical technology developments cannot receive funding from NSERC for prototype development. In addition, the technological and market risks are too high for external investors. As a result, this type of development requires funding without matching requirements.

5. Are "hard" costs eligible?

Development of physical technologies requires funding for hard costs such as machines and equipment, and not just salaries that are stressed in many programs.

6. Can anyone apply?

Physical technologies can be developed both within and outside academic environments. Programs that restrict funding to certain venues and do not allow anyone to apply restrict the ability to innovate.

7. Can the funding be used anywhere?

Similarly, funding that can only be used in a certain place such as a community college, restricts the potential for innovation.

Using these questions as guidance, we have narrowed down the 278 programs shown in Table 8 to 34 available to Ontario-based physical technology startups (refer to Appendix A). Unfortunately, there is not a single program that fully meets the specific needs of these types of startups during the low-TRL phase of their development. This means that entrepreneurs who are starting physical technology-based companies must spend a considerable amount of time to locate the program that has the closest applicability.

One program that is in much demand is the Market Readiness program administered by the Ontario Centres of Excellence (OCE). Although this program used to be available without the requirement for the entrepreneur to locate matching funding, this has now changed. OCE currently expects applicants to the program to have matching funds, and preferably from venture capitalists.

Unfortunately, there are no venture capitalists who will invest in a low-TRL company with significant technological risks. Therefore, entrepreneurs resort to private funds, contest winnings, and a variety of other sources (e.g. crowdsourcing platforms) to raise the needed funds. In doing so, they risk early exposure to the market, even before the feasibility is tested or proven.

Even if the technologies being developed are based on science and have been funded previously at universities through NSERC funding, we have a gap during the low-TRL phase for physical technology development funding. This is significantly different from the trajectory of life sciences technologies that get through the various stage of drug development with risk capital and established companies funding contract research organizations (Table 6). In contrast, NSERC will fund right up to the level where the scientific discovery can be validated. After that, all funding at a low-TRL level requires matching industry funding that make sustaining partnerships problematic.

Technologies that successfully make it through this "gap" and find themselves at a higher TRL and can prove a real market need, funding in the form of venture capital is available from federally-funded organizations such as BDC. There are other funding programs for even later-stage development from organizations such as the National Research Council's Industrial Research Assistance Program (IRAP) and Sustainable Development Technology Canada (SDTC) as well as tax credits from Scientific Research and Experimental Development (SRED).

When all of these threads are put together, our analysis suggests that the complexity of life sciences commercialization and the lack of specific funding for physical technology commercialization may be two factors contributing to losses in Canada's intellectual property rights. Several university technology transfer practitioners we spoke to in preparing this Brief admit that it is often easier to assign technology to an external party in return for payment or royalties rather than use scarce university resources and complex programs to fund the further development of university-developed knowledge.

Conclusion

If Canada is to compete more effectively on an international basis it will have to do one of two things:

1. Develop individual programs that operate to provide funding for each specific type of technology that is moving to market. In doing this, governments must ensure that they are not missing key technology types such as those featured in this Impact Brief.

2. Develop overarching programs that can cover a broad base of technologies with broader funding parameters such as the Small Business Innovation Research (SBIR) program in the US.

Currently, we have a proliferation of funds and a proliferation of funders. The common practice in Canada is to create specific programs for each sector and for each region. This inevitably creates administrative overkill as publicly funded not-for-profits create their own executive, administration and infrastructure.

This suggests a need for all governments to undertake regular reviews of programs, not for each one individually but on a holistic basis to ensure that there are not gaps in the system such as evidenced in the case of physical technologies. This review should track the method by which companies obtain funding, not just how it is handed out to determine whether the approach fits with client needs. The system should ensure that findings from either basic or applied research are not left without further support as attempts are made to commercialize discoveries.

In particular, the matching funds requirements need to be evaluated seriously. Companies in biotechnology and in physical technologies must go to tremendous lengths to secure additional funds when governments decide that funds must be matched for eligibility. Do governments require matching funds from companies so that they do not have to rely on their own decision-making capabilities and can look at the presence of these additional funds as evidence of merit? Or is this a clever way for the federal government to ensure that the provinces step up to their own responsibilities and vice versa?

Meanwhile, given the lack of specific programs to cover the physical technologies, governments at all levels should examine whether this is an area that they should be supporting more broadly. If so, they should be seeking to establish programs that fully support commercialization efforts in this domain.

Methodology

This report examines publicly available data related to GDP, R&D spending, and patents, along with corporate financial statements and a variety of materials that relate to the development and commercialization of new products in primarily three sectors; information technologies, life sciences and physical technologies. The sources consulted include the websites of Government of Canada, Statistics Canada, and Google Finance.

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.

Appendix A

Organization	Program	Physical Technology	Low TRL	Grant	No matching required	Hard costs	Anyone can apply	Money spent anywhere
NRC	Industrial Research Assistance Program (IRAP)	Yes	Yes	No	No	Yes	Yes	Yes
Canada Revenue	Scientific Research and Experimental Development Tax Incentive Program (SR&ED)	Yes	Yes	No	No	Yes	Yes	Yes
NRC	Youth Employment Program (YEP)	Yes	Yes	No	No	No	Yes	Yes
Public Works	Build in Canada Innovation Program (BCIP)	Yes	No	No	No	Yes	Yes	Yes
NSERC	Applied Research and Development Grants (ARD)	Yes	Yes	Yes	No	Yes	No	No
NSERC	Collaborative Research and Development Grants (CRD)	Yes	Yes	Yes	No	Yes	Yes	No
NSERC	Engage Grants (EG)	Yes	Yes	Yes	No	Yes	Yes	No
EDC	Experience Awards	Yes	Yes	No	No	No	Yes	Yes
Global Affairs	Export Development Canada (EDC)	Yes	No	No	No	Yes	Yes	Yes
Canadian Space Agency	Space Technology Development Program (STDP)	Yes	Yes	Yes	No	Yes	No	Yes
ISED	Canada Small Business Financing Program	Yes	No	Yes	No	No	Yes	Yes
Global Affairs	CanExport	Yes	No	No	No	Yes	No	Yes
Canarie	Digital Accelerator For Innovation And Research (DAIR)	No	No	Yes	Yes	No	Yes	No
BDC	Equipment Purchase Financing	Yes	No	Yes	No	No	Yes	Yes
Futurepreneur	Financing and Mentoring	Yes	No	Yes	No	Yes	No	Yes
BDC	Small Business Loan	Yes	No	No	No	Yes	Yes	Yes
BDC	Start-Up Financing	Yes	No	Yes	No	Yes	Yes	Yes
SDTC	SD Tech Fund	Yes	Yes	Yes	No	Yes	Yes	Yes
Agriculture and Agri-Food	Agri-Innovations Program-Enabling Commercialization and Adoption Stream	Yes	Yes	Yes	No	Yes	Yes	Yes
Agriculture and Agri-Food	Agri-Innovations Program-Industry-led Research and Development Stream	Yes	Yes	Yes	No	Yes	Yes	Yes
Genome BC	Genome BC	No	Yes	Yes	Yes	Yes	No	No
BDC	BDC Capital	Yes	No	Yes	Yes	Yes	Yes	Yes
Mitacs	Mitacs - accelerate, elevate, globalink	Yes	Yes	No	No	No	Yes	No
Ontario	Ontario Research and Development Tax Credit	Yes	Yes	No	No	Yes	Yes	Yes
FedDev Ont	Eastern Ontario Development Program (EODP)	Yes	No	Yes	No	Yes	Yes	Yes
FedDev Ont	Investing in Business Growth and Productivity (IBGP)	Yes	No	Yes	No	Yes	Yes	Yes
FedDev Ont	Investing in Business Innovation (IBI)	Yes	No	Yes	No	Yes	Yes	Yes
OCE	Ontario Centres of Excellence (OCE)	Yes	Yes	Yes	No	Yes	No	No
FedNor	For Women Entrepreneurs	Yes	No	Yes	Yes	Yes	No	Yes
FedNor	Community Futures Program	Yes	No	Yes	No	Yes	No	No
Ontario	Ontario Business Research Institute Tax Credit	Yes	Yes	No	No	Yes	Yes	No
Ontario	Ontario Innovation Tax Credit	Yes	Yes	No	No	Yes	Yes	No
FedNor	Targeted Manufacturing Initiative-Operational Assessments	Yes	No	Yes	No	Yes	No	Yes
FedNor	Targeted Manufacturing Initiative-Productivity Improvements	Yes	No	Yes	No	Yes	No	Yes

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

Read our collection of Impact Briefs: www.impactcentre.ca/discover/research

Contributors

Charles Plant
Author
Senior Fellow
cplant@imc.utoronto.ca
416-458-4850
@cplant

Emina Veletanlic
Editor
Manager, Strategic Initiatives
eveletanlic@imc.utoronto.ca
416-978-1457
@EminaVeletanlic

James Li
Harim Ulfig

UNIVERSITY OF
TORONTO

Impact Centre
Suite 411 - 112 College Street
Toronto, Ontario
Canada M5G 1L6

Tel: 416-978-3875
info@imc.utoronto.ca
www.impactcentre.ca