Innovation Canada: A Call to Action

Review of Federal Support to Research and Development – Expert Panel Report

Canada

About the Cover

While the great American inventor Thomas Edison is given credit for "inventing" the light bulb, the story is really one of incremental innovation. In 1810, British chemist Humphry Davy invented the "electric arc," a precursor to the light bulb. A series of innovations followed and, by the 1860s, the race was on to develop a commercially viable light bulb. Joining this race were two Canadians, Henry Woodward, a medical student in Toronto, and Mathew Evans, a hotel keeper. In 1874, they patented a nitrogen-filled light bulb that lasted longer than others of the era. But they could not get financing for their work, and in 1878 were eclipsed by British inventor Joseph Swan and then in 1879 by Thomas Edison. Realizing the commercial viability of the light bulb, Edison was successful in obtaining major financial backers. He used these funds to continue his experiments, but also to buy out many patents, including those of Swan and of Woodward and Evans.

As we reflected on our consultations held across Canada, during which we heard first-hand of the struggles and successes of Canadian entrepreneurs, we wondered: What if Woodward and Evans had been able to interest investors? What if they had been able to obtain financing to carry on their work and beat out Swan and Edison to be the first to commercialize the light bulb?

This report lays the foundation for a more innovative economy that supports and welcomes research, development and commercialization. It sets out goals and recommendations to take our country forward and help unleash the potential of entrepreneurs from all over Canada. Our hope is that the next Woodwards and Evanses will have all that they need to bring their ideas to the world and leave a lasting impact for future generations.

For more information, see: Library and Archives Canada, "Patent no. 3738. Filing year 1874," http://www.collectionscanada.gc.ca/innovations/023020-2710-e.html.

Innovation Canada:

A Call to Action

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Dear Minister,

Please find attached the report of the Independent Panel on Federal Support to Research and Development. This report represents the consensus views of all Panel members.

It is our sincere hope that our report will be of value to you and your colleagues in Cabinet as you consider these important issues for the country.

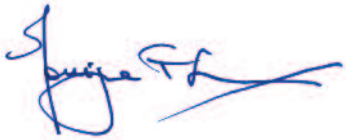
The Panel has been ably supported in its work by a talented secretariat, led by Iain Stewart. We are very grateful to the many Canadians and others who offered us their time and opinions as we worked to respond to your charge.

Sincerely,

Tom Jenkins, Chair

Bev Dahlby

Arvind Gupta



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Acknowledgements

Secretariat

The Panel was capably supported in its work by a secretariat comprised of officials from the Government of Canada departments with responsibilities for many of the programs within the scope of the review. These officials had expertise in aspects of R&D and innovation, and were seconded to the secretariat for the duration of the review. The secretariat was responsible for a range of activities in support of the Panel, such as providing strategic advice and analysis in support of Panel deliberations, organizing the Panel's consultations, managing its online written submissions process, liaising with the 17 Government of Canada departments and other entities implicated in the review, coordinating the travel of Panel members, coordinating the Panel's program of research with external experts, and managing the review's logistics, schedule and finances.

Iain Stewart was the secretary to the Panel and head of the secretariat, and was supported by Samuel Millar, the secretariat's executive director. John Lester, Mary Preville and Mélanie Robert served as the secretariat's directors of research, program assessment, and consultations and communications, respectively. Sarah Charette, David Côté, Thomas Ferguson, Alexandre Hamel and Brandon La Carte served as policy advisers. Ana Fierro, Gail Gaudreau and Katherine O'Rourke supported the Panel's administration and logistics. Gladys Fisher provided support in financial administration and contracting.

Special Advisers

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- Peter Nicholson, who wrote the report with David Côté of the secretariat, under the direction of the Panel
- Andrei Sulzenko, for his work supporting us on procurement advice
- Paul Berg Dick, for his work supporting our understanding of the Scientific Research and Experimental Development tax credit.

Other Important Acknowledgements

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The Panel would also like to recognize various international organizations for sharing their research and resources over the course of the review, including the Information Technology & Innovation Foundation, Germany's Fraunhofer-Gesellschaft, the US National Academy of Sciences, the OECD, Partnership for New York City, Universities Australia, and the Urban Institute and Brookings Institution's Tax Policy Center.

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Lastly, the Panel would like to thank Industry Canada and the Department of Finance Canada in particular for the data, information, research, analyses and other resources made freely available to the Panel, and the 17 federal departments and agencies for providing time and information in support of our learning about their important programs and initiatives.

For a full list of all interlocutors who contributed views and expertise to the review, please visit the Panel's website at www.rd-review.ca.

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List of Acronyms

AAFC	Agriculture and Agri-Food Canada
ACOA	Atlantic Canada Opportunities Agency
BDC	Business Development Bank of Canada
BERD	business expenditure on research and development
BIC	proposed Business Innovation Committee
CCA	Council of Canadian Academies
CCPC	Canadian-controlled private corporation
CED-Q	Canada Economic Development for Quebec Regions
CICP	Canadian Innovation Commercialization Program
CIHR	Canadian Institutes of Health Research
CRA	Canada Revenue Agency
CSA	Canadian Space Agency
CSLS	Centre for the Study of Living Standards
CVCA	Canada's Venture Capital & Private Equity Association
DRDC	Defence Research and Development Canada
EMS	Expenditure Management System
FedDev ON	Federal Economic Development Agency for Southern Ontario
FedNor	Federal Economic Development Agency for Northern Ontario
FIN	Department of Finance Canada

GDP	gross domestic product
GERD	gross domestic expenditure on research and development
GOVERD	government intramural expenditure on research and development
HERD	higher education expenditure on research and development
IAC	proposed Innovation Advisory Committee
IC	Industry Canada
ICT	information and communication technologies
IP	intellectual property
IPR	intellectual property right
IRAP	Industrial Research Assistance Program
IRB	Industrial and Regional Benefits
IRIC	proposed Industrial Research and Innovation Council
LSVCF	labour-sponsored venture capital fund
MFP	multifactor productivity
NRC	National Research Council Canada
NRCan	Natural Resources Canada
NSERC	Natural Sciences and Engineering Research Council
OECD	Organisation for Economic Co-operation and Development
R&D	research and development
RDA	regional development agency
S&T	science and technology
SADI	Strategic Aerospace and Defence Initiative
SBIC	Small Business Investment Company program (US)
SBIR	Small Business Innovation and Research program (US)
SDTC	Sustainable Development Technology Canada
SME	small and medium-sized enterprise
SR&ED	Scientific Research and Experimental Development
SRC	proposed Science and Research Committee
SSHRC	Social Sciences and Humanities Research Council
SSTI	State Science & Technology Institute
STIC	Science, Technology and Innovation Council
Tri-Council	the three granting councils: NSERC, SSHRC and CIHR
TSB	Technology Strategy Board (UK)
UK	United Kingdom
US	United States
VC	venture capital
WD	Western Economic Diversification Canada

List of Recommendations

Recommendation 1

Create an Industrial Research and Innovation Council (IRIC), with a clear business innovation mandate (including delivery of business-facing innovation programs, development of a business innovation talent strategy, and other duties over time), and enhance the impact of programs through consolidation and improved whole-of-government evaluation.

Recommendation 2

Simplify the Scientific Research and Experimental Development (SR&ED) program by basing the tax credit for small and medium-sized enterprises (SMEs) on labour-related costs. Redeploy funds from the tax credit to a more complete set of direct support initiatives to help SMEs grow into larger, competitive firms.

Recommendation 3

Make business innovation one of the core objectives of procurement, with the supporting initiatives to achieve this objective.

Recommendation 4

Transform the institutes of the National Research Council (NRC) into a constellation of large-scale, sectoral collaborative R&D centres involving business, the university sector and the provinces, while transferring NRC public policy-related research activity to the appropriate federal agencies.

Recommendation 5

Help high-growth innovative firms access the risk capital they need through the establishment of new funds where gaps exist.

Recommendation 6

Establish a clear federal voice for innovation, and engage in a dialogue with the provinces to improve coordination and impact.

Executive Summary
Innovation Canada: A Call to Action

Canada has a solid foundation on which to build success as a leader in the knowledge economy of tomorrow. We have a strong financial sector and attractive corporate tax rates. We have a diverse, well-educated workforce and significant natural resource endowments. We have institutions that safeguard the rights of individuals and encourage initiative. Yet, despite these notable strengths, challenges remain.

Studies have repeatedly documented that business innovation in Canada lags behind other highly developed countries. This gap is of vital concern because innovation is the ultimate source of the long-term competitiveness of businesses and the quality of life of Canadians. The ability to conjure up new products and services, to find novel uses for existing products and to develop new markets — these fruits of innovation are the tools that will ensure Canada's success in the twenty-first century.

Recognizing that innovation is paramount to continued prosperity, Budget 2010, *Leading the Way on Jobs and Growth*, announced a comprehensive review of support for research and development (R&D) in order to optimize the contributions of the Government of Canada to innovation and related economic opportunities for business. Our Panel was appointed in October 2010 and was mandated by the Minister of State (Science and Technology)

The Panel's Advice in a Nutshell

Create an Industrial Research and Innovation Council (IRIC), with a clear business innovation mandate (including delivery of business-facing innovation programs, development of a business innovation talent strategy, and other duties over time), and enhance the impact of programs through consolidation and improved whole-of-government evaluation.

Simplify the Scientific Research and Experimental Development (SR&ED) program by basing the tax credit for small and medium-sized enterprises (SMEs) on labour-related costs. Redeploy funds from the tax credit to a more complete set of direct support initiatives to help SMEs grow into larger, competitive firms.

Make business innovation one of the core objectives of procurement, with the supporting initiatives to achieve this objective.

Transform the institutes of the National Research Council (NRC) into a constellation of large-scale, sectoral collaborative R&D centres involving business, the university sector and the provinces, while transferring NRC public policy-related research activity to the appropriate federal agencies.

Help high-growth innovative firms access the risk capital they need through the establishment of new funds where gaps exist.

Establish a clear federal voice for innovation, and engage in a dialogue with the provinces to improve coordination and impact.

to conduct the review announced in the Budget.

This report records our advice to the government on how federal programs that support business and commercially oriented R&D can make an even stronger contribution to a more innovative and prosperous Canada.

What We Heard and Learned

During our extensive consultations, we learned about many Canadian success stories and heard from numerous entrepreneurs who said that federal programs have served them well. We also heard that there is opportunity to enhance the impact of programs to make them even better. We heard that the government should be more focussed on helping innovative firms to grow and, particularly, on serving the needs of small and medium-sized enterprises (SMEs). We heard that programs need to be more outcome oriented as well as more visible and easy to access. We heard that whole-of-government coordination must be improved and that there should be greater cooperation with provincial programs, which often share similar objectives and users. We also learned that innovation support is too narrowly focussed on R&D — more support is needed for other activities along the continuum from ideas to commercially useful innovation. This extensive feedback, supplemented by research and analysis and interpreted in the course of the Panel's internal dialogue, forms the basis of our advice.

A Framework for Action

Our work has been guided by a long-term vision of a Canadian business sector that stands shoulder-to-shoulder with the world's innovation leaders — ultimately, this means a more productive and internationally competitive economy that supports rising living standards for Canadians. To transform this vision into reality, we believe that the government must focus its efforts on the goal of growing innovative firms into larger enterprises, rooted in Canada but facing outward to the world and equipped to compete with the best.

Achieving the Panel's vision requires public policy action on a number of fronts, including ongoing efforts to refine and enhance marketplace and regulatory policies that influence the climate for private sector competition and investment. While these framework policies are not within the scope of this review, we would emphasize that the impact of our advice depends ultimately on complementary efforts to strengthen those policies — especially as they relate to encouraging the competitive intensity that is a central motivator of innovation.

The core of our advice can be summarized in six broad recommendations, the details of which are elaborated subsequently. Taken together, they provide a framework for action.

Industrial Research and Innovation Council

We envisage a new, whole-of-government program delivery vehicle — the Industrial Research and Innovation Council (IRIC) — that would be the centrepiece of the federal government's efforts to help entrepreneurs bring their innovative ideas to the marketplace and grow their companies into internationally successful businesses. To this end, the IRIC should take on at least the following industry-facing activities:

- deliver an expanded Industrial Research Assistance Program (IRAP) and a commercialization vouchers pilot program that connects SMEs to providers of commercialization support

- provide a national "concierge" service and associated website to help firms find and access the support tools they need
- work with partners to develop a federal business innovation talent strategy.

Moreover, the IRIC could assume the following responsibilities: in partnership with the federal granting agencies, joint oversight of appropriate business-facing programs administered by those agencies; technical assessment of the innovation element of project proposals submitted to the regional development agencies; and oversight of federal support for business-oriented collaborative research institutes evolved from the current institutes of the National Research Council, as further discussed below.

Scientific Research and Experimental Development (SR&ED) Tax Credit

In line with feedback from stakeholders, we are recommending that the SR&ED program should be simplified. Specifically, for SMEs, the base for the tax credit should be labour-related costs, and the tax credit rate should be adjusted upward. The current base, which is wider than that used by many other countries, includes non-labour costs, such as materials and capital equipment, the calculation of which can be highly complex. This complexity results in excessive compliance costs for claimants and dissipates a portion of the program's benefit in fees for third-party consultants hired to prepare claims.

Canada's program mix is heavily weighted toward the SR&ED program and, during our consultations, we heard many calls for increased direct expenditure support. As well, many leading countries in innovation rely much less than Canada on indirect tax incentives as opposed to direct measures. That is why we are recommending other improvements to the SR&ED program that will generate savings for the government. The savings should be redeployed to fund direct support measures for SMEs, as proposed in our other recommendations. Specifically, to ensure a greater focus on promoting the growth of firms, the portion of the credit (claimed by SMEs) that is refundable — that is, paid regardless of whether the firm generates taxable income — should be reduced, such that part of the benefit would depend on the company being profitable. Given the central importance of the SR&ED program to firms across the country, our recommended changes should be phased in over several years to allow time for adjustment.

Risk Capital

Innovative, growing firms require risk capital, yet too many innovation-based Canadian firms that have the potential for high growth are unable to access the funding needed to realize their potential. The government can play an important role by facilitating access by such firms to an increased supply of risk capital at both the start-up and later stages of their growth. We therefore recommend measures to establish risk capital funds that target these areas. The federal government's contribution to the funds would be delivered through the Business Development Bank of Canada (BDC), with incentives and governance designed to ensure strong private sector participation and leadership.

Collaborative R&D Institutes

Canada needs a fundamentally new approach to building public–private research collaborations in areas of strategic importance and opportunity for the economy. Accordingly, we recommend that the business-oriented institutes of the National Research Council (NRC) should become independent collaborative research organizations, intended to be focal points for sectoral research and innovation strategies with the private sector. Those NRC institutes that perform primarily fundamental research would become affiliates of universities,

while those with core public policy mandates would be transferred to the most relevant federal department or agency.

Public Sector Procurement

The government should make better use of its substantial purchasing power to create opportunity and demand for leading-edge goods, services and technologies from Canadian suppliers. This will foster the development of innovative and globally competitive Canadian companies connected to global supply chains, while also stimulating innovation and greater productivity in the delivery of public goods and services. We therefore recommend that encouragement of innovation in the Canadian economy should become a stated objective of procurement policies and programs. Further to this end, we recommend, among other measures, that the current pilot phase of the Canadian Innovation Commercialization Program (CICP) evolve into a permanent, larger and effective program that provides incentives for solving operational problems identified by federal departments.

Whole-of-Government Leadership

The responsibility to foster innovation cuts across many functions of government and requires a system-wide perspective. For this reason, the government needs to establish business innovation as a whole-of-government priority. This will require the designation of a minister as the voice for innovation, with a stated mandate to put innovation at the centre of the government's economic strategy and to engage the provinces in a dialogue on innovation to improve coordination and impact.

Effective implementation of our action plan will depend on an oversight structure that ensures the timely achievement of desired outcomes. We recommend that the government's main tool in that regard should be an external Innovation Advisory Committee (IAC) — a body with a whole-of-government focus that would oversee the realization of our proposed action plan, as well as serve as a permanent mechanism to promote the refinement and improvement of the government's business innovation programs going forward.

Guiding Principles

In the course of our consultations and research, we developed a set of broad guiding principles — essentially a philosophy of program design to promote business innovation (see Chapter 4 in our main report). These principles, which are reflected in the foregoing framework for action, can be summarized as follows.

Transformative Programs

Programs to support business innovation should focus resources where market forces are unlikely to operate effectively or efficiently and, in that context, address the full range of business innovation activities, including research, development, commercialization and collaboration with other key actors in the innovation ecosystem. The design and delivery of federal business innovation programs must always strive to result in R&D activity and commercialization outcomes that meet the highest global standards.

Require Positive Net Benefit

The total benefit of any given program should be greater than the cost of funding, administering and complying with the program. Support programs should reduce the subsidy amount provided — or move to a repayable basis — the closer the activity being supported is to market, and therefore the more likely it is that the recipient firm will capture most of the benefit for itself. There is also a need for coordination across the full suite of innovation programs to avoid excessive "stacking" of incentives that may result in subsidies that are higher than needed to achieve policy objectives. Excessive subsidization not only wastes financial resources, but also risks encouraging or sustaining activities that deliver little societal benefit.

Favour National Scope and Broad Application

The core of the federal suite of business innovation programs should be large national programs of broad application — for example, the SR&ED program and IRAP — that support business innovation activity generally, empowering firms and entrepreneurs to make market-driven investment decisions according to their own timelines and regardless of sector, technology or region.

Build Sector Strategies Collaboratively

Beyond programs of broad application, there is a complementary role for programs tailored to the needs of specific sectors that the government identifies as being of strategic importance. For industry sectors that are concentrated in particular regions, initiatives should be designed and delivered to work collaboratively with the relevant provinces and other local interests.

Require Commercial Success in Regional Innovation

Regionally oriented programs to support business innovation should focus on creating the capacity of firms in the target region to succeed in the arena of global competition. That is why it is essential for regional innovation programs to apply the same high standards of commercial potential as are required by programs of nationwide application.

Establish Clear Outcome Objectives, Appropriate Scale and a User-Oriented Approach

A program to foster business innovation should be designed to address a specific problem for which a government initiative is needed as part of the solution. The program should have well-defined outcome objectives, be of a scale appropriate for the problem at hand, be well known to its target clientele, and be easy and timely to access and use.

Design for Flexibility

Federal innovation programs should themselves be innovative and flexible in their design, setting clear objectives and measurable outcomes, and then allowing program users to propose novel ways of meeting the objectives. For example, where appropriate, programs should invite civil society to make proposals to develop new approaches and to actually deliver programs, rather than relying exclusively on established government delivery mechanisms.

Assess Effectiveness

More extensive performance management information is required to ensure an outcome-driven and user-oriented approach to federal support for business innovation. This entails regular public reporting on the outcomes both of individual programs and of the full suite of federal innovation support. The performance information would inform periodic evaluations, not only against the objectives of programs themselves, but also of the programs' relative effectiveness within the overall portfolio.

Approach to Our Mandate

The Panel was asked by the government to provide advice in respect of the effectiveness of federal programs to support business and commercially oriented R&D, the appropriateness of the current mix and design of these programs, as well as possible gaps in the current suite of programs and what might be done to fill them. The mandate specified that our recommendations must not result in either an increase or a decrease in the overall level of funding of federal R&D initiatives. Therefore, where we have identified opportunities for savings — such as from some reduction in the refundability of the SR&ED tax credit — we expect the government to reallocate the savings to provide funds for our other recommendations.

The year-long process culminating in this report began with foundational briefings from experts and decision makers in both the federal and provincial governments. We implemented, in parallel, an ambitious agenda of research and program assessment. The latter encompassed a set of 60 programs (worth about $5 billion in the 2010–11 fiscal year) covering the gamut of federal initiatives to foster business R&D. Our extensive consultations included 228 written submissions in response to the release of our consultation paper in December 2010. These were supplemented by in-person group sessions in cities from coast to coast: Vancouver, Calgary, Winnipeg, Waterloo, Toronto, Ottawa, Montréal, Québec and Halifax. We extended the scope of consultations beyond Canada to gather international perspectives on issues germane to this review. Meetings took place in Australia, Germany, Singapore, the United Kingdom and the United States, and with officials of the Organisation for Economic Co-operation and Development (OECD) and Tekes[1] in Paris. Finally, we commissioned a survey of more than a thousand R&D-performing businesses representative of the range of sizes, sectors and provinces.

[1] Tekes is a Finnish funding agency for technology and innovation.

Recommendations

Our headline advice has been summarized in the Framework for Action and associated Guiding Principles sections above. What follows are detailed statements of our recommendations, organized in response to the three specific questions in the Panel's mandate.

Program Effectiveness

The first question in the Panel's mandate asks: What federal initiatives are most effective in increasing business R&D and facilitating commercially relevant R&D partnerships?

The government regularly evaluates individual programs against the stated objectives of each program. But these objectives vary widely among programs in terms of the outcomes being targeted, and the evaluation data collected for individual programs have generally not been designed to enable assessment of the *comparative* effectiveness of programs. Our advice in respect of program effectiveness is therefore based not only on available data regarding the 60 programs we reviewed but also, and more particularly, on our consultations and related research.

From what we heard and learned, there is a need to improve the business expertise of program delivery staff and to achieve greater scale and efficiency in program implementation. We have concluded that SMEs need enhanced access to services and small grant or voucher-based funding to assist their innovation activities. We found that the bewildering array of innovation support programs (at both the federal and provincial levels) made it difficult for companies to navigate the landscape to locate the right programs for their purposes.

Our survey of R&D-performing firms demonstrated that client awareness of most programs is low (with the exception of the SR&ED program and IRAP). We also found that the current suite of programs to develop and deploy the talent needed to meet the needs of innovative businesses is a patchwork of largely subscale initiatives. More generally, we found that there are opportunities to improve program efficiency and flexibility by combining smaller initiatives with similar objectives. Finally, we concluded that adequate tools do not exist to comparatively assess relative program effectiveness. Therefore, the evidence base is lacking for a regular and systematic reallocation of resources among programs to achieve the most cost-effective support for business innovation.

Based on these findings, as detailed in Chapter 5 of our main report, we make the following recommendations.

Recommendation 1

Create an Industrial Research and Innovation Council (IRIC), with a clear business innovation mandate (including delivery of business-facing innovation programs, development of a business innovation talent strategy, and other duties over time), and enhance the impact of programs through consolidation and improved whole-of-government evaluation.

1.1 Industrial Research and Innovation Council (IRIC) — Create an arm's-length funding and delivery agency — IRIC — with a clear and sharply focussed mission to support business innovation. IRIC should become the common service platform for all appropriate federal business innovation support programs. Over time, it should take on at least the following industry-facing activities, as further elaborated in Recommendations 1.2 through 1.4:

- delivery of the Industrial Research Assistance Program (IRAP) and a commercialization vouchers pilot program (1.2)
- delivery of a national concierge service and related web portal (1.3)
- development of a federal business innovation talent strategy (1.4).

1.2 Resources for IRAP and commercialization vouchers — Increase IRAP's budget to enable it to build on its proven track record of facilitating innovation by SMEs throughout Canada, and create a national commercialization vouchers pilot program, delivered within the suite of existing support mechanisms offered through IRAP, to help SMEs connect with approved providers of commercialization services in post-secondary, government, non-profit and private organizations.

1.3 Innovation concierge service — Establish a national "concierge" service and associated comprehensive web portal to provide companies with high-quality, timely advice to help identify and access the most appropriate business innovation assistance and programs for the individual firm.

1.4 Talent — IRIC should lead the development of a federal business innovation talent strategy, working closely with the provinces and relevant federal departments and agencies, focussed on increasing business access to, and use of, highly qualified and skilled personnel.

1.5 Program consolidation — Over time, consolidate business innovation programs focussed on similar outcome areas into a smaller number of larger, more flexible programs open to a broader range of applicants and approaches.

1.6 Program evaluation — Build a federal capacity to assess the effectiveness of new and existing business innovation programs to enable comparative performance evaluation and to guide resource allocation going forward.

Program Mix and Design

The second question in the Panel's mandate asks: Is the current mix and design of tax incentives and direct support for business R&D and business-focussed R&D appropriate?

The SR&ED tax credit — which currently provides approximately $3.5 billion annually toward the cost of business R&D — is the flagship of federal support for business innovation. The program lowers the cost of R&D for firms, promotes greater investment in R&D, and makes Canada a more attractive place to locate R&D activity. It allows almost 24 000 firms across all economic sectors and regions of the country to make individual, market-driven decisions about the R&D they need to compete

and succeed. It is essential that this highly valued program be made simpler, more predictable and more cost effective in promoting business innovation.

However, the heavy reliance on the program implies that federal support for innovation may be overweighted toward subsidizing the cost of business R&D rather than other important aspects of innovation. For this reason, we believe that the government should rebalance the mix of direct and indirect funding by decreasing spending through the SR&ED program and directing the savings to complementary initiatives outlined in our other recommendations.

For the reasons outlined above, as detailed in Chapter 6 of our main report, we make the following recommendations.

Recommendation 2

Simplify the SR&ED program by basing the tax credit for SMEs on labour-related costs. Redeploy funds from the tax credit to a more complete set of direct support initiatives to help SMEs grow into larger, competitive firms.

2.1 Simpler compliance and administration — The tax credit benefiting small and medium-sized Canadian-controlled private corporations (CCPCs) should be based on labour-related costs in order to reduce compliance and administration costs. Because the credit would be calculated on a smaller cost base than at present, its rate would be increased. Over time, the government should also consider extending this new labour-based approach to all firms, provided it is able to concurrently provide compensatory assistance to offset the negative impacts of this approach on large firms with high non-labour R&D costs.

2.2 More predictable qualification — Improve the Canada Revenue Agency's preclaim project review service to provide firms with pre-approval of their eligibility for the credit.

2.3 More cost effective — Reduce the amount of SR&ED tax credit assistance by introducing incentives that encourage the growth and profitability of small and medium-sized enterprises (SMEs) while decreasing the refundable portion of the credit over time. Redeploy the savings to fund new and/or enhanced support for innovation by SMEs, as proposed in the Panel's other recommendations.

2.4 More accountable — Provide data on the performance of the SR&ED tax credit on a regular basis to permit evaluation of its cost-effectiveness in stimulating R&D, innovation and productivity growth.

2.5 Phased implementation and consultation — Adopt the proposed changes through a phased-in approach to give the business sector time to plan and adjust smoothly. There should be early consultations with the provinces on the proposed changes, given that they may want to consider adopting the same base as the federal government.

Program Gaps

The third question in the Panel's mandate asks: What, if any, gaps are evident in the current suite of programming, and what might be done to fill these gaps?

Based on our consultations, the identification by the OECD of gaps in Canada's innovation system, and the findings of panels before us — namely, the Competition Policy

Review Panel and the Expert Panel on Commercialization — we concluded that three gaps were most significant: (i) the strategic use of public sector procurement to foster innovation, (ii) the enhanced use of large-scale research collaboration and (iii) the availability of risk capital to finance the development and growth of innovative businesses. The following three recommendations, as detailed in Chapter 7 of our main report, address each of these gaps in turn.

Public Sector Procurement

We concluded from our consultations and research that government support for business innovation needs to employ more "demand-pull" measures to complement the more traditional suite of "research-push" measures. To this end, public sector procurement and related programming should be used to create opportunity and demand for leading-edge goods, services and technologies from Canadian suppliers. This will foster the development of innovative and globally competitive Canadian companies while also stimulating innovation and greater productivity in the delivery of public sector goods and services.

Recommendation 3

Make business innovation one of the core objectives of procurement, with the supporting initiatives to achieve this objective.

3.1 Innovation as an objective — Make the encouragement of innovation in the Canadian economy a stated objective of procurement policies and programs.

3.2 Scope for innovative proposals — Wherever feasible and appropriate, base procurement requests for proposals on a description of the needs to be met or problems to be solved, rather than on detailed technical specifications that leave too little opportunity for innovative proposals.

3.3 Demand-pull — Establish targets for departments and agencies for contracting out R&D expenditures, including a subtarget for SMEs, and evolve the current pilot phase of the Canadian Innovation Commercialization Program (CICP) into a permanent, larger program that solicits and funds the development of solutions to specific departmental needs so that the government stimulates demand for, and becomes a first-time user of, innovative products and technologies.

3.4 Globally competitive capabilities — Plan and design major Crown procurements to provide opportunities for Canadian companies to become globally competitive subcontractors.

3.5 Working collaboratively — Explore avenues of collaboration with provincial and municipal governments regarding the use of procurement to support innovation by Canadian suppliers and to foster governments' adoption of innovative products that will help reduce the cost and improve the quality of public services.

Public–Private Research Collaboration

We believe that public–private research consortia in Canada lack the scale needed to have significant impact on the development of globally competitive Canadian companies. Consequently, Canada needs a fundamentally new approach to building such collaborations in areas of strategic importance and opportunity for the economy. The existing institutes of the NRC are a unique asset in terms of infrastructure, talent and sectoral and regional coverage. Consistent with the new direction being taken by NRC management, we believe that several of the institutes should be evolved to become a core national constellation of R&D

and technology institutes mandated to collaborate closely with business in key sectors. The appropriate individual institutes could become focal points for the development of R&D and innovation strategies for key sectors, for major enabling technologies and for regional clusters of innovative firms and supporting services.

Recommendation 4

Transform the institutes of the National Research Council (NRC) into a constellation of large-scale, sectoral collaborative R&D centres involving business, the university sector and the provinces, while transferring NRC public policy-related research activity to the appropriate federal agencies.

4.1 Evolution of the NRC — Charge the NRC to develop a plan for each of its existing institutes and major business units that would require their evolution over the next five years into one of the following:

(a) an industry-oriented non-profit research organization mandated to undertake collaborative R&D and commercialization projects and services, funded by amounts drawn against existing NRC appropriations together with revenue earned from collaborative activities

(b) an institute engaged in basic research to be affiliated with one or more universities and funded by an amount drawn against existing NRC appropriations together with contributions from university and/or provincial partners

(c) a part of a non-profit organization mandated to manage what are currently NRC major science initiatives and potentially other such research infrastructure in Canada

(d) an institute or unit providing services in support of a public policy mandate and to be incorporated within the relevant federal department or agency.

4.2 IRAP — Transfer the Industrial Research Assistance Program to the proposed Industrial Research and Innovation Council (IRIC).

4.3 Structure and oversight — Institutes could be established as independent non-profit corporations, with the federal government's share of funding managed and overseen by the proposed IRIC for industry-oriented institutes in category (a) above, and by the Natural Sciences and Engineering Research Council (NSERC) or Canadian Institutes of Health Research (CIHR) for categories (b) and (c) above. (Apart from functions in category (d), any residual activities of NRC, or institutes that are unable to secure adequate funding, would be wound down according to an appropriate transition plan.)

Financing Growth of Innovative Businesses

We heard repeatedly that too many innovative firms with high growth potential have difficulty attracting sufficient risk capital to finance the path from an initially promising idea through to commercial viability. Similar observations have been made by earlier panels that have addressed the issue. Data demonstrate that the supply of risk capital for innovation-based businesses is comparatively much smaller in Canada than in the US. Consequently, Canadian start-ups are less likely to get the capital they need to achieve commercial viability. In addition, the preponderance of foreign (mostly US-based) investors in late-stage venture capital and buyouts of Canadian firms means that the intellectual property is likely to be exploited primarily outside Canada.

Recommendation 5

Help high-growth innovative firms access the risk capital they need through the establishment of new funds where gaps exist.

5.1 Start-up stage — Direct the Business Development Bank of Canada (BDC) to allocate a larger proportion of its portfolio to start-up stage financing, preferably in the form of a "sidecar" fund with angel investor groups.

5.2 Late stage — Provide the BDC with new capital to support the development of larger-scale, later-stage venture capital funds and growth equity funds in support of the private venture capital and equity industry. These funds would specialize in deal sizes of $10 million and above that are managed by the private sector and subject to appropriate governance practices.

Whole-of-Government Leadership

Innovation is the principal source of productivity growth in the long run, and thus lies at the heart of Canada's future prosperity. But innovation far transcends just the application of science and technology and R&D. A responsibility to foster innovation cuts across many functions of government and therefore requires a system-wide perspective and whole-of-government priority. This will require restructuring the governance of the government's business innovation agenda, while developing a shared and cooperative approach with provincial and business leaders.

Recommendation 6

Establish a clear federal voice for innovation, and engage in a dialogue with the provinces to improve coordination and impact.

6.1 Assign responsibility — Identify a lead minister responsible for innovation in the Government of Canada together with a stated mandate to put business innovation at the centre of the government's strategy for improving Canada's economic performance.

6.2 Whole-of-government advice — Transform the Science, Technology and Innovation Council (STIC) to become the government's external Innovation Advisory Committee (IAC), with a mandate to provide whole-of-government advice on key goals, measurement and evaluation of policy and program effectiveness, the requirement for new initiatives responding to evolving needs and priorities going forward, and all other matters requiring a focussed external perspective on the government's innovation agenda. The IAC should act though through two standing subcommittees: a Business Innovation Committee (BIC) and a Science and Research Committee (SRC).

6.3 National dialogue on innovation — Through the minister responsible for innovation, engage provincial and business leaders in an ongoing national dialogue to promote better business innovation outcomes through more effective collaboration and coordination in respect of program delivery, talent deployment, sectoral initiatives, public sector procurement, appropriate tax credit levels and the availability of risk capital.

In Conclusion

Guided by strong leadership and sound principles, and through concerted action, the end result of our recommendations will be a rebalanced system of federal assistance for business innovation that provides more effective support to innovative firms, especially SMEs, to help them grow and become large competitive Canadian enterprises. Federal support for business innovation will be outcome oriented, collaborative and innovative in its implementation. It will be held to account by state-of-the-art procedures for evaluation across the suite of programs. The Government of Canada will have assumed a leadership role by establishing innovation as a whole-of-government priority and by engaging the provinces, businesses and post-secondary institutions in a national dialogue on innovation.

Going forward, the Panel welcomes the opportunity to meet with government officials, business leaders and post-secondary institutions to discuss our recommendations. The agenda is ambitious, but so too is our vision — a Canadian business sector that stands shoulder-to-shoulder with the world's innovation leaders. While this is a long-term goal, government action must be swift and decisive, because the impact of the initiatives begun today may take years, even decades, to be fully realized.

The longest journey begins with the first step, so the time to act is now.

Chapter 1

Motivation and Mandate

Canadians enjoy an enviable standard of living, but sustaining our prosperity depends on maintaining economic competitiveness in a global context both filled with opportunities and fraught with challenges. Among these is increased competition due to a convergence of factors, including vastly more powerful communications technologies that have shrunk "economic space" and virtually overnight transformed the scope and intensity of competition. The emerging competitors — China, India, Brazil and many others in the wings or already on stage — are no longer merely the low-cost suppliers of services and manufactured goods. They are using education, research and development (R&D), and the commitment of their governments to innovate and rapidly ascend the value chain. The challenge for highly developed countries like Canada, accustomed to generations atop the global economic league tables, is clear.

Equally clear is the prospect that the emergent economies, already home to more than half the world's population, will convert their burgeoning prosperity into the greatest market opportunities ever. But these are not available simply for the asking. The winners will be the companies that can provide products matched to the culture, priorities and state of development of the new customers — for example, medical devices that perform at close to state-of-the-art but for a small fraction of the cost. The fact is that the emerging markets already include large and rapidly growing populations of middle and upper income consumers equipped with both spending power and new generations of infrastructure such as advanced wireless networks. In short, to seize the opportunities and to meet the challenges of today's economy, Canadian businesses need to adopt a thoroughly global outlook coupled with a focus on innovation. This will require, for many, a significant shift in habit, perspective and strategy.

Perhaps the greatest risk is complacency. Canadians can be justly proud of the way the country has fared during the recent crisis years. A sound banking system, buoyant demand for many of our natural resources, ready access to the world's greatest market on our southern border, and years of prudent fiscal management have served Canada well and will continue to do so. But a strong Canadian currency and stubborn economic weakness in the United States, our dominant export market, challenge Canadian businesses to become much more innovative.

Being more innovative is also what is needed to take advantage of leading-edge technologies like biotechnology, nanotechnology and information technology. These are giving rise to entirely new markets and are providing novel approaches to the pressing challenges of our era — such as how economies can continue to grow in ways that are environmentally sustainable, or how health care expectations can be met in ways that are fiscally sustainable.

At the same time, the ageing of the baby-boom generation means that the share of Canada's population that is of working age will decline, thus increasing the competition for workers and skills and requiring more output per worker — that is, greater productivity — to support a growing proportion of dependants.

Taken together, these realities imply that Canada's prosperity will depend, more than ever, on an innovative economy. Innovation drives our ability to create more economic value from an hour of work. The resulting productivity growth increases economic output per worker, creating the potential for rising wages and incomes, and thus for a higher standard of living. It is for this reason that business innovation delivers great benefit, not only for individual firms, but also for society as a whole.

Countries around the world have recognized the importance of business innovation as the ultimate source of competitive advantage and increasing prosperity. Many governments are therefore increasing support for innovation even as they struggle to balance overall budgets. Significant efforts are being devoted to the development of new and more effective ways to encourage and support business innovation. In fact, just as businesses are challenged to become more innovative, so too are public policy-makers.

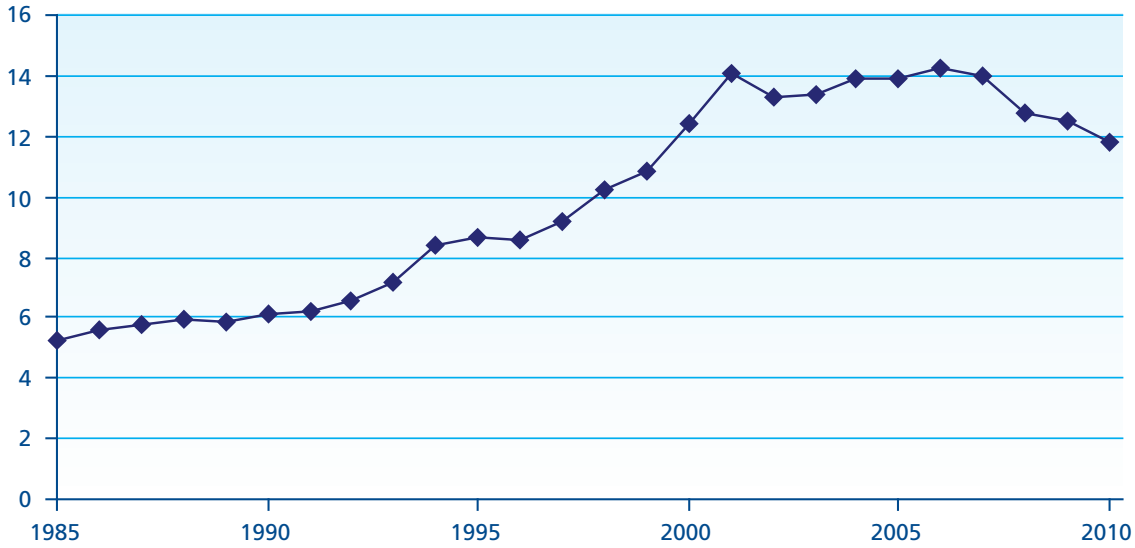
The federal and provincial governments play an important role in fostering an economic climate that encourages business innovation — for example, by supporting basic and applied research and related training of highly qualified, skilled people, and by providing substantial funding through tax incentives and program support to directly enhance business R&D.

For decades, Canadian business spending on R&D — a key input to many kinds of innovation — maintained a steady up-trend, evidence of the country's economic and technological progress. Other highly industrialized countries were doing the same, so R&D spending by Canadian businesses remained near the middle of the pack of our peer group of member countries of the Organisation for Economic Co-operation and Development (OECD), and well behind leaders like the United States, Japan, Germany, Sweden and Finland (OECD 2011). But until the collapse of the "tech bubble" in 2001, our R&D gap, relative to the OECD average, had begun to narrow, driven by exceptionally strong R&D spending in the telecommunications equipment sector as Internet and wireless infrastructure was rapidly built out. Then, suddenly, the decades-long up-trend of business R&D in Canada stalled. In fact, business R&D spending (adjusted for inflation) has been falling since 2006 and is now below its level in 2001 (Figure 1.1).

Research and development is a key ingredient in a great deal of business innovation and is also an essential contributor to Canada's international competitiveness and productivity growth. The fact that Canada's business R&D momentum stalled a decade ago and has not resumed is both alarming and unacceptable. It is urgent that business R&D in Canada start growing strongly again.

Recognizing this, Budget 2010, *Leading the Way on Jobs and Growth*, announced a comprehensive review of federal support to R&D in order to optimize federal contributions to innovation and to economic opportunities for business (Department of Finance 2010a). The decision to undertake this review came in the wake of a series of reports — including *State of the Nation 2008* (since updated for 2010) by the Science, Technology and Innovation Council (STIC 2011), and *Innovation and Business Strategy: Why Canada Falls Short*, by the Council of Canadian Academies (CCA 2009) — which provided in-depth analyses of Canada's weak performance in the interrelated areas of business R&D, business innovation and productivity growth.

Figure 1.1 Canadian Business Expenditure on Research and Development (BERD), 1985–2010 (billions of 2000 constant dollars)



Source: OECD (2011).

On October 14, 2010, the government appointed an independent panel to undertake the review. The members of our Panel are:

- Thomas Jenkins (Chair), Executive Chairman and Chief Strategy Officer, Open Text Corp.
- Bev Dahlby, Professor of Economics, University of Alberta
- Arvind Gupta, Chief Executive Officer and Scientific Director, MITACS Inc.
- Monique F. Leroux, Chair of the Board, President and Chief Executive Officer, Desjardins Group
- David Naylor, President, University of Toronto
- Nobina Robinson, Chief Executive Officer, Polytechnics Canada.

This report is the culmination of the ensuing year-long review — an exercise focussed on enhancing federal government programming to foster a more innovative Canadian economy, thereby improving the competitiveness of Canadian firms and the productivity of the economy.

The Panel's Mandate

Building on the foundational work of the CCA and STIC, we were asked to conduct an assessment of key programs within the government's portfolio of initiatives in support of business and commercially oriented R&D — specifically, the following:

- tax incentive programs such as the Scientific Research and Experimental Development (SR&ED) program
- programs that support innovative business R&D, including general support, sector support and regional support

- programs that support business-focussed R&D through federal granting councils and other departments and agencies, including research performed in universities and colleges that fosters support for business R&D, such as the Centres of Excellence for Commercialization and Research program.

We were given the latitude to consider other federal initiatives relevant to the review's scope. However, the review was to exclude: (i) research conducted in federal laboratories to fulfil their regulatory mandates and (ii) basic research conducted in institutions of higher education and not intended to foster support for business R&D.

We were asked specifically to provide advice related to the following questions:

- What federal initiatives are most effective in increasing business R&D and facilitating commercially relevant R&D partnerships?
- Is the current mix and design of tax incentives and direct support for business R&D and business-focussed R&D appropriate?
- What, if any, gaps are evident in the current suite of programming, and what might be done to fill these gaps?

Consistent with our mandate, we were asked to address any and all federal programs that have an impact on business or commercially oriented R&D, as well as how such programs fit within the larger innovation context. The mandate specified furthermore that our recommendations should not result in an increase or decrease in the overall level of funding required for federal R&D initiatives. Where we have recommended measures that would yield savings, we have also identified areas in need of the funds that would be freed up. Our primary objective has been to advise on how the government's existing outlays in support of business and commercially oriented R&D can be deployed more effectively to promote innovation, productivity growth and increased prosperity for Canadians. Therefore, while the immediate effect of our recommendations is meant to be budget neutral, the ultimate impact will be a more productive economy and a stronger fiscal position.

The Panel's Approach

In fulfilment of our mandate, we have, with the aid of a secretariat seconded from the federal government, overseen a thorough process of research, program assessment and consultation. The research included expert briefings, an extensive literature review and other technical background work by, or on behalf of, the secretariat. The program assessment, which is described more fully in Chapter 3, encompassed a set of 60 programs covering the gamut of federal initiatives to foster business R&D.

Our consultation phase began with the issue of a public consultation paper in December 2010. This elicited 228 submissions — 96 from companies, 80 from organizations and associations, 38 from academic institutions, seven from governments or governmental organizations, and seven from individuals. To supplement written submissions, face-to-face consultations were held in Vancouver, Calgary, Winnipeg, Waterloo, Toronto, Ottawa, Montréal, Québec and Halifax. We met a total of 164 participants during the course of 32 sessions, each of which focussed on a theme or sector of relevance to the host region. Meetings were also held with senior officials from many federal departments and agencies and from all provinces.

We extended the scope of in-person consultations beyond Canada to learn about international perspectives on issues germane to

this review. Meetings took place in Australia, Germany, Singapore, the United Kingdom and the United States, and with officials of the OECD and Tekes[1] in Paris.

We complemented our face-to-face consultations with a survey conducted by EKOS Research Associates Inc. of more than a thousand R&D-performing businesses of varying sizes, sectors and provinces. The survey results provided us with a rich base of data, from the client perspective, on the impact, strengths and weaknesses of federal support for business R&D.

This extensive process of consultations, research and program assessment, supplemented by our own deliberations and analyses, formed the basis upon which we developed our advice for the government.

[1] Tekes is a Finnish funding agency for technology and innovation.

Chapter 2

The Context of the Review

The purpose of this chapter is to provide a brief overview of the principal concepts as well as facts and figures regarding business innovation in Canada and in relation to our peer group of highly developed countries. It draws on reports by the Council of Canadian Academies (CCA) and the Science, Technology and Innovation Council (STIC), work by Statistics Canada and the Organisation for Economic Co-operation and Development (OECD), and background research conducted for the Panel.

Innovation and Productivity Growth

The material standard of living of a society depends on productivity — the value of goods and services produced per hour of work. A high level of employment is clearly important, and favourable movements in the world prices of a country's exports — for example, certain natural resources in Canada's case — can boost prosperity, at least for a time. But over the long run, it is labour productivity growth that drives increases in average per capita incomes and business competitiveness. Productivity growth, in turn, is primarily the result of innovation.

In a phrase, innovation means "new or better ways of doing valued things" (CCA 2009, p. 21). Innovation is not synonymous with invention, although the spark of invention or creativity is a necessary precedent for innovation. Business innovation occurs when a new or improved "something" — a good, a service, a process, a business model, a marketing tool or an organizational initiative — is put into practice in a commercially significant way. In more technical terms, the *Oslo Manual* (OECD and Eurostat 2005, p. 46) reflects the current international consensus that defines innovation as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations" (see also Box 2.1).

The means by which an idea or prototype is transformed into a market-ready product is often referred to as commercialization and is at the core of the process by which invention becomes business innovation — the process from "mind to market." Commercialization is a multi-faceted and multi-stage phenomenon that, depending on the product, often involves design, engineering, production planning and the related research and development (R&D). Moreover, it almost always involves capital investment, market assessment and sales planning as well as financial and legal analysis, among other activities.

Some innovations — like the automobile, the Internet or penicillin — are game changers. But the vast majority of innovation is incremental — the continuous improvement of products and processes. Innovations must of course start somewhere but, unless and until an innovation

Box 2.1 Types of Innovation and Their Support by Government

The *Oslo Manual* (OECD and Eurostat 2005) defines innovation broadly to encompass product, process, organization and market innovation. This four-part typology is elaborated upon by Lynch and Sheikh (2011) as follows.

- **Product innovation.** New products (whether goods or services) that move up the value-added chain or are first to market typically carry higher profit margins because they face less cost competition than standardized products. New information and communication technology devices and software or new (pre-generic) pharmaceuticals are typical examples. Product innovation can be the result of R&D and/or of aggregating existing leading technologies in a new way that better meets customer demands, as illustrated, for example, by the "smart phone" (wireless telephony, GPS, email, camera, etc.).
- **Process innovation.** The objective is to change how products are produced and delivered to reduce cost and/or to increase convenience for users. Topical examples include development of global supply chains, and Internet-based shopping. Many Canadian manufacturers have proven to be adept "plant floor" process innovators — for example, Canadian auto plants are regularly rated among the most productive in North America. Innovation by Canadian natural resources companies — in oil and gas, mining and forest products — has also focussed mainly on processes as distinct from the development of advanced machinery for resources production or leading-edge products derived from natural resources. A spectacular example of Canadian process innovation is the "steam-assisted gravity drainage" (SAGD) method for bitumen recovery from oil sands.
- **Organization innovation.** The capacity to convert creativity, technology and knowledge about customers into marketable innovations requires a corporate focus on how to best organize and manage for innovation. Successful business innovation requires the integration of human capital management and training, technology management and strategic management into structures that are "innovation supportive."
- **Market innovation.** Examples include entering a new geographical market (e.g., a high-growth emerging market like China, India or Brazil), or addressing a market in an entirely new way (e.g., via the Internet or a smart phone channel). This can shift a firm from fighting for market share in existing markets to a temporary "monopoly" position for its particular product in the new market.

Innovations in product, process and market will usually require complementary innovation in organizational form and behaviour in order to be fully effective. While all four types of business innovation are potentially mutually reinforcing, most government programs that support business innovation address directly product and process innovation and, more specifically, R&D and related investment in appropriately trained people, as well as risk sharing for investment in innovative early-stage companies. (The latter are usually built around a novel product or process.)

Organizational innovation is highly specific to an individual firm and therefore does not lend itself to direct support by government programs, although such innovation may be fostered indirectly by any policy or program that encourages business innovation generally. Market innovation is also usually firm specific, although there is scope here for government program support, particularly to facilitate access to important new geographic markets.

spreads widely, it is of relatively little economic or social significance. In the context of productivity growth, the process of innovation diffusion and adaptation is most important, since most innovation that occurs in any given area or jurisdiction is through adaptation of significant innovations originating elsewhere (CCA 2009, p. 27). The adoption/adaptation by an individual enterprise of a new or better way of doing something is therefore also recognized as a form of business innovation — indeed, the most common. It often requires substantial creativity to redesign business processes, organization, training and marketing to take advantage of the adopted innovation.

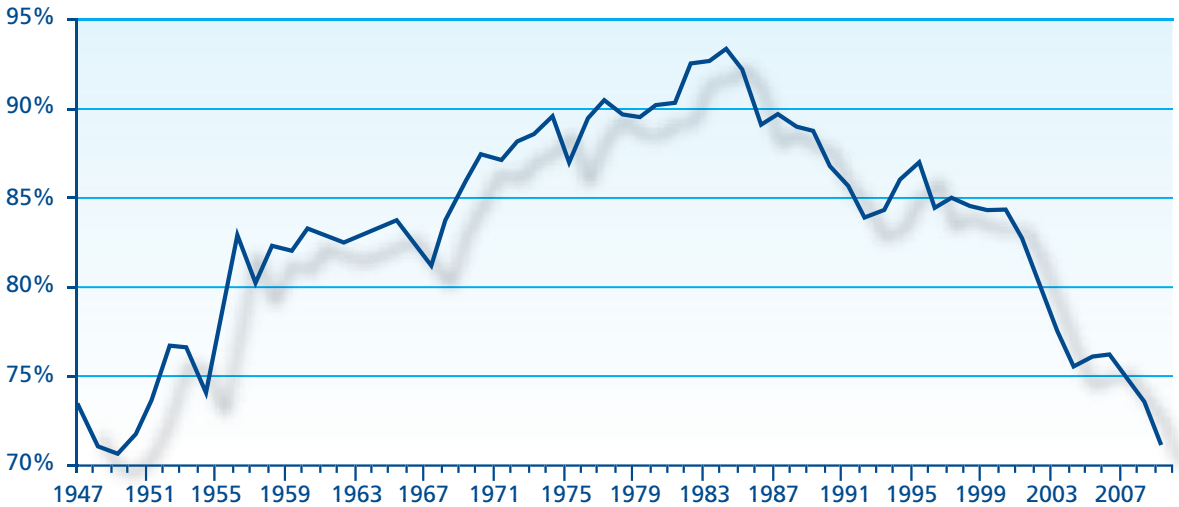
Canada has a business innovation problem. The most telling indicator is Canada's subpar productivity growth, which has averaged a mere 0.6 percent over the 2000–2009 period, or less than half the average of 1.5 percent for all OECD countries (OECD productivity database, accessed November 2010). Relative to the United States (US), as depicted in Figure 2.1, labour productivity in Canada's business sector has fallen from approximately 93 percent of the US level in 1984 to 71 percent in 2009 — a quarter-century of relative decline that cannot be explained by temporary or one-time factors.

The Canada–US gap has been analysed statistically in terms of the three principal factors that account for labour productivity growth:

- **workforce composition** — changes in the level of education, training and experience of the workforce
- **capital deepening** — growth in the amount of capital used to support workers
- **multifactor productivity (MFP) growth** — a residual measure that captures all other factors that affect productivity. MFP reflects how effectively labour and capital are employed jointly to produce output. Investment by businesses in R&D is one important contributor to long-run MFP growth.

Analysis by Statistics Canada of the evolution of these three factors in Canada and the US over the years from 1961 to 2008 shows conclusively

Figure 2.1 Relative Level of Labour Productivity in the Business Sector, 1947–2009
(Canada as a percentage of the United States)



Source: CSLS (2011a).

Figure 2.2 Sources of Canada–US Gap in Average Annual Labour Productivity Growth
(differences in percentage growth rates: Canada minus the US)[a]

	1961–2008	1961–1980	1980–2000	2000–2008
Gap in labour productivity growth	-0.3	0.4	-0.4	-1.9
(i) Capital deepening	0.4	0.8	0.2	0.1
(ii) Workforce composition	0.2	0.4	0.1	0.1
(iii) Multifactor productivity	-0.9	-0.9	-0.6	-2.1

[a] The numbers in the first line of the table — the difference between Canada and the US in average annual labour productivity growth — are equal to the sum of lines (i) through (iii), which decompose the productivity growth gap into components related to capital intensity, workforce composition and MFP (subject to rounding).

Source: Baldwin and Gu (2009).

that Canada's productivity growth problem is due to persistently weak MFP growth, particularly during the past decade (Baldwin and Gu 2009; also see Figure 2.2). Although a multiplicity of factors is involved, longer-term MFP growth trends reflect the pace of business innovation (CCA 2009, pp. 36–44). It follows that Canada's subpar productivity growth is largely attributable to relatively weak business innovation. (There are of course a great many highly innovative Canadian businesses but, relative to many other advanced countries, they play a proportionally smaller role in Canada's economy.)

Innovation and R&D

Investment by businesses in R&D is a key input to many kinds of innovation (Box 2.2). In view of the relatively weak R&D spending by Canadian businesses (Box 2.3), it is not surprising that MFP growth has also been weak.

The great majority of business R&D is undertaken to support defined market objectives and is thus at the "development" end of the R&D spectrum. (Activities characterized as "experimental development" make up about 80 percent of business R&D spending in Canada; see Statistics Canada 2009.) Although the business sector accounts for a much smaller percentage of total R&D in Canada than in countries such as the US, Germany, Japan or Sweden, business is nonetheless the largest R&D performer in the country, accounting for more than 50 percent of the total (OECD 2011).

Box 2.2 Defining R&D

The *Frascati Manual* (OECD 2002), first published in 1963, is the basis for the OECD's definition of R&D, which emphasizes the creation and novel use of knowledge. The measurement of R&D expenditure includes both current costs (labour costs and non-capital purchases of materials, supplies and equipment) and capital costs (land and buildings, instruments and equipment, and computer software) devoted to R&D, which covers three activities:

> Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view. Applied research is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective. Experimental development is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed. (OECD 2002, p. 30)

The annual spending on R&D performed by a country's business sector is referred to as BERD (business expenditure on R&D), while that performed by the higher education sector is referred to as HERD (higher education expenditure on R&D). Reference is often made to "BERD intensity" or "HERD intensity," defined as the value of BERD or HERD expressed as a proportion of gross domestic product (GDP).

In the above definition of R&D, the emphasis on knowledge creation and novel use has important implications for the classification of scientific activities as "R&D" as distinct from "scientific or technological services." For example, the search for reserves of oil and gas qualifies as R&D only if new survey methods or techniques have been developed to undertake the search. Similarly, exploratory drilling is not R&D, but there may be cases where the development of new drilling methods or techniques would qualify as R&D.

While the definition of R&D has remained unchanged since the first edition of the *Frascati Manual*, its methodological guidelines have expanded and now include greater attention to the measurement of R&D in services. The *Frascati Manual* is accepted by consensus of all OECD countries, thus ensuring international agreement on the definition of R&D, as well as the application of guidelines for its measurement. There is nevertheless still some room for national differences of interpretation as well as variation in the depth and specificity of data collected by statistical agencies for indicators such as HERD and BERD. So while OECD data allow for meaningful international comparisons of R&D activity, perfect cross-national comparability remains an aspiration and not yet a reality.

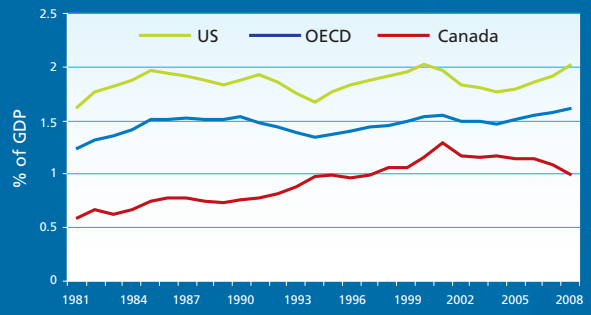
Box 2.3 International Comparisons of R&D Spending

Canada is a middle-of-the-pack performer in the OECD with respect to gross domestic expenditure on R&D (GERD) as a percentage of GDP, ranking 15th in 2008 out of the 31 countries for which data are available. Total R&D can be broken down among three principal groups of performer — business, higher education and government (see also Figure 2.5).

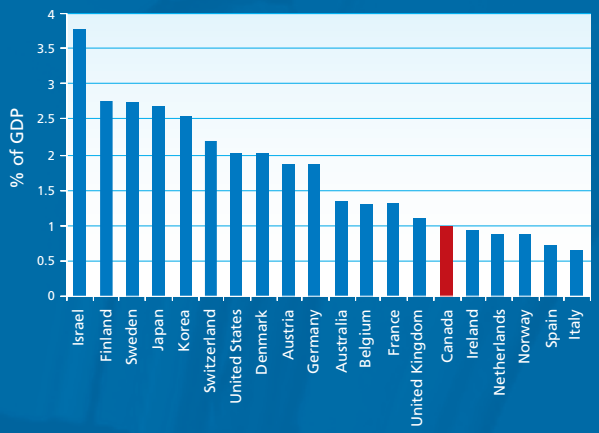
In 2008, Canada ranked 18th among 31 OECD countries in respect of business expenditure on R&D (BERD) as a percentage of GDP. (In the figure to the right below, based on 20 comparable countries in terms of size and degree of development, Canada's BERD intensity was at the bottom of the third quartile.) At 1 percent of GDP, Canada's BERD intensity was well below the OECD average of 1.6 percent and, moreover, has declined steadily since the peak of the "tech boom" in 2001 (see the figure to the left below). In fact, business R&D spending, adjusted for inflation, has been declining every year since 2006 (Figure 1.1). This trend is both surprising and ominous. By contrast, Canada's higher education sector is a relatively strong R&D performer, ranking fourth in the OECD at 0.68 percent of GDP in 2008, although the trend of this ratio has been fairly flat since 2003. (International rankings fluctuate from year to year and are sensitive to inevitable inaccuracies in data. General positioning within comparable groups of countries and trends over time are the more relevant indicators in international comparisons.)

The amount of R&D performed by governments in Canada (not to be confused with the amount funded by governments) has been flat to slightly declining as a percentage of GDP for more than 10 years and, at 0.19 percent of GDP in 2008, was well below the OECD average of 0.26 percent.

BERD Intensity Trends, 1981–2008



BERD Intensity of Selected OECD Countries, 2008

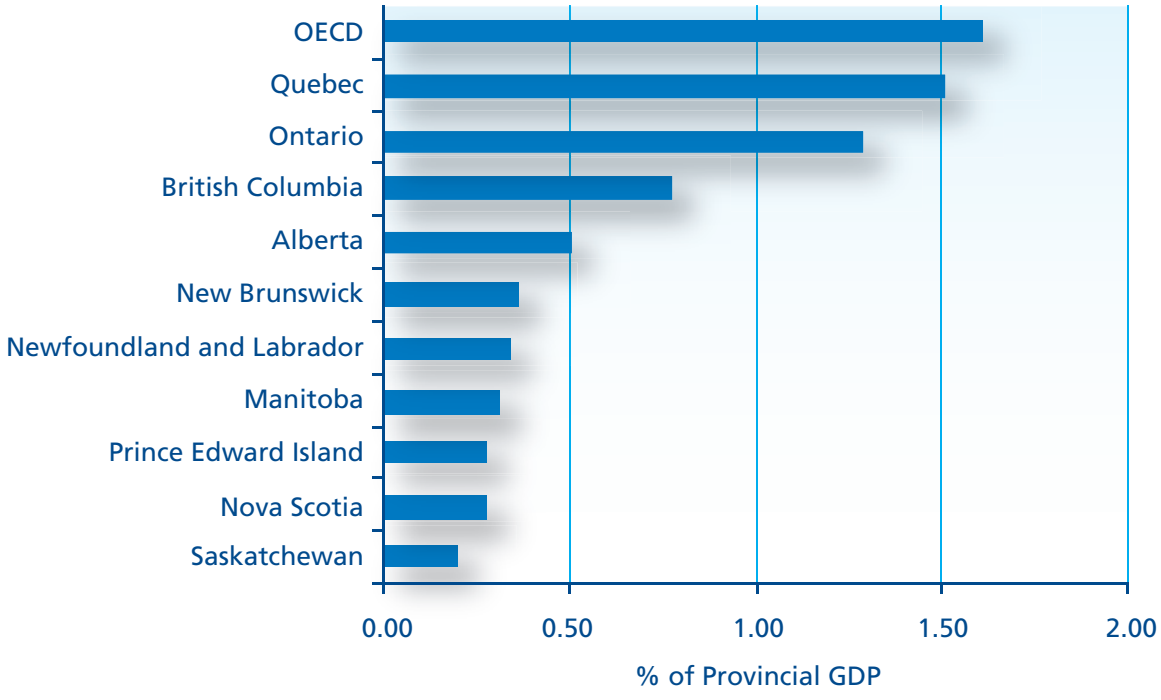


Source: OECD (2011).

In absolute terms, BERD in Canada is weighted toward a relatively small number of large firms in a limited number of sectors. About a third of BERD is performed by only 25 firms and about half by 75 firms (Statistics Canada 2011). However, while the vast majority of smaller businesses throughout the economy do not perform R&D, those that do so tend to be more R&D intensive than larger firms — that is, they spend more on R&D as a percentage of company revenue. Statistics Canada's preliminary data for 2008 indicate that R&D expenditure among the largest R&D-performing companies (those with revenues exceeding $400 million) represented about 1 percent of their revenue, whereas for the smallest R&D-performing companies (revenue of less than $1 million), the figure was almost 40 percent (Statistics Canada 2011).

BERD intensities (that is, business R&D as a percentage of GDP) vary widely across sectors, with the most intensive being within the broad manufacturing sector — particularly computer and electronic products, pharmaceuticals and medicine, and aerospace products and parts. From a regional perspective, there is also significant variation in BERD intensity (Figure 2.3). Ontario and Quebec account for roughly 80 percent of Canada's business R&D (Statistics Canada 2010b), reflecting the relatively high proportion of R&D-intensive industries such as information and communication technologies (ICT), pharmaceuticals and aerospace in those two provinces.

Figure 2.3 Provincial BERD Intensities in Canada, 2008
(business expenditure on R&D as a percentage of provincial GDP)



Source: Statistics Canada (2010b) and OECD (2011).

The Canada–US BERD Gap

The Canada–US gap in respect of BERD intensity (see chart in Box 2.3) had narrowed significantly by the time of the collapse of the "tech boom" in 2000–01, but has widened considerably since 2003. A sector-by-sector analysis of the gap over the 16-year period 1987–2003 (the most recent year for which a full set of comparable data is available) considered the effect of two key factors in contributing to the gap: (i) variations in the sectoral composition of the Canadian and US economies and (ii) differing R&D intensities within the same sectors. It concluded that "generally lower Canadian R&D spending within the same sectors in both the United States and Canada accounts for a greater portion of the gap . . . than does Canada's adverse sector mix — i.e., the greater weight in Canada's economy of resource-related and other activities that have inherently low R&D spending" (CCA 2009, p. 6). In other words, relative to the US, there is a pervasive weakness in BERD intensity across many sectors in Canada.

Differences between Canada and the US in the distribution of firm size could affect the business R&D gap. However, Canada's greater proportion of small firms does not explain a meaningful proportion of the gap (CCA 2009, p. 102, drawing on the work of Boothby, Lau and Songsakul 2008). This is because the fraction of total R&D performed by small firms — those with fewer than 20 employees — is very small and therefore the US–Canada difference in the proportion of such firms necessarily accounts for a very small part of the R&D gap. To the extent there is a size effect, it is within the largest firms — those with 500 or more employees. Such firms account for a large proportion of total R&D and Canada's share of them is relatively low. (As noted above, small firms that perform R&D tend to be more research intensive than larger firms; however, the latter have bigger revenue bases and, despite having lower average R&D intensities, account for the majority of total business R&D spending.)

The prevalence of foreign-controlled companies in Canada is also relevant to the BERD gap, since corporations often conduct the majority of R&D near their headquarters — the auto assembly industry being a prime example of particular significance for Canada. This contributes to the proportionately lower volume of business R&D performed in Canada (CCA 2009, pp. 97–102). Several caveats are nevertheless in order. First, a number of Canadian industries with extensive foreign ownership are quite R&D intensive — for example, pharmaceuticals, aerospace and computers. Second, even in instances where foreign multinationals conduct most of their R&D abroad, Canadian subsidiaries still benefit from R&D embodied in capital equipment and from the transfer of other innovative processes and know-how originating in the parent company. Finally and most importantly looking forward, global companies are increasingly doing R&D in the most advantageous locations all over the world. The job for Canada therefore is to create the conditions to attract an increasing share of the global market for R&D.

In summary, the level and pattern of R&D spending by the business sector in Canada — as well as the gap in BERD intensity between Canada and the US — are the result of an extraordinarily complex combination of influences. If there is one overarching factor at play, it is the lower commitment of Canadian businesses, taken as a whole, to innovation-based strategies relative to counterparts in the US and many other economically advanced countries. Well-designed public policies and programs can influence the business strategy choice toward a greater role for innovation, but the more powerful incentive will come from the forces in the marketplace identified in the following section.

Innovation and Business Strategy

What influences the decision of an enterprise to make innovation the core of its competitive strategy? What leads some firms and not others to look constantly for ways to create or enter new markets, to develop new or improved products, to tolerate the disruption of introducing more efficient processes and organization, and to take the (calculated) risks that innovation always involves? Although there is no consensus on all the factors that come into play, the Panel adopted, as a working hypothesis, a modified version of the logic model developed by the CCA's Expert Panel on Business Innovation (Figure 2.4). According to this view, a firm's decision on whether (or not) to adopt an innovation-based strategy depends principally on the following six broad factors, the relative importance of which will vary with the firm's specific circumstances.

- **Market opportunities.** A successful business strategy depends, first and foremost, on an understanding of the needs of the customer and the related identification of market opportunity. Business strategies focussed on innovation constantly seek better ways to meet existing customer needs — for example, the overnight courier — or ways to stimulate entirely new sources of demand — for example, the smart phone.
- **Structural characteristics.** Is the firm in a sector that is traditionally innovation oriented, such as biotech or computers, or is it involved in the provision of a more standard product or service? Is the firm a subsidiary of a foreign company that conducts most R&D abroad? Does the firm sell its product to the end-user, or does it provide an intermediate input — for example, lightly processed resources — in a global value chain?
- **Competitive intensity.** Must the firm continuously innovate to survive because it provides a product or service driven by evolving customer tastes? Is the firm active in a market (domestic or foreign) that is exposed to intense global competition and must therefore innovate to survive and prosper?
- **Climate for new ventures.** Is the firm part of an innovation cluster in which there is a readily available supply of sophisticated venture financing, cutting-edge knowledge, highly skilled graduates and other firms with complementary expertise?
- **Public policies.** Are legal and regulatory frameworks and policies — for example, in areas such as competition, corporate taxation, bankruptcy and intellectual property — conducive, or not, to business innovation?
- **Business ambition.** What is the corporate culture of the firm? To what extent is it risk averse? To what extent is it dedicated to expansion?

It is beyond the scope of this review to address all of these factors. The Panel's mandate is focussed on federal government support programs for R&D that is undertaken by business or that is commercially oriented. The effectiveness of that support will nevertheless depend ultimately on the extent to which businesses in Canada are motivated to adopt innovation-based business strategies that require R&D to be performed. In this regard, competitive intensity provides the strongest motivation overall. In business, the "necessity" created by competition is often the "mother" of innovation. The Panel's advice in this review will therefore have much more impact on Canada's economic performance if it is complemented by a suite of policies to foster competition as recommended by the Competition Policy Review Panel (2008), also known as the "Wilson panel" (see Annex B). That panel pointed to several sectors that remain buffered from competition by various regulations, including restrictive

Figure 2.4 A Firm-Centric Model of the Business Innovation Process

Source: Based on the logic map of the business innovation process developed by the Council of Canadian Academies' Expert Panel on Business Innovation and adjusted in response to stakeholder comments to the Panel (CCA 2009, p. 85).

foreign ownership rules. Regulated industries account for about 15 percent of Canada's overall business sector GDP (Gu and Lafrance 2010, p. 50; based on 2006 nominal GDP), which suggests that there is significant scope for regulatory reform to foster competition and, as a result, innovation and productivity growth.

A business strategy focussed on innovation is what creates the demand for R&D as a key input. On the other hand, the extent of R&D undertaken by a company will also depend on its cost. Consequently, if government policies and programs reduce the supply cost of R&D for a business, it will likely undertake more R&D than would otherwise be the case. Research and

development incentives may even be sufficiently attractive to induce a shift over time in a business's strategy toward a greater focus on innovation.

Business Innovation: Beyond R&D

Innovation occurs throughout the economy, in all sectors and in firms of all sizes. Consequently, business innovation involves much more than R&D. This is abundantly clear in the OECD's definition of innovation cited earlier and in Box 2.1. Innovation is found not only, or even primarily, in sectors associated with high technology, although the effective use of technology continues to be a key driver of innovation and productivity growth in modern economies. Even in sectors where R&D is prevalent, many innovations are developed without it. For example, based on survey data from 22 countries (including Canada's manufacturing sector), a recent OECD report indicates that "a large share of firms develop their process, product, organizational or marketing innovations without carrying out any formal R&D. This holds true even for new-to-market innovators who successfully introduce innovations regarded as 'technological'" (OECD 2010a, p. 23).

Research and development is nevertheless of disproportionate significance for the economy, since it contributes in an essential way to innovation in many of the most dynamic firms and sectors that are at the leading edge of global growth and value creation — for example, firms that either produce or intensively use pervasive technologies like ICT, biotechnology and advanced materials. There is usually a close relationship between activities that are heavily knowledge based and those that require R&D. Business expenditure on R&D also correlates strongly with other standard indicators of innovation such as patents, exports of technology-intensive products and employment of people with advanced education. Moreover, the economic benefit of R&D spending is rarely confined to the R&D performer alone, and instead "spills over" to other firms, thus amplifying the economic impact. For all of these reasons, a thorough survey of the literature by the US Congressional Budget Office concluded that "a consensus has formed around the view that R&D spending has a significantly positive effect on productivity growth," while allowing that it is difficult to quantify the effect precisely (2005, p. 1).

The Panel, consistent with its mandate to address business R&D in the larger context of innovation, considered not only those government programs that foster increased business R&D investment directly, but also those that support the key factors that complement R&D in a firm's innovation strategy. These are captured in Figure 2.4 as the four categories of enabling inputs needed to implement an innovation strategy in cases where R&D is a key component. The four complementary innovation inputs are:

- ideas and knowledge that underpin innovation
- talented, educated and entrepreneurial people whose imagination and energy drive the development and implementation of innovative business strategies
- networks, collaborations and linkages that enable innovation partners to pool staff and resources, and to share information, risks and costs
- capital and financing that help entrepreneurs build a bridge between their innovative ideas and commercial viability.

This review is focussed on federal initiatives to help businesses develop or access each of these inputs. To set the context for the Panel's findings and recommendations in subsequent chapters, what follows is a discussion of the four

identified inputs to R&D-based business innovation, drawing on recent studies to summarize the key facts and hypotheses.

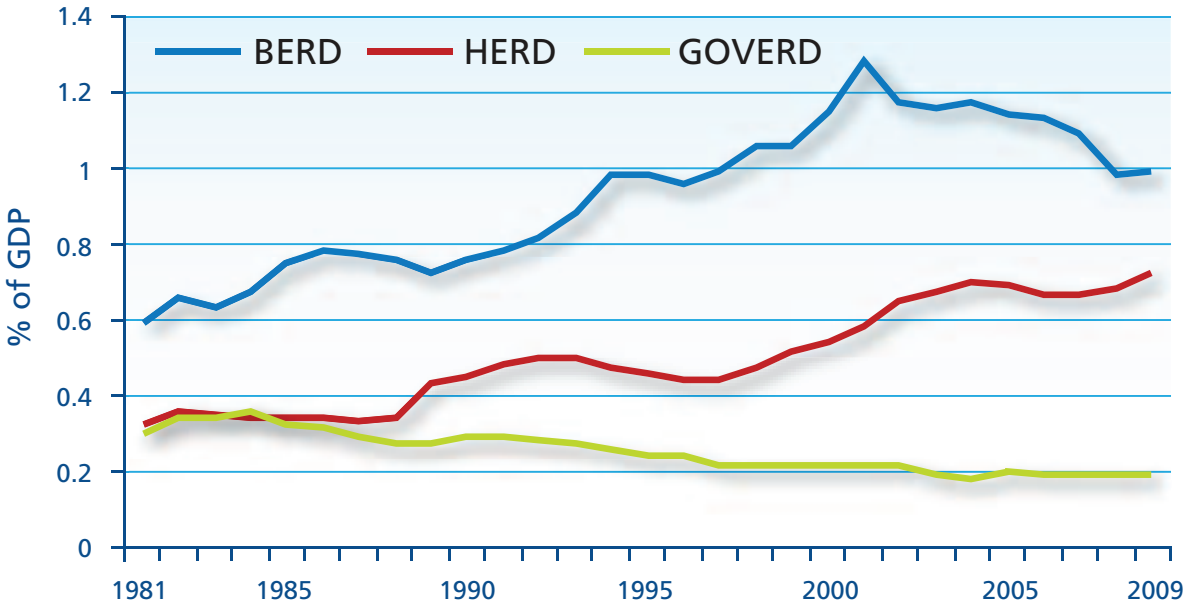
Innovation Input: Ideas and Knowledge

In the context of this review, the acquisition by a company of ideas and knowledge refers primarily to the output of R&D, whether performed in-house or sourced externally. There are, of course, many other channels by which businesses acquire the ideas that stimulate innovation. In fact, surveys of innovating firms demonstrate consistently that the great majority of ideas originate with employees, customers and other firms (Box 2.4). Nevertheless, converting these ideas into something of commercially significant value will often require R&D to be undertaken, and almost always when there are technical complexities to be understood and mastered. Moreover, firms engaged in R&D and close to the frontier of relevant technology are better placed to adopt or adapt innovations that originate elsewhere.

The total value of all R&D performed in Canada in 2009 was just under $30 billion, or 1.92 percent of GDP. The business sector accounted for the largest portion of this amount ($15.2 billion), followed by the higher education ($11.1 billion) and government ($3 billion) sectors (OECD 2011). The history of R&D spending (relative to GDP) of these three major performing groups is traced in Figure 2.5.

As discussed earlier, the higher education and government sectors are key players in Canada's innovation system and complement the role of business. Universities perform the great majority of basic research, although basic and applied research activities are increasingly intertwined. The R&D undertaken at colleges and polytechnics is often focussed on helping

Figure 2.5 R&D Expenditure in Canada, 1981–2009 (percentage of GDP)



Source: OECD (2011).

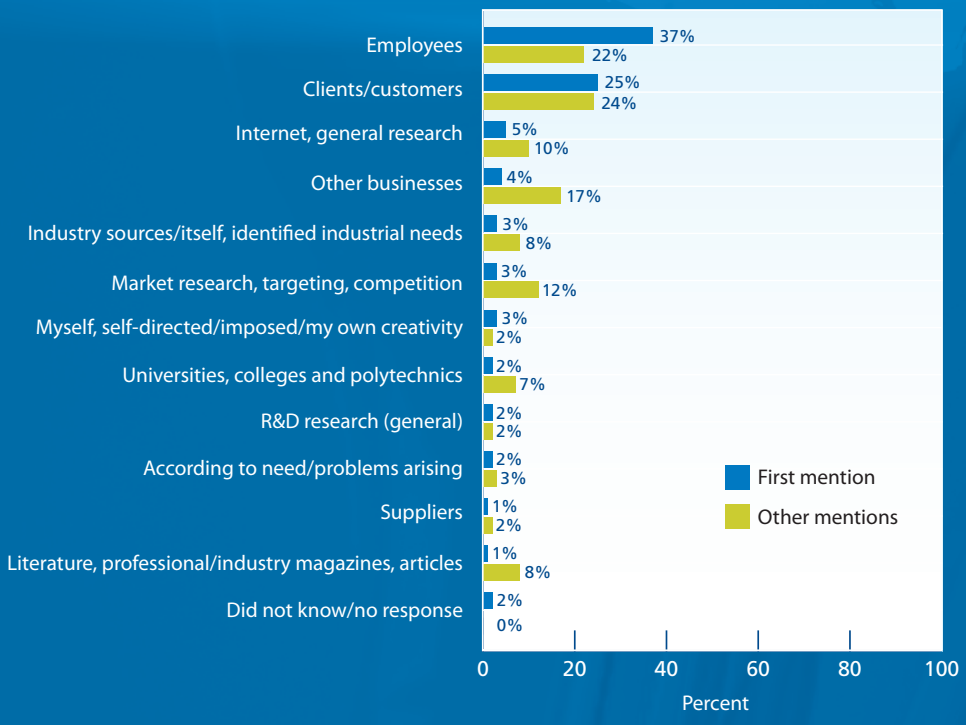
Box 2.4 Where Do Businesses Get Their Ideas for Innovation?

The Panel undertook a survey of R&D-performing firms in Canada with a sample of more than one thousand companies randomly selected to be representative along the dimensions of size, region and sector.[a] A key question in the survey asked: "What are the most important sources for your firm's innovation ideas?" (respondents were able to identify multiple sources). More than a third (37 percent) first mentioned "employees" as the most important source of innovation ideas, and an additional 22 percent identified employees in further mentions. The next most important source was "clients/customers" (25 percent of first mentions). No other source of innovation ideas was first mentioned by more than 5 percent of the surveyed R&D-performing businesses.

[a] Further discussion of the survey is found in Chapter 5.

Most Important Sources of Firms' Innovation Ideas

"What are the most important sources for your firm's innovation ideas?"
[Open ended – Multiple responses accepted]



n = 1009

Source: Results from a survey of firms conducted for the Panel by EKOS Research Associates Inc., 2011.

companies address commercialization challenges by turning those challenges into student-led applied research problems. Colleges and polytechnics also directly assist firms with their innovation needs — this is the case, for example, with the long-standing College Centres for the Transfer of Technologies associated with Quebec colleges and Cégeps, which assist innovative companies through technical support, technological development, and information and training (see also Figure 2.6). Government laboratories, meanwhile, conduct science in support of public policy mandates as well is in relation to certain commercially oriented activities.

Innovation Input: Talented, Educated and Entrepreneurial People

Canada's future as an innovation-based economy depends on ensuring there are sufficient numbers of talented, educated and entrepreneurial people. The primary source of such talent is our public post-secondary education institutions — the universities, polytechnics and community colleges (including Cégeps in Quebec) that produce the innovators and those who support innovative activity. These institutions are primarily funded through the provinces, although the federal government plays a role through transfer payments, student financial assistance and direct support for research training and innovation skills enhancements. The diversity of higher education institutions with varying missions and mandates provides Canada with the highly qualified and skilled people who are the bedrock of innovation. Each of these post-secondary education institutions has a unique role to play, producing workers for different components of the innovation ecosystem. Our university graduate programs produce the advanced Master's and PhD degree holders who can contribute breakthrough ideas that can ensure companies stay at the cutting edge of R&D; our universities and colleges produce Bachelor's degree holders who are often the front-line innovation performers; and our colleges produce technicians and technologists to facilitate the commercialization efforts of the firm.[1]

It is the interplay among these complementary types of talent that builds an innovation economy. Since Canada's innovation gap is partly an education gap, improving our global performance will require the right mix in both the quantity and quality of talent. This demands a collaborative approach that brings together our post-secondary institutions, federal and provincial agencies as well as industry and other partners to ensure appropriate recruitment, training and deployment for industrial innovation needs. While Canada ranks first in the OECD for the percentage of its population with post-secondary attainment, it is middle of the pack in baccalaureate output and near the bottom for the number of doctoral graduates per capita. It is nevertheless encouraging that the growth in the number of doctoral degrees granted in Canada has been stronger — particularly in science and engineering — than in most comparable countries over the 2005–08 period, helping to improve our relative position (STIC 2011).

The earnings advantage of individuals with advanced degrees (relative to high school graduates) is less pronounced in Canada than in the US (Institute for Competitiveness &

[1] Canada's rich and diverse landscape of about 250 post-secondary institutions includes 152 colleges, of which about 48 are Cégeps in Quebec, some are degree granting, some are known as institutes of technology and some are known as polytechnics. Many colleges are emerging actors in downstream innovation near the commercialization activities of small and medium-sized enterprises. There are 95 universities throughout Canada, many of which have world-class research capabilities.

Prosperity 2010, p. 35). This is one indicator of relatively weaker demand by businesses in Canada for people with advanced degrees, and a situation consistent with a weaker commitment to innovation-based strategies by Canadian businesses. Statistics Canada has found that up to a fifth of doctoral graduates intend to leave Canada following completion of their degrees (Desjardins and King 2011). When they go, these graduates take with them knowledge and skills that could contribute to a more innovative and prosperous future for Canada.

Students learn not only through traditional classroom experiences, but also through hands-on research experience that exposes them to the realities of the business world and teaches the professional and entrepreneurship skills needed to fully contribute to their eventual workplaces. Employers see programs that encourage post-secondary student participation in research projects with business as having a number of benefits, including (i) the chance to identify the best recruits, (ii) the ability to influence curricula to be more industry-relevant, (iii) exposure to new ideas and specialized equipment in educational institutions and (iv) access to a flexible workforce.

While domestic production of innovation workers is an imperative, demographic realities dictate that this is not sufficient to meet the expected industry demand; by some estimates, within 20 years there could be almost two million vacancies for skilled knowledge workers in Ontario alone (Miner 2010). An immigration system that targets necessary skill sets presents Canada with an opportunity to leverage the skills, insights and entrepreneurial talents of those born in other countries who come to Canada.

Innovation Input: Networks, Collaborations and Linkages

Collaboration among businesses, governments and the higher education sector can contribute importantly to the conception and successful introduction of new products and processes. Businesses develop strategic partnerships in order to connect to global knowledge flows, share research results and R&D risks, pool skilled staff, commercialize inventions and help to access new markets. As a result, social and physical infrastructure linking collaborators and supporting networks are important for business innovation.

Effective collaboration between the business and higher education sectors depends on linking the "supply-push" of research and discoveries with the "demand-pull" of firms seeking to exploit the commercial potential of new ideas. As depicted schematically in Figure 2.6, this involves not only firms, universities, colleges and polytechnics, but also a spectrum of intermediary players that belong to an innovation "ecosystem" characterized by effective synergies, connections, and flows of knowledge and ideas. This is a complex mix, not least because of diverging incentives and organizational cultures among different institutions. These intermediary actors include the following:

- technology transfer offices, which provide support to help bring university-generated research and intellectual property to the commercial sphere (others also perform this function, such as the Centres of Excellence for Commercialization and Research)
- college applied research offices, through which colleges and polytechnics support firms with solutions for their specific commercialization needs

- public research institutes and programs, such as government labs, National Research Council Canada institutes and others that are discussed in subsequent chapters
- incubators, which offer technical expertise, mentorship and other services to help accelerate the development of entrepreneurial firms
- angels and venture capitalists, who provide the risk capital that innovative start-up firms require to build a bridge between their new ideas and commercial viability.

In its overview of public–private collaborations, the STIC (2009, p. 34) explains:

> While the overall picture is mixed, the balance of evidence suggests that many Canadian universities are first-rate scientific institutions. But in the context of the knowledge-based economy, it is not considered sufficient for a country's universities to produce ground-breaking scientific research in isolation . . . effective links between the three principal innovation funding/performing sectors [business, post-secondary education and government] are an important contributor to a successful national innovation system, especially as a mechanism for transfer of S&T into the commercial sphere.

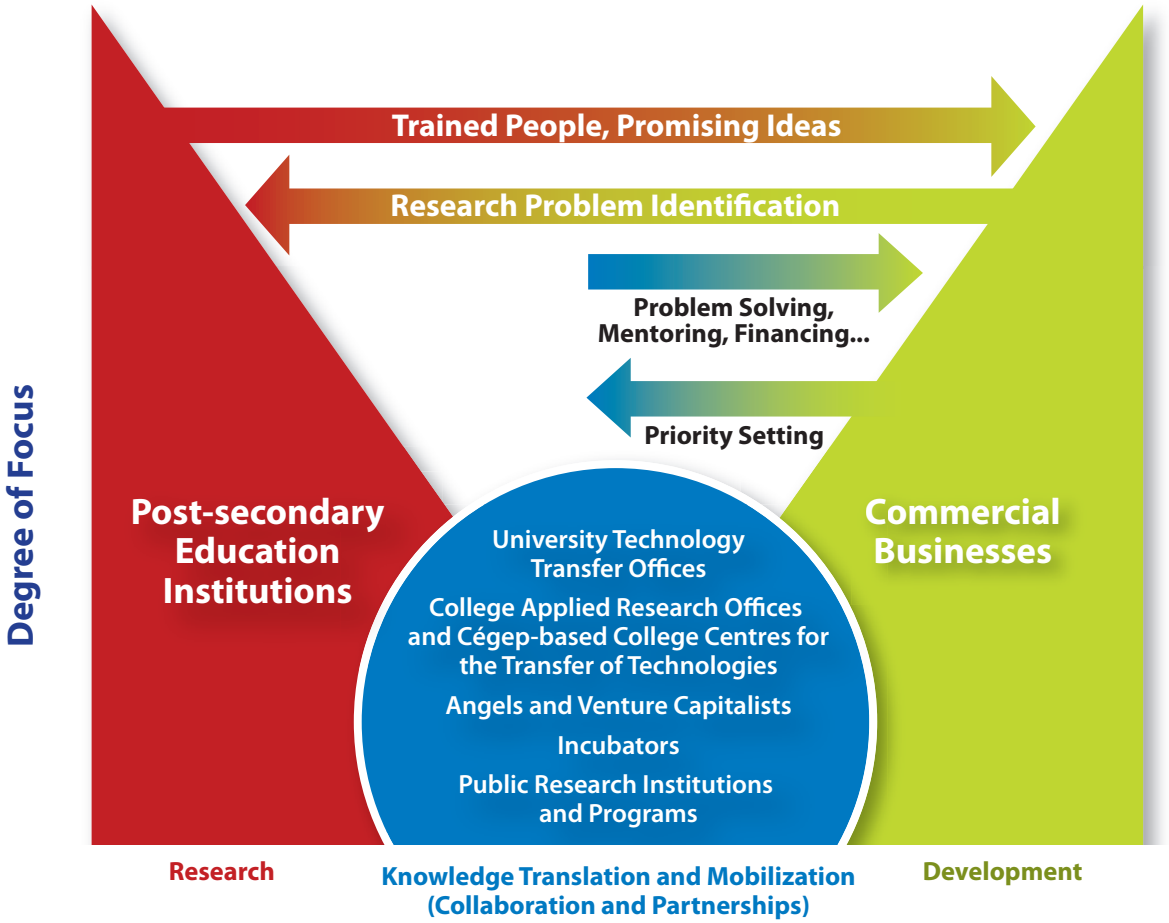
Canada ranks above the OECD average in respect of the percentage of higher education expenditure on R&D financed by industry — more than 8 percent in 2008 (OECD 2011). This means that post-secondary institutions are playing an important role as a resource for business innovation for certain activities and sectors. But the extent of collaboration appears to be relatively narrowly based, since Canada ranks near the bottom of OECD countries in terms of the proportion of businesses collaborating with universities for R&D (STIC 2009, p. 36).

Although commercialization of research-based knowledge is a key activity of public–private collaborations, networks and linkages, there are many other benefits stemming from such partnerships, including industry access to specialized equipment and personnel (particularly, potential future employees), and stimulation of new research questions and directions arising from problems faced by innovative firms (Figure 2.6).

Some have argued that concerns over the handling of intellectual property rights (IPRs), as well as restrictions that may be placed by corporate partners on the publication of research, are inhibiting productive collaboration between business and academic researchers. While such concerns may be well justified in certain cases, the vast majority of university research appears in the public domain in a timely way, allowing full access across the spectrum of potential industry users. With regard to IPRs, the Panel is not persuaded that any one model of ownership is best for all circumstances. Rather, negotiations over IPRs seem to be impeded most often by divergent valuations of early-stage intellectual property (IP). What inventors and institutions often see as an invaluable breakthrough, businesses may see as needing costly downstream development.

In addition to the above considerations related to IPRs, the Panel is concerned that Canada is not benefiting as much as it should from the valuable IP being generated in this country. While Canada produces IP in abundance, it is less adept at reaping the commercial benefits; too many of the big ideas it generates wind up generating wealth for others. The Panel believes that the government needs to explore this issue further. In particular, there is a need to develop the skills and knowledge of Canadian entrepreneurs regarding the effective management of their IP.

Figure 2.6 The Innovation Ecosystem: Converting "Research" into "Innovation"[a]



[a] The horizontal axis represents the R&D continuum from curiosity-inspired fundamental research at the left to market-facing experimental development at the right-hand end. The focus of many post-secondary education institutions declines as R&D shifts from fundamental research toward development, although these institutions are active in applied areas, and colleges in particular are focussed in the mid-range of the spectrum. The R&D emphasis of business declines as the developmental and market-facing content diminishes. This creates an inherent structural gap in the mid-range of the R&D spectrum and requires a variety of intermediary institutions to complement the roles of post-secondary education and business participants in the innovation ecosystem.

Source: Adapted from Nicholson (2011).

Innovation Input: Capital and Financing

Innovative start-up firms need access to risk capital to build a bridge between their new ideas and commercial viability. Risk capital can come from internal earnings or from external sources. With respect to the latter, it can take the following forms.

- **Seed and start-up capital** to finance the very early stages of firms' development — activities such as proof-of-concept, product development and initial marketing — usually comes first from founders, family and friends, then from "angel" investors. The latter are typically individuals who have succeeded as entrepreneurs in technology-based enterprises and who are consequently able to provide not only financial investment but also mentoring of early-stage entrepreneurs in the angel's area of experience.
- **Venture capital** provides financing for firms that survive the seed and angel-financed stage of development. Venture capital is generally provided through professionally managed funds combining the resources of a group of investors, which may also include public sector players.
- **Public markets, mergers and acquisitions** enter the picture beyond the early stages of commercialization in response to the need for funds to support expansion, but before the company is able to access more conventional forms of finance such as bank or cooperative financial services loans.

Without an active presence in Canada of adequate sources of capital, some of the commercial benefits of innovations originating in this country could be exploited by firms in other countries with greater risk investment capacity and/or propensity.[2] This and related issues are addressed in Chapter 7.

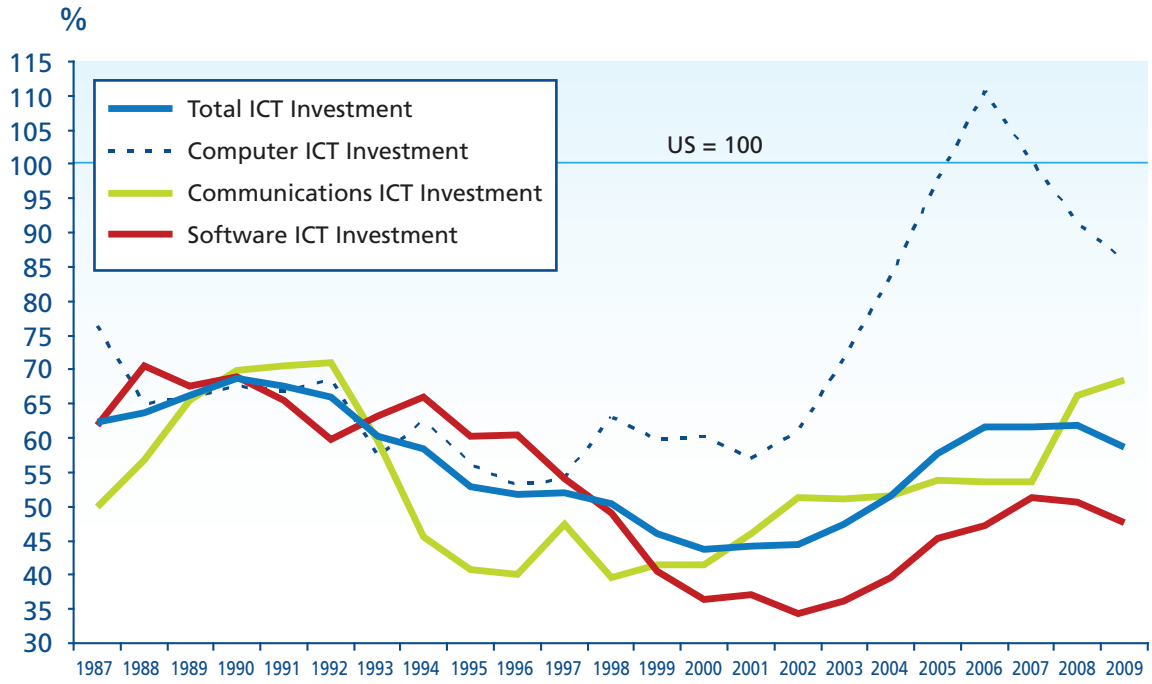
The limited data available on angel investment in Canada suggest that "they are much less extensive, in relative terms, than comparable sources in the United States" (CCA 2009, p. 8). This has repercussions extending beyond the availability of financing, since early-stage investors are an invaluable source of mentorship and expertise. Rates of return of Canadian venture capital funds have been well below those in the US for both private and tax-assisted ("labour-sponsored") venture capital funds. The relatively low returns result from a number of factors, including subscale venture capital funds and a comparatively young venture capital industry in Canada that "has not yet developed sufficient breadth and depth of experience to select and mentor the best potential investment candidates" (CCA 2009, p. 8).

Capital investment in machinery and equipment also supports innovation within firms, as these assets embody the latest ideas, technologies and innovations developed by others. It is particularly noteworthy that the Canadian business sector has persistently lagged behind its US counterpart in ICT investment per worker (Figure 2.7). Given that the production and application of ICT played the central role in stimulating very strong productivity growth in the US over the past decade or more, the lagging ICT investment record of the private sector in Canada is a source of great concern.[3]

[2] For example, a 2009 study published by Canada's Venture Capital & Private Equity Association states that "US-based funding generally supports later-stage companies and sometimes results in a shift of the company activities to the US. Building a strong and innovative technology-based economy in Canada requires a strong Canadian-based venture capital industry" (Duruflé 2009, p. 41).

[3] As part of the government's "Digital Economy Strategy," Budget 2011 provided $80 million of funding for a pilot initiative, through the Industrial Research Assistance Program (IRAP) and colleges, to boost the adoption of appropriate ICT by small and medium-sized enterprises (Department of Finance 2011).

Figure 2.7 ICT Investment per Worker in the Business Sector, Canada as a Proportion of the United States, 1987–2009 (current US dollars)



Source: CSLS (2011b).

The Institute for Competitiveness & Prosperity (2010, pp. 39–40) underlines two main challenges that have inhibited the willingness of Canadian businesses to ramp up investments in technology: relatively high tax rates on capital investment and a lack of competitive intensity. Significant progress has already been made, and continues to be made, on the tax front — for example, a steady reduction in corporate tax rates, elimination of capital taxes and the further harmonization of provincial and federal sales tax regimes. The comparative lack of competitive intensity in Canada is more recalcitrant and is due primarily to a relatively small and geographically fragmented market and to policies that insulate some sectors from international competition. Initiatives to promote competition — and specifically, as noted earlier, those recommended by the "Wilson panel" — constitute an essential foundation for innovation policy in Canada.

Having now situated the Panel's mandate in the wider innovation context, the next chapter drills down into the programs at the core of the Review of Federal Support to Research and Development. Thereafter, the Panel presents its advice on how the government can enhance the impact of those programs.

Chapter 3

Overview of Programs to Support Business R&D

The Panel was asked to review three types of federal programs intended to support research and development (R&D) that is undertaken by business or that is commercially oriented. These include (i) the Scientific Research and Experimental Development (SR&ED) tax credit, (ii) programs that support business R&D through direct expenditure (which may be of general application or targeted to sectors or regions) and (iii) programs funded through the federal granting councils, departments and agencies that support commercially focussed R&D, often performed by academic institutions. The purpose of this descriptive chapter is to introduce and characterize the suite of programs analysed by the Panel. First, it is important to recall the reasons why governments create programs that provide support for business innovation and R&D.

Rationale for Government Support of Business Innovation

The fundamental motivation for government intervention in private sector commercial activity is to improve market outcomes for the betterment of society at large. There are conditions under which markets do not allocate resources efficiently, and governments intervene to try to correct or at least diminish "market failures" — for example, to guard against monopoly, to protect property rights, to provide public goods such as basic research that generate benefits for society at large or to overcome problems of inadequate information. Interventions may also be motivated by a concern for equity — for example, provision of a social safety net or, where international agreement cannot be reached, to level the playing field in situations where subsidies provided in other countries put domestic firms at a competitive disadvantage.

In the context of this review, the most fundamental motivation for government programs to foster business R&D is the desire to improve Canada's productivity growth by encouraging more business innovation. Specifically in the case of R&D, there is abundant empirical evidence that an individual firm cannot capture all the benefit of its investment in R&D (see, for example, Parsons and Phillips 2007). Some of the knowledge generated is picked up "for free" by other firms and is eventually used, by some at least, to improve their productivity. The existence of such spillovers means that a dollar of R&D investment by a firm returns greater value to the economy at large, and not just to the investing firm alone. For this reason, governments provide incentives such as tax credits, grants and advisory services to induce firms to perform more R&D than they otherwise would.

There are other motivations to intervene. A number of programs to encourage greater business innovation are designed to help

overcome the disadvantage of small scale or to lower the barriers to getting started. For example, student internships in business can provide the crucial first experience. In addition, many smaller R&D-focussed companies cannot afford to maintain in-house all the specialized expertise and infrastructure they need, and must rely on public sector labs and advisory services such as the Industrial Research Assistance Program (IRAP). Government as a lead customer may also help a young innovative business achieve the production scale and credibility to compete in the wider market. Moreover, public sector contributions to seed and venture capital may be needed to risk-share in the early stages of a company's development and thereby enable many technology-based companies in Canada to grow to a viable size.

Public intervention has costs as well as benefits. The taxes raised to fund government programs diminish economic performance through adverse effects on incentives to work, save and invest. All programs generate costs of administration and compliance, which must be netted against the benefits. Just as there are market failures, there may also be "government failures." These may be due to inadequate information or to political pressure — for example, favouring certain vested interests, creating too many small-scale programs or continuing to support activities that should be terminated.

All of these considerations need to be borne in mind when deciding whether government intervention to correct a perceived market failure is warranted. These issues are addressed concretely in subsequent chapters. The remainder of this chapter describes the universe of programs addressed by the Panel.

Profile of Federal Government Support for Business R&D

The federal government supports business and commercially oriented R&D through a broad array of programs,[1] each of which varies across a number of salient features:

- **input supported** — ideas and knowledge; talented, educated and entrepreneurial people; networks, collaborations and linkages; and capital and financing
- **type of activity supported** — basic research, applied research, experimental development and commercialization
- **form of support** — tax incentives, repayable or non-repayable grants and contributions, provision of services, and procurement of research and of innovative goods and services
- **eligible recipient** — support provided directly to a business versus support to other organizations conducting commercially oriented R&D activities
- **size** — program budget, number of projects supported, amount of administrative staff and maximum assistance provided
- **scope** — national, sectoral and regional.

To capture this variety, the Panel established a government-wide program database covering 60 programs, delivered by 17 federal entities (Figure 3.1).[2] The Panel's findings are limited to the 60 programs, which encompass most but not all federally supported business and commercially oriented R&D (Box 3.1). This exercise is the first of its kind, and is an essential step toward conceptualizing the diversity of federal business R&D programs as an overall portfolio of support.

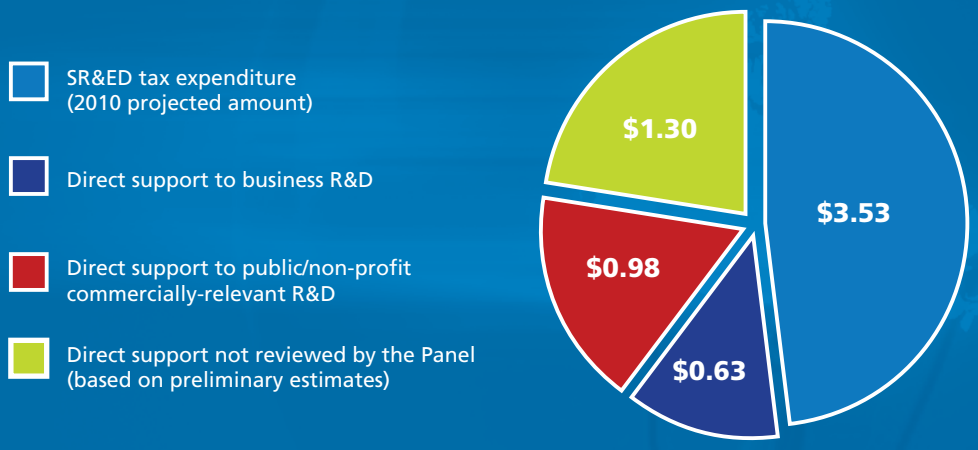
[1] "Programs" are broadly defined in this review and include tax credit support, direct spending programs, venture capital investments and federally performed R&D.

[2] Program expenditure information in the database and cited throughout this report is based on figures provided in July 2011 by the departments and agencies that administer the programs within this review. Program expenditure information was available for 58 of the 60 programs.

Box 3.1 Expenditure Reviewed by the Panel

The Panel was mandated to review federal expenditure encouraging business R&D. Based on figures provided by departments and agencies, it is estimated that expenditure in support of business innovation was approximately $6.44 billion in fiscal year 2010–11, which comprises more than 100 programs and institutes.

Expenditure in Support of Business R&D, 2010–11
($ billion, including federal program administration costs)



Source: Based on figures provided by departments and agencies.

Of this amount, the Panel reviewed 60 programs and institutes totalling $5.14 billion (or $4.96 billion when federal program administration costs are removed). These programs were drawn largely from an illustrative list that accompanied the Panel's mandate letter. The Panel had the flexibility to choose the programs for review. It refined the initial list by removing a limited number of programs whose primary purpose was not to support business innovation. In addition, it added others to ensure representative coverage of the diversity of instruments in the portfolio. The resulting list (Annex A) captures key programs and the majority (about 80 percent) of federal R&D expenditure supporting business innovation.

In the 2010–11 fiscal year, the 60 programs in the review — hereafter referred to collectively as the "envelope" — had estimated expenditure of approximately $4.96 billion (excluding federal program administration costs).[3] Of this amount, about 70 percent ($3.47 billion) is the

[3] Business Development Bank of Canada (BDC) venture capital is excluded from this total, since BDC disbursements are investments rather than expenditures. In addition, while the government capitalizes BDC, it does not provide specific funding on a regular basis for this specific activity. As of the third quarter of 2010, the BDC venture capital portfolio commitment for direct investments was about $550 million and was about $267 million for fund investments. Note as well that the federal tax credit provided to individuals for the acquisition of shares in labour-sponsored venture capital corporations costs the federal government $125 million a year.

projected contribution of the SR&ED tax credit,[4] with the balance of 30 percent ($1.5 billion) coming from 59 direct expenditure programs.

The distribution of expenditure across the many direct spending programs is highly skewed: the largest five represent about 40 percent of direct expenditure, while the largest 15 account for about 72 percent (Figure 3.2). Only one program — IRAP — accounted for more than 15 percent of direct expenditure in 2010–11, while more than 50 percent of the programs each spent less than 1 percent of the $1.5 billion direct expenditure total.

There is considerable diversity among the direct programs, as the examples below show.

- IRAP is a broad-based program that provides advisory services and contribution funding to support high-risk R&D projects by small and medium-sized enterprises (SMEs). It also provides support to non-profit and post-secondary institutions for the provision of technical and commercialization advice to SMEs.
- Sector-focussed initiatives include the National Research Council's (NRC) Institute for Aerospace Research, which performs collaborative R&D with business, in addition to licensing and fee-for-service arrangements. Examples of arm's-length delivery of business innovation support include FPInnovations, a public–private partnership with the forest products sector, and Sustainable Development Technology Canada, a federally funded non-profit corporation that provides funding for environmental technology initiatives.
- The Strategic Aerospace and Defence Initiative (SADI) is the second largest direct spending program and, as announced in Budget 2011, will be part of a specific review of all federal policies and programs related to the aerospace industry. The Panel consequently did not reach specific findings regarding SADI, although it welcomes the opportunity to provide advice and any other assistance in support of the review.
- Seventeen NRC institutes, including the Industrial Materials Institute and the above-mentioned Institute for Aerospace Research, undertake a great variety of basic and applied research for business and public sector clients. Expenditure of appropriated funds by these institutes was $276 million in 2010–11, about 19 percent of federal direct spending in support of R&D.
- The Atlantic Innovation Fund, the Western Diversification Program and the Business and Regional Growth Program (Quebec) are regional development programs. (Smaller programs, not shown among the 15 largest in Figure 3.2, are provided by the Ontario regional agencies FedNor and FedDev ON.) The regional agencies, which collectively accounted for about 14 percent of direct expenditure in support of business innovation in 2010–11, generally provide repayable support to businesses and non-repayable support to not-for-profit entities.
- Several programs link the post-secondary education sector to business innovation. For example, the Networks of Centres of Excellence and Strategic Network Grants fund large-scale, multisectoral collaborative research, and the Collaborative R&D Grants aim to support joint research projects among businesses, universities and researchers.

[4] Note that the 2010 amount for the SR&ED tax credit is a projection for the 2010 taxation year (see Department of Finance 2010b).

Figure 3.1 Total Envelope Expenditure[a]
($ million, excluding federal program administration costs)

	2007–08	2008–09	2009–10	2010–11	% 2010–11 Direct Expenditure
Total envelope expenditure	4184.1	4567.6	4668.0	4962.9	—
Total indirect expenditure: SR&ED tax credit (FIN and CRA)	3256.0[b]	3485.0	3280.0	3470.0	—
Total direct expenditure	928.1	1082.6	1388.0	1492.9	100.0%
Direct expenditure: repayable contribution programs (amounts given to businesses in parentheses)					
Strategic Aerospace and Defence Initiative (IC)	9.7 (9.7)	33.7 (33.7)	61.5 (61.5)	112.7 (112.7)	7.6%
Atlantic Innovation Fund (ACOA)	59.0 (24.7)	58.1 (25.0)	57.6 (28.6)	66.2 (28.0)	4.4%
Business and Regional Growth Program (CED-Q)	3.1 (2.1)	13.1 (5.5)	38.0 (15.7)	51.2 (22.7)	3.4%
Business Development Program (ACOA)	17.7 (9.9)	15.6 (11.3)	16.7 (12.1)	13.4 (11.4)	0.9%
Northern Ontario Development Program (IC – FedNor)	5.42 (0.48)	12.41 (1.32)	6.12 (0.65)	5.08 (0.41)	0.3%
Investing in Business Innovation Program (FedDev ON)	NA[c] (NA)	NA (NA)	NA (NA)	0.1 (0.1)	0.0%
Automotive Innovation Fund (IC)	NA (NA)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0%
Subtotal	*94.9*	*132.9*	*179.9*	*248.7*	*16.7%*
Direct expenditure: non-repayable grant and contribution programs					
Industrial Research Assistance Program (NRC)	86.1	86.5	231.0	237.3	15.9%
Networks of Centres of Excellence Program (Tri-Council)	72.4	75.7	68.3	78.4	5.3%
FPInnovations (NRCan)	28.6	28.4	48.8	78.3	5.2%
SD Tech Fund (SDTC)	53.8	101.7	109.8	76.8	5.1%
Western Diversification Program (WD)	63.7	69.8	82.7	73.3	4.9%
Strategic Project Grants (NSERC)	67.0	73.6	61.1	57.0	3.8%
Collaborative Research and Development Grants (NSERC)	44.4	50.3	52.5	55.5	3.7%
Centres of Excellence for Commercialization and Research Program (Tri-Council)	0.0	10.9	30.9	49.8	3.3%
Strategic Network Grants (NSERC)	16.5	22.6	31.8	33.5	2.2%
Industrial Research Chairs (NSERC)	22.0	23.4	27.0	26.6	1.8%
College and Community Innovation (NSERC)	NA	2.1	14.6	28.0	1.9%
Agricultural Bioproducts Innovation Program (AAFC)	0.6	7.3	20.5	15.7	1.1%

Figure 3.1 Total Envelope Expenditure[a]
($ million, excluding federal program administration costs) (cont.)

	2007–08	2008–09	2009–10	2010–11	% 2010–11 Direct Expenditure
Collaborative Health Research Projects (NSERC)	9.2	9.1	11.7	13.7	0.9%
Canadian Agri-Science Clusters (AAFC)	NA	NA	1.3	12.6	0.8%
Engage Grants (NSERC)	NA	NA	1.4	11.6	0.8%
Industrial R&D Internship Program (Tri-Council)	NA	3.2	6.3	7.3	0.5%
Idea to Innovation (NSERC)	5.5	7.4	6.3	5.7	0.4%
Proof of Principle Program (CIHR)	6.6	4.4	1.8	5.4	0.4%
Industrial Postgraduate Scholarships (NSERC)	6.0	5.6	5.1	5.3	0.4%
Developing Innovative Agri-Products (AAFC)	NA	NA	1.4	5.2	0.4%
Automotive Partnership Canada (Tri-Council, CFI and NRC)	NA	NA	0.2	5.1	0.3%
Industrial R&D Fellowships (NSERC)	3.7	3.7	4.6	4.7	0.3%
Industry Partnered Collaborative Research Program (CIHR)	8.0	8.6	6.2	4.5	0.3%
Business-led Networks of Centres of Excellence Program (Tri-Council)	NA	0.0	4.0	4.3	0.3%
Industrial Undergraduate Students Research Awards (NSERC)	3.4	3.4	3.3	3.9	0.3%
Applied Research and Commercialization Initiative (FedDev ON)	NA	NA	NA	0.9	0.1%
Partnership Workshops Program (NSERC)	0.1	0.4	0.2	0.3	0.0%
Interaction Grants Program (NSERC)	NA	NA	0.1	0.2	0.0%
Technology Development Program (FedDev ON)	NA	NA	NA	0.0	0.0%
Subtotal	*497.5*	*598.1*	*832.6*	*901.0*	*60.4%*
Direct expenditure: procurement programs					
Technology Demonstration Program (DRDC)	31.2	30.1	23.4	23.5	1.6%
Space Technology Development Program (CSA)	14.6	9.7	15.3	7.7	0.5%
Subtotal	*45.8*	*39.8*	*38.7*	*31.2*	*2.1%*
Direct expenditure: federally performed R&D – National Research Council institutes[d]					
Industrial Materials Institute (NRC)	25.1	34.0	37.1	33.8	2.3%
Institute for Aerospace Research (NRC)	36.7	28.7	33.1	30.1	2.0%
Biotechnology Research Institute (NRC)	28.0	27.6	32.1	27.0	1.8%
Institute for Research in Construction (NRC)	26.3	29.3	29.6	26.8	1.8%
Institute for Microstructural Sciences (NRC)	24.1	25.1	25.9	24.3	1.6%
Institute for Information Technology (NRC)	22.1	21.0	21.8	20.1	1.3%

Figure 3.1 Total Envelope Expenditure[a]
($ million, excluding federal program administration costs) (cont.)

	2007–08	2008–09	2009–10	2010–11	% 2010–11 Direct Expenditure
Institute for Marine Biosciences (NRC)	16.3	18.4	18.6	16.6	1.1%
Plant Biotechnology Institute (NRC)	14.7	14.7	15.1	13.7	0.9%
Institute for Biological Sciences (NRC)	15.3	14.9	16.1	13.4	0.9%
Institute for Biodiagnostics (NRC)	13.3	13.1	15.5	13.3	0.9%
National Institute for Nanotechnology (NRC)	12.5	12.2	12.7	12.3	0.8%
Institute for Fuel Cell Innovation (NRC)	10.7	13.0	13.8	11.8	0.8%
Steacie Institute for Molecular Sciences (NRC)	13.1	12.1	12.8	11.0	0.7%
Institute for Chemical Process and Environmental Technology (NRC)	10.6	12.1	12.3	10.3	0.7%
Institute for Ocean Technology (NRC)	10.9	10.4	11.0	10.1	0.7%
Centre for Surface Transportation Technology (NRC)	1.3	1.6	1.9	1.1	0.1%
Canadian Hydraulics Centre (NRC)	1.0	0.6	0.6	0.5	0.0%
Subtotal	*281.9*	*288.9*	*310.1*	*276.3*	*18.5%*
Direct expenditure: federally performed R&D – other					
Agricultural Bioproducts Innovation Program (AAFC)	1.7	16.6	17.2	15.4	1.0%
Canadian Agri-Science Clusters (AAFC)	0.0	0.0	0.9	6.7	0.4%
Developing Innovative Agri-Products (AAFC)	0.0	0.0	0.5	5.8	0.4%
FPInnovations – Canadian Wood Fibre Centre (NRCan)	6.4	6.4	8.2	7.9	0.5%
Subtotal	*8.1*	*23.0*	*26.8*	*35.8*	*2.4%*

[a] BDC venture capital investments are not included above. SR&ED tax expenditures are projections for 2009 and 2010. SR&ED values are for taxation years and not fiscal years. Some of the programs listed as "repayable contribution programs" also provide non-repayable assistance, notably to not-for-profit entities. NRC expenditure for the Technology Clusters Program and expenditure in support of Automotive Partnership Canada are included in the NRC institute totals. The programs listed under "federally performed R&D – other" all have a grant and contribution component in addition to federally performed R&D — these activity totals are reported separately in the table. Subtotals may be subject to rounding. See List of Acronyms (page x) for the full name of sponsoring bodies (in parentheses).

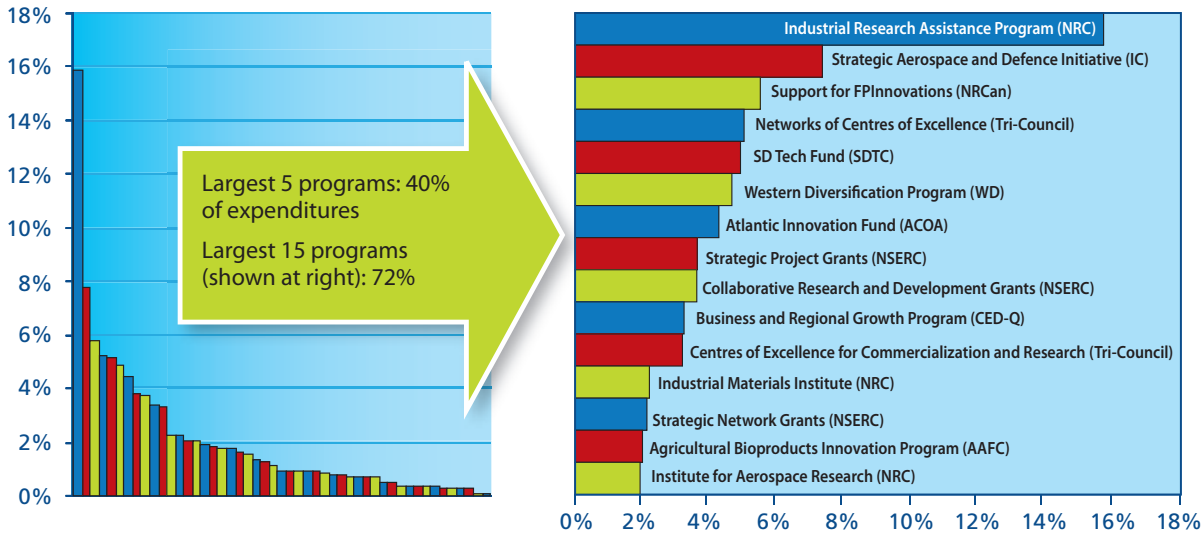
[b] The 2007 figure for the SR&ED tax credit reported in *Tax Expenditures and Evaluations 2010* is slightly higher at $3.35 billion (Department of Finance 2010b). That figure is based on updated data obtained after the Panel began its analysis.

[c] NA indicates a program did not exist in that particular fiscal year.

[d] Figures for the NRC institutes refer to the expenditure of appropriated funds.

Source: Based on figures provided by departments and agencies.

Figure 3.2 The Largest Direct Expenditure Programs in the Envelope, 2010–11



Source: Based on figures provided by departments and agencies.

Envelope Expenditure by Form of Support

The SR&ED tax credit is by far the largest program of federal support for business R&D, projected to comprise about 70 percent of envelope expenditure (Figure 3.3).

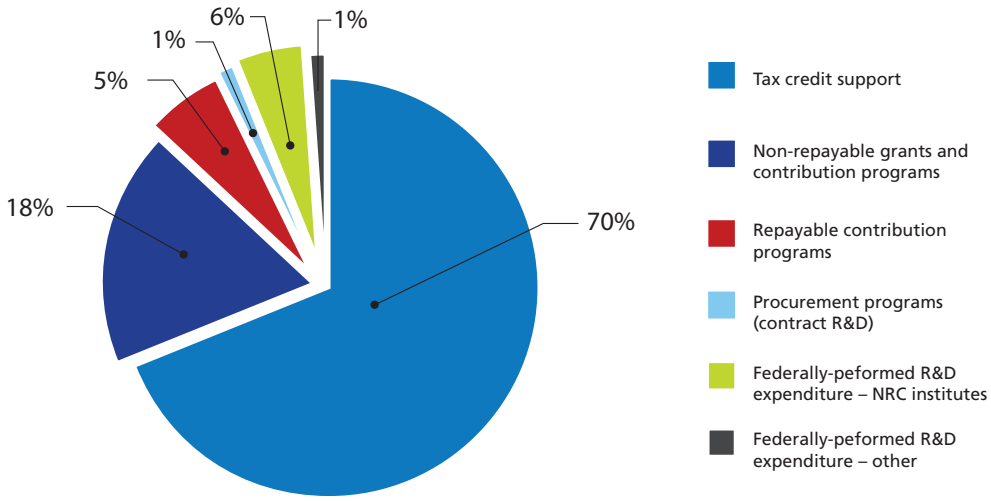
In the category of direct expenditure, non-repayable grant and contribution programs make up the largest proportion — $901 million in 2010–11, or 60 percent of the direct expenditure category. IRAP is by far the largest, with 2010–11 expenditure of $237.3 million, although it should be noted that this reflects a substantial two-year increase in budget as part of the government's stimulus program. (IRAP expenditure in each of 2007–08 and 2008–09 was about $86 million, or only a little more than a third of its 2010–11 budget, and about 8–9 percent of direct expenditure in those years.) There is a total of 29 programs or program components in the non-repayable grant and contribution group.

Programs providing repayable contributions are smaller — $248.7 million in 2010–11, or about 17 percent of direct spending. The Strategic Aerospace and Defence Initiative (SADI) is the largest of these programs, with 2010–11 expenditure of $112.7 million, although this annual amount will rise substantially as the program ramps up. There are seven programs in this group, with the remaining total largely delivered by the regional development agencies (see Figure 3.1).

Envelope Expenditure by Type of Recipient

Figure 3.4 breaks down total expenditure by recipient and shows that 81 percent is projected to go to businesses, with the great majority made available through the SR&ED program. Much of the direct support for large businesses is repayable. The allocation of expenditure from direct programs in 2010–11 was roughly as follows: 11 percent to large businesses, 26 percent to small businesses, 27 percent to

Figure 3.3 Program Envelope, by Form of Support, 2010–11[a]



[a] Amounts do not add up due to rounding. The value of tax credit support is a projection for the 2010 taxation year.

Source: Based on figures provided by departments and agencies.

the academic sector (including students), 21 percent to NRC institutes and other federally performed R&D, 12 percent to Canadian non-profits, and 3 percent to "other" recipients (including provincial and municipal governments, foreign performers and other Canadian performers). The breakdown of indirect expenditure in 2007 — the latest year for which a breakdown by recipients is available — was as follows: 56 percent to large businesses, 40 percent to small Canadian-controlled private corporations (CCPCs), and 4 percent to other businesses, that is, small non-CCPCs and CCPCs in expenditure limit phase-out range.[5]

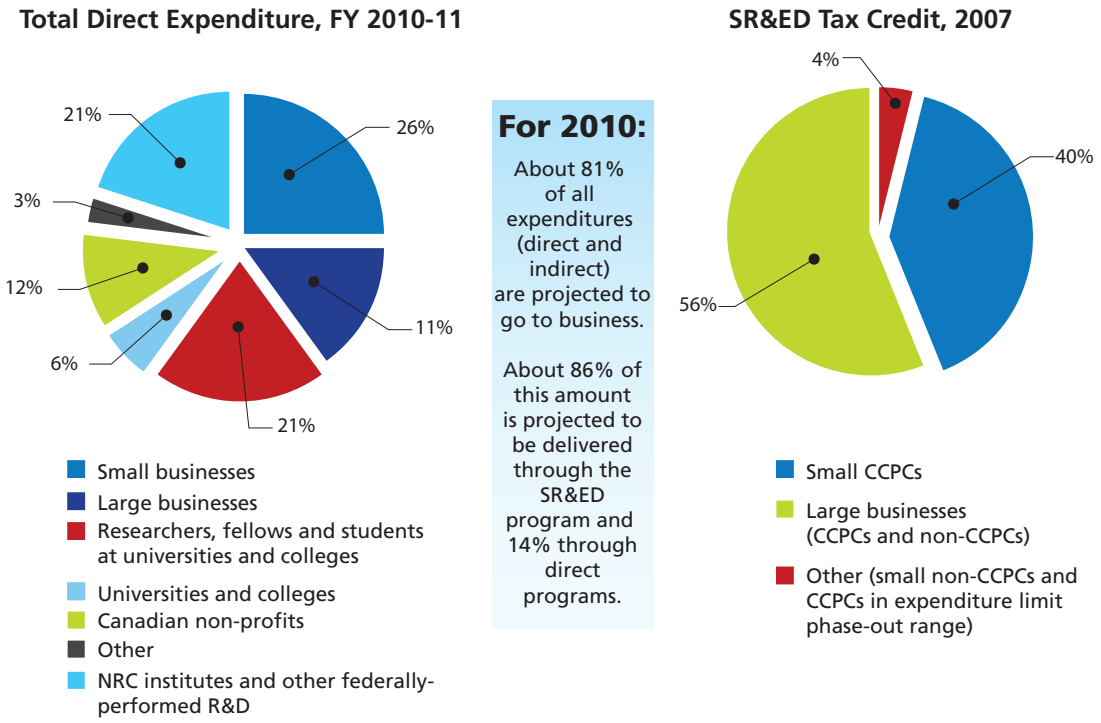
Envelope Expenditure by Sector

Figure 3.5 (at the end of this chapter) lays out the allocation of both direct and SR&ED tax credit expenditure across all goods and services producing industries. In the case of the direct programs, a sectoral breakdown is provided for the $1.5 billion in 2010–11 expenditure. In the case of the SR&ED tax credit, the sectoral allocation of about $3.3 billion is for 2007, the most recent year for which a sectoral distribution is available. The following are some key observations around the envelope expenditure by sector.

- **Direct expenditure.** Direct expenditure programs, in total, are heavily oriented toward goods-producing industries (about 72 percent), reflecting primarily a focus on manufacturing. Approximately 27 percent of direct spending programs support services producers, notably the professional, scientific and technical services subsector (about 12 percent) and information and cultural industries (about 5 percent). While direct

[5] The definitions of small and large businesses used by the SR&ED program and the direct programs are not fully comparable. In the case of many direct programs, the business's number of employees is used to define the size of the business. For the purposes of the SR&ED program, a "small CCPC" is one with prior-year taxable income of $500 000 or less and prior-year taxable capital of $10 million or less. These companies receive a refundable tax credit on their first $3 million of eligible expenses.

Figure 3.4 Envelope Expenditure, by Type of Recipient, Total Direct Expenditure, 2010–11, and SR&ED Tax Credit, 2007



Source: Based on figures provided by departments and agencies.

program expenditure has increased by over $550 million from 2007–08 to 2010–11 (Figure 3.1), the sectoral allocations have remained relatively similar over that period.

- **Indirect expenditure.** The estimated allocation of the SR&ED tax expenditure is spread more evenly across sectors and, as would be expected given its base of calculation, mirrors more closely the sectoral distribution of Canada's total business expenditure on R&D (BERD). For example, approximately 56 percent of SR&ED credits were associated with goods producers, a group that performed about 58 percent of BERD (the services shares are the complements).

It should be noted that the program expenditure in Figure 3.5 cannot be interpreted simply as funding a portion of the BERD total. While some programs transfer cash directly to business — notably the refundable amounts from the SR&ED program and the various grant and contribution programs (some of which are intended to be repaid) — other direct expenditure is by federal entities such as NRC or goes to academic institutions and not-for-profits.

Envelope Expenditure by Province

It was difficult on the basis of available data to determine accurately the geographic distribution of SR&ED tax credits. For example, from 2000 to 2007, some 40–50 percent of the SR&ED credits were claimed by multi-jurisdiction firms, but typically reported by location of head office. As a result, it was not possible to determine precisely in which region these firms are performing their SR&ED activities, and consequently to draw an

overall conclusion about the distribution of SR&ED claims by region. Subject to these important caveats, the Panel's analysis has shown that, for the years 2000–07, the estimated average distribution of SR&ED tax expenditure for the firms operating in a single jurisdiction appears to correspond closely with the average provincial distribution of BERD — that is, mostly in Ontario and Quebec, with moderate amounts in the four western provinces and some in the Atlantic provinces.

The distribution of the direct expenditure total is more nearly in line with provincial population shares,[6] though with a significantly larger proportion in the Atlantic provinces (about 12 percent of direct expenditure compared with slightly more than 7 percent of Canada's population) and somewhat less than proportional per capita in British Columbia, Alberta, Manitoba and Ontario.

Envelope Expenditure by Activity Supported

The great majority of R&D performed by business is for "experimental development" (Statistics Canada 2009), which the *Frascati Manual* defines as "systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed" (OECD 2002, p. 30). Allocation of the SR&ED tax credit, averaged over 2000–07, is estimated to be mostly in support of experimental development. Direct expenditure programs were more evenly spread, with 38 percent of 2010–11 expenditure estimated to be in support of experimental development, a roughly equal amount of 35 percent for applied research, 13 percent for basic research and 11 percent for "commercialization" (planning, marketing and production support, which are not eligible for SR&ED credits). Three percent of direct support was not categorized.

When direct and indirect programs are combined, it is estimated that the majority of federal support for business and commercially oriented R&D is directed to experimental development. This activity is usually very close to the market and therefore is less conducive to collaboration and partnership with other players in the innovation system. There also appears to be less spillover to the economy at large from this "close-to-market" R&D, the benefit of which is likely to be more fully appropriated by the R&D-performing business than would be the case for basic and applied research, which is usually more widely shared and also subject to more wide-ranging application.

[6] With the exception of Ontario and Quebec, provinces have a slightly smaller share of BERD relative to their share of Canada's population.

In Summary

The picture conveyed by the envelope of business R&D support programs is one of dramatically contrasting scales. The great majority of support is delivered by one program, the SR&ED tax credit, which accounts for about 70 percent of the envelope, is not sectorally targeted and supports business R&D spending explicitly. The 59 programs in the direct expenditure envelope are extremely heterogeneous as to target, delivery vehicle and administering agent. IRAP is by far the largest and in 2010–11 accounted for about 16 percent of direct expenditure, although this reflects an extraordinarily increased allocation as part of the government's economic stimulus expenditure. The great majority of the other direct spending programs each account for less than 2 percent of the direct total, and may in some cases be too small to have significant impact. Moreover, the combination of small size and sheer number virtually ensures that there will be little awareness among potential business sector beneficiaries of many of the programs. This challenge is exacerbated by the large additional number of business innovation support programs delivered by provincial governments.

The Panel believes, for reasons presented in Chapter 5, that rationalization of programs is required to increase scale, reduce duplication, improve delivery efficiency and create much greater awareness among potential business sector clients.

Figure 3.5 Sectoral Distribution of Direct and Indirect (SR&ED) Expenditure

Sector	Direct (2010–11)	SR&ED (2007)	BERD (2007)
Goods Industries			
Agriculture, Forestry, Fishing and Hunting	9.8%	1.4%	1.0%
Manufacturing[a]	52.7%	44.5%	49.2%
Construction	2.3%	1.1%	0.6%
Utilities	3.1%	0.3%	1.6%
Oil and Gas and Mining[b]	3.8%	8.7%	5.3%
Subtotal - goods industries	*71.7%*	*55.80%*	*57.7%*
Services Industries			
Transportation and Warehousing	0.8%	0.7%	0.4%
Information and Cultural Industries	4.9%	11.2%	8.8%
Wholesale Trade	1.0%	0.1%	5.9%
Retail Trade	0.7%	0.6%	0.3%
Finance and Insurance, Real Estate and Rental and Leasing	0.1%	2.0%	2.7%
Professional, Scientific and Technical Services	11.6%	23.6%	18.7%
Other Services	8.0%	5.7%	5.4%
Subtotal - services industries	*27.0%*	*44.0%*	*42.3%*
Unclassified	**1.2%**	**0.2%**	**0.0%**
Total - all industries	**100.0%**	**100.0%**	**100.0%**

[a] The total for manufacturing does not include petroleum and coal product manufacturing, which is instead included as part of oil and gas and mining (see note b, below).

[b] Includes mining, quarrying, oil and gas extraction and petroleum and coal product manufacturing.

Source: Based on figures provided by departments and agencies; and Statistics Canada (2011) for the sectoral allocation of BERD.

Chapter 4

Vision and Principles

The preceding chapters provide background information on business innovation and present an overview of the federal programs at the core of this review. With the context thus established, the remainder of this report focusses on the Panel's advice to the Government of Canada.

This advice is shaped by the Panel's ultimate vision of a Canadian business sector that stands shoulder-to-shoulder with the world's innovation leaders. To turn this vision into reality, the Panel believes that Canada must focus its efforts on growing innovative firms into larger enterprises, rooted in Canada but facing outward to the world. This goal is key for Canada's companies to compete with the best. Consequently, it is a primary consideration underpinning the Panel's recommendations.

Achieving the Panel's vision requires public policy action on a number of fronts, including ongoing efforts to refine and enhance marketplace policy and regulatory frameworks that influence the climate for private sector competition and investment. The Panel therefore emphasizes that the impact of its advice depends ultimately on complementary efforts to strengthen those policies — especially as they relate to encouraging the competitive intensity that is a central motivator of innovation.

Guiding Principles

The subsequent chapters set out the Panel's advice to improve the impact of federal programming in support of business innovation. This advice reflects a set of broad principles — essentially a philosophy of program design to promote business innovation — that the Panel has developed as a result of its consultations, research and internal dialogue. These guiding principles are as follows.

Transformative Programs

Federal programs to foster business innovation play an important role in the government's strategy to boost Canada's lagging productivity growth. These programs should focus resources where market forces are unlikely to operate effectively or efficiently and, in that context, should address the full range of business innovation activities, including research, development, commercialization and collaboration with other key actors in the innovation ecosystem — provinces, post-secondary education institutions, civil society organizations and the relevant investor communities. The design and delivery of federal business innovation programs must always strive to result in research activity and commercialization outcomes that meet the highest global standards.

Require Positive Net Benefit

The primary purpose of government programs in support of business innovation is to improve market outcomes to better Canada's economic performance. The total benefit of any given program should be greater than the cost of funding, administering and complying with the program. Support programs should reduce the subsidy amount provided — or move to a repayable basis — the closer the activity being supported is to market, and therefore the more likely it is that the recipient firm will capture most of the benefit for itself. There is also a need for coordination across the full suite of federal innovation programs — and ideally also between programs of the federal and provincial governments — to avoid excessive "stacking" of incentives that may result in subsidies that are higher than needed to achieve policy objectives. Excessive subsidization not only wastes financial resources, but also risks encouraging or sustaining activities that deliver little societal benefit. As set out in Chapter 6, all of these considerations are reflected in the advice regarding improvement of the Scientific Research and Experimental Development (SR&ED) tax credit. The Panel has concluded that the program should be simplified to reduce compliance and administration costs. Moreover, the benefit should be restructured to generate savings for reallocation to other initiatives benefiting small and medium-sized firms.

Favour National Scope and Broad Application

The Panel believes that the foundational core of the federal suite of business innovation programs should be large national programs of broad application — for example, the SR&ED program and Industrial Research Assistance Program (IRAP) — that support business innovation activity generally, empowering firms and entrepreneurs to make market-driven investment decisions according to their own timelines and regardless of sector, technology or region. As set out in Chapter 5, this is among the reasons the Panel believes that funding for IRAP should be increased and that a commercialization vouchers pilot program should be delivered within the suite of existing support mechanisms offered through IRAP.

Build Sector Strategies Collaboratively

Beyond programs of broad application, there is a complementary role for programs tailored to the needs of specific sectors that the government identifies as being of strategic importance. For industry sectors that are concentrated in particular regions, initiatives should be designed and delivered to work collaboratively with the relevant provinces and other local interests. These considerations inform the Panel's recommendation in Chapter 7 to evolve the National Research Council's business-oriented institutes into independent collaborative research organizations, intended to be even more responsive to the needs of sectoral research and innovation strategies. It is also expected that the Panel's recommendation in Chapter 7 to use public procurement to promote development of innovative Canadian suppliers will contribute significantly to enhanced capabilities in several sectors.

Require Commercial Success in Regional Innovation

The Panel is strongly of the view that regionally oriented programs to support business innovation should focus on creating the capacity of firms in the target region to succeed in the arena of global competition. That is why it is essential for regional innovation programs to apply the same high standards of commercial potential as are required by programs of nationwide application. For this reason, the Panel is recommending that the proposed Industrial Research and Innovation Council set

out in Chapter 5 — which would be a national delivery agency for federal business innovation programming — should provide the technical assessment of proposals for commercialization and R&D projects submitted to the regional development agencies (RDAs), while serving as a platform for RDAs to share best practices. This would allow for increased cross-country collaboration and for the development of common national standards of success in regional innovation.

Establish Clear Outcome Objectives, Appropriate Scale and a User-Oriented Approach

A program to foster business innovation should be designed to address a specific problem for which a government initiative is needed as part of the solution. The program should have well-defined outcome objectives, be of a scale appropriate for the problem at hand, be well known to its target clientele, and be easy and timely to access and use. These fundamental design principles, which should apply to all programs, have led the Panel to recommend in Chapter 5, for example, consolidation of groups of subscale programs that have common outcome objectives.

Design for Flexibility

Federal innovation programs should themselves be innovative and flexible in their design, setting clear objectives and measurable outcomes, and then allowing program users to propose novel ways of meeting the objectives. For example, where appropriate, programs should invite civil society to make proposals to develop new approaches and to actually deliver programs, rather than relying exclusively on established government delivery mechanisms. This design principle is in evidence in the Panel's recommendations on programs in Chapter 5 and on procurement in Chapter 7, where it is proposed that requests for proposals be based, wherever feasible, on a description of the needs to be met rather than on detailed technical specifications that leave too little opportunity for truly innovative solutions.

Assess Effectiveness

Finally, the Panel is convinced that more extensive performance management information is required to ensure an outcome-driven and user-oriented approach to federal support for business innovation. This entails regular public reporting on the outcomes both of individual programs and of the full suite of federal innovation support. The performance information would inform periodic evaluations, not only against the objectives of individual programs, but also of the programs' relative effectiveness within the overall portfolio. Comparative evaluation of this kind is an extremely challenging task, but it is key to an evidence-based reallocation of resources away from underperforming programs and toward new or redesigned programs that can better serve changing priorities and evolving business needs. To assist the government in this vitally important regard, the Panel proposes improved program evaluation approaches in Chapter 5 and creation of an external Innovation Advisory Committee in Chapter 8, which would in addition provide whole-of-government advice on the goals of innovation policy, on opportunities for new initiatives, and on any other matters arising from the government's innovation agenda.

Approach to the Recommendations

Overall, the advice presented in the next three chapters is organized in response to the Panel's three mandate questions:

- **Chapter 5: Program Effectiveness.**
  What federal initiatives are most effective in increasing business R&D and facilitating commercially relevant R&D partnerships?
- **Chapter 6: Program Mix and Design.**
  Is the current mix and design of tax incentives and direct support for business R&D and business-focussed R&D appropriate?
- **Chapter 7: Filling the Gaps.**
  What, if any, gaps are evident in the current suite of programming, and what might be done to fill these gaps?

Chapter 5

Program Effectiveness

This chapter addresses the first question in the government's charge to the Panel: "What federal initiatives are most effective in increasing business research and development (R&D) and facilitating commercially relevant R&D partnerships?"

While the Panel determined that Canada is considered to be among the leaders in program assessment,[1] it was concerned to learn, in the course of briefings with federal officials, that the tools are not in place to undertake comparative assessments as contemplated in this question. In the federal framework for program evaluation, "effectiveness" is defined by the Treasury Board of Canada Secretariat (2009) as "the extent to which a program is achieving expected outcomes." There is no common evaluation framework in place to determine relative program effectiveness across departmental lines. As a result, standardized performance and outcome indicators do not exist for the roughly $5 billion of business innovation programs in the review, and the supporting information is not retained in a common form or database.

This changes the nature of the advice that the Panel is able to offer. Instead of assessing the relative effectiveness of the 60 programs described in Chapter 3, the Panel is making recommendations that respond to stakeholder issues and concerns and that, if implemented, will establish the missing framework needed to shape a comprehensive and consistent evaluation of R&D program effectiveness going forward.

To establish a context for the Panel's recommendations, the following sections summarize (i) the relevant evaluation machinery already in place in the federal government, (ii) some international experience in respect of the evaluation and comparative assessment of programs that support business innovation and (iii) what the Panel heard from stakeholders regarding the effectiveness (and shortcomings) of innovation support programs in Canada.

Existing Assessment Procedures for Federal Programs

There are several mechanisms in place for assessing federal program expenditures, including audits by the Auditor General, strategic reviews and ongoing program evaluations. Performance assessment has a well-defined role within the government's expenditure management system (EMS) — the overall framework for decision making on spending. In recent years, the EMS has evolved to put greater focus on results. The 2006 *Federal Accountability Act* requires departments and agencies to review the relevance and effectiveness of their grants and contributions

[1] More specifically, the net public benefit evaluation of the SR&ED tax credit by the Department of Finance in 2007 (Parsons and Phillips 2007) is considered to be state-of-the-art for program assessments of its type.

every five years. Budget 2007 announced a new EMS that includes a requirement for spending proposals to clearly define expected results, and for departments to manage against these results and formally evaluate program performance (Department of Finance 2007). Budget 2007 also introduced strategic reviews of departmental expenditures on a four-year cycle to determine whether they are achieving their intended results and are aligned with the government's priorities. Because these strategic reviews are Cabinet documents, their results were not available to the Panel. In Budget 2011, the government announced a strategic and operating review that will assess $80 billion in direct program spending across the federal government in order to achieve at least $4 billion in ongoing annual savings by 2014–15 (Department of Finance 2011).

Although this program evaluation machinery is useful for management purposes, it does not, for reasons discussed below, enable assessment of which of the programs reviewed by the Panel are relatively more or less effective.

Assessment of Program "Effectiveness"

Effectiveness, as noted earlier, is defined by the Treasury Board Secretariat as simply "the extent to which a program is achieving expected outcomes." Based on the Panel's assessment of programs, it is clear that individual programs' "expected outcomes" are as varied as the programs themselves, and to a large extent are incommensurable. For example, the Scientific Research and Experimental Development (SR&ED) program, because it is delivered through the tax system, does not have a results-based accountability framework and its performance is not evaluated on a regular basis. However, the Department of Finance has occasionally undertaken economic assessments of the program from a net benefit perspective — that is, estimating the economy-wide benefits and netting out the estimated costs of administration, compliance and the imposition of taxes (for the most recent assessment, see Parsons and Phillips 2007). Work undertaken for this review applied the net public benefit methodology to a sample of other programs but, for reasons outlined in Chapter 6, the Panel has concluded that the method is not sufficiently precise and well developed at this stage for general use to assess the *comparative* effectiveness of programs.

The more sector-focussed programs, such as the SD Tech Fund and FPInnovations, have intended final outcomes that are relatively narrow in scope — for example, increased market growth, sector competitiveness and specific environmental benefits. On the other hand, many programs include outcome objectives at the scale of the entire economy — for example, productivity growth or the overall prosperity of Canadians. Such ultimate impacts of individual programs are effectively impossible to measure, since the specific contribution of the program in question can rarely be isolated from the myriad factors that affect all macroeconomic outcomes.

Intermediate outcomes, which occur closer to a program's point of influence, are obviously easier to measure and attribution is stronger, although almost never definitive. The Panel has observed that intermediate outcomes are typically identified according to each program's specific objectives. Internship programs, for example, have as desired outcomes increased job opportunities in the business sector for graduates. Other programs seek to increase partnerships and collaboration, establish networks, foster an entrepreneurial culture, develop and retain researchers in Canada, or advance the commercialization of new products

and processes. All of these contribute in varying degrees to business innovation, and thus to business competitiveness and prosperity for Canadians, but the linkage to such ultimately desired outcomes is usually indirect and long term. In the end, the linkage must be assessed based on a combination of econometric analysis, anecdote, accumulated experience and intuitive plausibility.

The diversity of outcomes in the portfolio of R&D programs in this review further complicates comparison of their relative impact on business innovation and commercially relevant R&D partnerships. It is nevertheless possible to conceive of common intermediate outcomes for similar program types, and potentially to evaluate the comparative effectiveness of those programs in achieving the common outcomes. This is explained later in this chapter in Recommendation 1.6.

International Practices in Comparative Program Assessment

The Panel met with government representatives from the United Kingdom (UK), Germany, the United States, Australia, Singapore, Finland and the Organisation for Economic Co-operation and Development (OECD) to discuss approaches to performance measurement and the comparative review of programs. It concluded that all jurisdictions recognize the importance of performance measurement and regularly evaluate individual programs within specific ministerial accountabilities. However, whole-of-government assessments of innovation programs for comparative effectiveness are either still in development or not contemplated at all. To the extent that comparative assessments are undertaken, they look at the broad performance of innovation systems and policy — for example, the recent study of the Finnish innovation system (Finland 2009) — and not at the relative effectiveness of individual programs.

Other jurisdictions are thus confronted with the same issues as Canada in assessing the value of their innovation support measures. In a forthcoming publication on business innovation policies, the OECD notes that, while growing attention is being paid to evaluation internationally, the overall evaluation record remains "patchy" (OECD forthcoming). The Panel believes that Canada should encourage, through the OECD, focussed collaboration regarding analysis and best practices in the evaluation of innovation policy and associated suites of programs.

Consultations with Stakeholders

In the absence of the data and methodologies needed for objective and consistent assessment of *relative* program effectiveness, the opinions of stakeholders provide some basis for judgment on comparative effectiveness. For example, programs that have little uptake or awareness by target clients — even though they may be well designed — are not able to have a significant impact on business innovation nationally.

The Panel heard the opinions of domestic stakeholders through (i) consultations in the form of in-person group sessions, held in nine cities across Canada, and a call for written submissions, which elicited 228 responses and (ii) a survey of firms conducted by EKOS Research Associates Inc., which generated responses from more than one thousand R&D-performing businesses of varying sizes, sectors and provinces. The full results of this survey will be made available through the Panel's website at www.rd-review.ca.

These activities shed valuable light on aspects of the comparative effectiveness of the programs under review. It must of course be borne in

mind that stakeholders, by definition, have vested interests. They are beneficiaries of the programs being discussed. Inevitably, some may be excessively complimentary or critical, depending on individual objectives and experience. Nevertheless, because the Panel's consultations — both in person and via written submissions — were extensive and reasonably representative of the span of interests, it is likely that the most oft-repeated views have good grounding in reality.

Consultations

Three federal programs that support R&D were most often mentioned in the Panel's consultations and survey: SR&ED tax credits, the Industrial Research Assistance Program (IRAP) and, to a lesser extent, the Natural Sciences and Engineering Research Council's (NSERC) suite of business-facing programs in support of internships, networking and collaboration. Some corporate stakeholders called the SR&ED program and IRAP the lifelines that saved their businesses; without them, their companies would have foundered.

The SR&ED program, in view of its scale and scope, drew considerable commentary. Much was positive: the program is seen to encourage new investment in R&D, offset the high cost of exploratory work, directly support operations, generate cash flow, and facilitate access to credit, while leaving the specific choice of R&D activity up to the individual business. At the same time, reflecting the fact that it is the best known of the programs being reviewed, the SR&ED program also drew more critical commentary than any other R&D program. Many stakeholders called the claims process cumbersome, complex and time-consuming. Uncertainties associated with qualification and timing are sometimes so great that the SR&ED program is excluded from R&D investment decisions. Many smaller businesses find the claims process so unwieldy that they are forced to engage SR&ED "consultants," sometimes surrendering significant percentages of their refunds as contingency fees. (These issues, as well as the striking preponderance of SR&ED tax credits in the total mix of business R&D support, are addressed in detail in Chapter 6.)

IRAP was widely praised as an effective, well-run program that provides industry with non-repayable contributions, mentorship and technical business advice. The main criticism is the exhaustion of funds very early in the fiscal year, but this is also one indication of the high level of demand for the program. Some believe that the amounts of IRAP funding awards are too small to be effective and that the application process is excessively difficult for first-time applicants.

A frequently raised issue was the need for more efficient and targeted collaboration between post-secondary institutions and businesses, particularly as it relates to mobilizing academic contributions for commercialization. NSERC's current suite of industry-facing programs is extensive, but is not well known by the population of firms it is meant to support. Those stakeholders who were aware of NSERC programs were generally pleased with them. Others, however, urged that the programs be marketed more widely, because businesses often do not know that they can access R&D through post-secondary institutions. This problem is clearly related to the small scale of most of NSERC's business-facing programs and reduces their overall impact. The Panel emphasizes that, although program budgets may be fully subscribed, it is still important for the programs to be widely known in order to attract more applicants. The selection process would then be more competitive, leading to better overall outcomes for any given program budget.

Regarding the supply of graduates and their skills, the Panel heard that businesses require a

full spectrum of skills, at all levels, to support their R&D and innovation activities. This is consistent with a recent OECD report on workforce skills and innovation:

> As with the broader concept of innovation, there is great diversity in the range of activities undertaken within R&D and, consequently, considerable diversity in the occupational structure of the R&D workforce. . . . The great bulk of business R&D expenditure is devoted to Development, not Research; that is to say, it is directed not at fundamental or basic research, but to improve existing products, services and production methods. . . . Such activities are a key function of trade and technician occupations. (Toner 2011, pp. 24–25)

Participants in consultations suggested that greater use of co-ops and internships would improve the market readiness of higher education graduates. To this end, they suggested more support for such programs and broad eligibility to include students at colleges and polytechnics. They also endorsed wider participation in programs that blended science and/or technology skills with management training.

Many provincial collaboration programs were endorsed in the consultations, including the Ontario Network of Excellence, the Colleges Ontario Network for Industry Innovation (CONII), MaRS Innovation centres, the College Centres for the Transfer of Technologies of the Quebec-based Cégeps, BCIC New Ventures, and Alberta Innovates. While stakeholders urged the federal government to include elements of these programs in its own R&D supports, they cautioned against duplication of existing provincial initiatives. Instead, they said, the federal government should consider whether its programs could become accessible to more firms if they were delivered through existing provincial and local organizations and, to this end, they encouraged greater collaboration between the two orders of government.

In addition to feedback on specific programs, stakeholders also commented on the program landscape as a whole. Some frequent themes in this regard were that (i) many programs are not known to as many businesses as they should be and (ii) businesses that learn of the existence of programs are often bewildered by the array of choices across many departments and agencies. Stakeholders called for programs to be consolidated and delivered by fewer organizations. Another oft-raised comment was that the government's business innovation support is heavily oriented toward R&D and is in fact dominated by the SR&ED tax credit. Consequently, there is a need to provide complementary support for other kinds of activities along the continuum from idea to commercial success.

Survey of R&D-Performing Firms

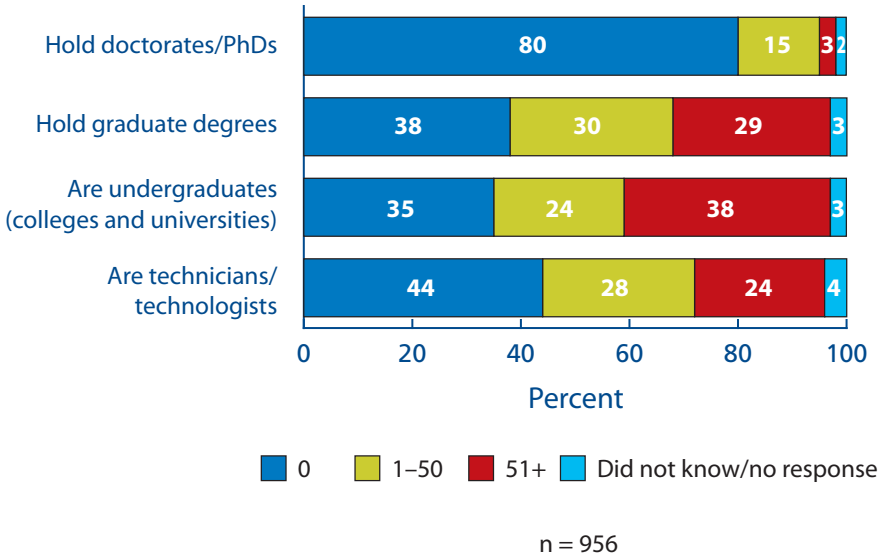
The survey questionnaire enabled the Panel to obtain more comprehensive feedback from R&D-performing firms (see also Box 2.4 in Chapter 2). The findings emerging from this work provide an additional layer of insight.

Surveyed firms that performed in-house R&D were most likely to have R&D employees who held undergraduate degrees (62 percent of firms in the sample) or graduate degrees (59 percent) or who were technicians or technologists (52 percent). By comparison, only 18 percent of responding firms had PhD holders working as R&D employees (Figure 5.1).

Of the 1009 R&D-performing firms surveyed, about one-third (331 respondents) reported never having attempted to access a federal program, including tax credits, that supports business or commercially oriented R&D. When asked, from a prompted list, why they had never participated, more than half said they were not aware of any available programs. Slightly more

Figure 5.1 Types of R&D Performers Employed by Firm

"Approximately what percentage of your R&D performers....?"
[Addressed to firms reporting that they perform in-house R&D]



n = 956

Source: Results from a survey of firms conducted for the Panel by EKOS Research Associates Inc., 2011.

than a third claimed the application process was too burdensome. All other responses were mentioned much less frequently (Figure 5.2).

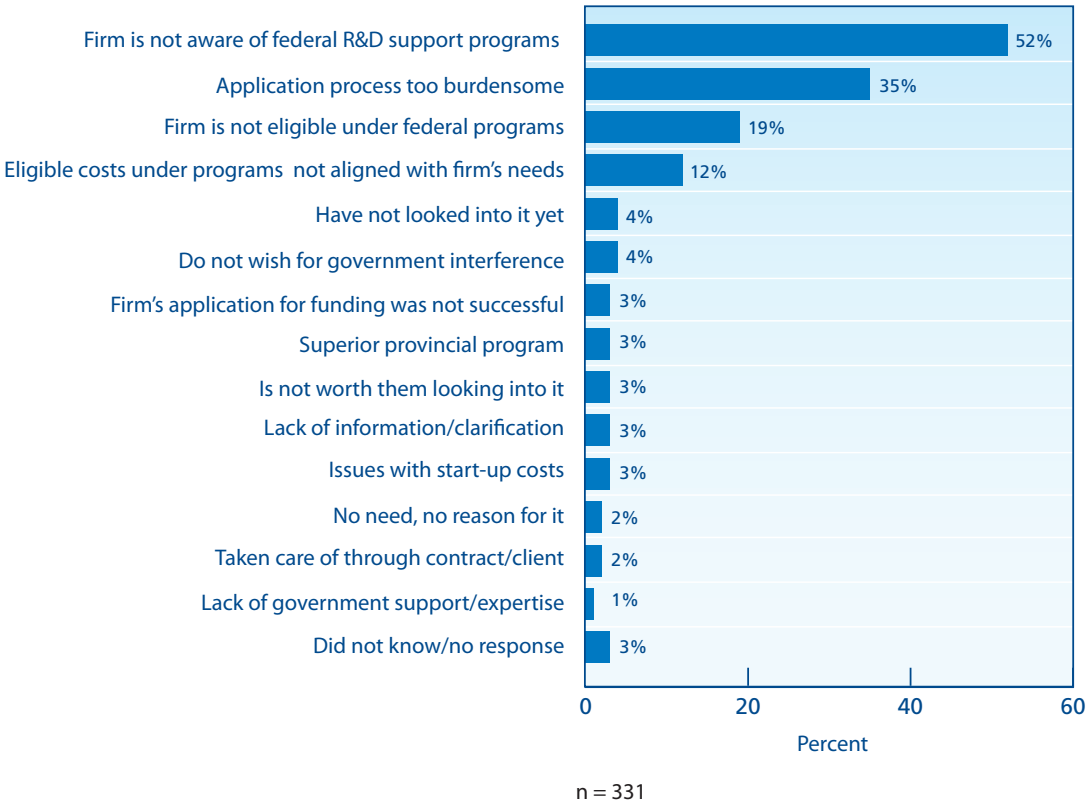
Two-thirds of the 1009 firms surveyed reported having used a federal R&D program sometime in the past and 72 percent of those (488 firms) had accessed such a program in the past three years. Of the 678 firms that were past or present program users, 58 percent stated that their firms expended more on R&D as a result of receiving federal support. This included 79 percent of IRAP users and 71 percent of SR&ED program users — further evidence of the impact of these two large-scale programs on the propensity of companies to undertake R&D. (This of course still does not permit conclusions about the comparative effectiveness of the SR&ED program and IRAP, nor objective quantification of their net public benefit.)

Among the 488 survey respondents that had accessed a federal R&D program in the past three years, 73 percent reported using the SR&ED program and 17 percent IRAP. No other program was identified (unprompted) by more than 1 percent of the companies (Figure 5.3). This strongly suggests that other federal programs are not well known to firms. Moreover, it implies that the survey responses to questions about firms' experiences in using federal R&D programs for the most part concern the SR&ED program and/or IRAP, with the SR&ED program the more prevalent by a ratio of more than four to one.

Bearing this significant qualification in mind, recent program users were also asked to rate their satisfaction in relation to ten aspects of the programs they had used (Figure 5.4). Generally speaking, the surveyed firms expressed high levels of satisfaction with federal R&D support programs — in effect, the SR&ED program and

Figure 5.2 Reasons for Not Participating in R&D Programs

"Are any of the reasons listed below among the reasons your firm has never used or participated in federal programs that support business or commercially oriented R&D?" [Addressed to R&D-performing firms reporting that they never accessed a federal progam]



Source: Results from a survey of firms conducted for the Panel by EKOS Research Associates Inc., 2011.

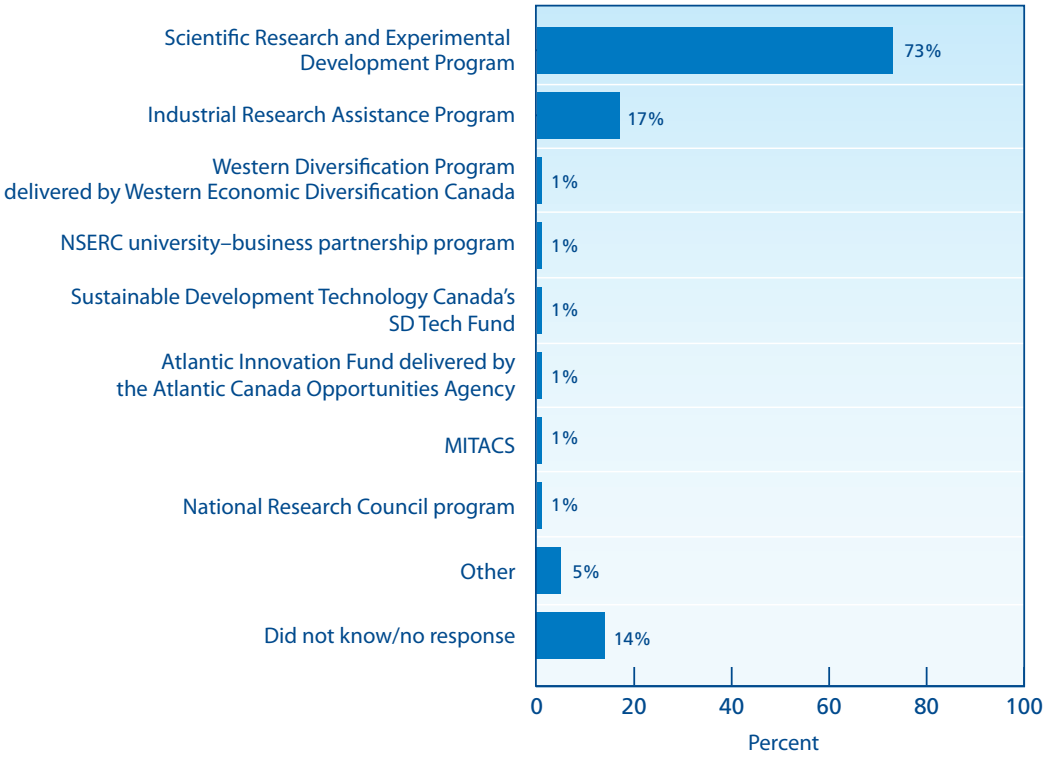
IRAP. More than seven in ten were satisfied with the overall quality of program delivery and the form of support. Roughly two-thirds were also satisfied with the conditions on eligibility, eligible expenses and length of time between decision and receipt of funds. At the bottom of the list, although still garnering majority satisfaction ratings, were the reporting requirements, the length of time between application and decision, and the appropriateness of the selection process.

Following from the overview of the 60 programs in Chapter 3, the discussion of existing program effectiveness evaluation "infrastructure" and the survey of stakeholder views regarding the effectiveness of programs, the Panel believes that change is required to improve the effectiveness and impact of federal programs in support of business innovation in Canada.

Specifically, the rest of this chapter sets out a comprehensive and transformative agenda of recommendations that will, over time, greatly

Figure 5.3 Program from Which Funding Received

"In the last three fiscal years, from which program did your firm receive funding or support from the federal government in relation to business R&D?" [Open ended - multiple responses accepted]

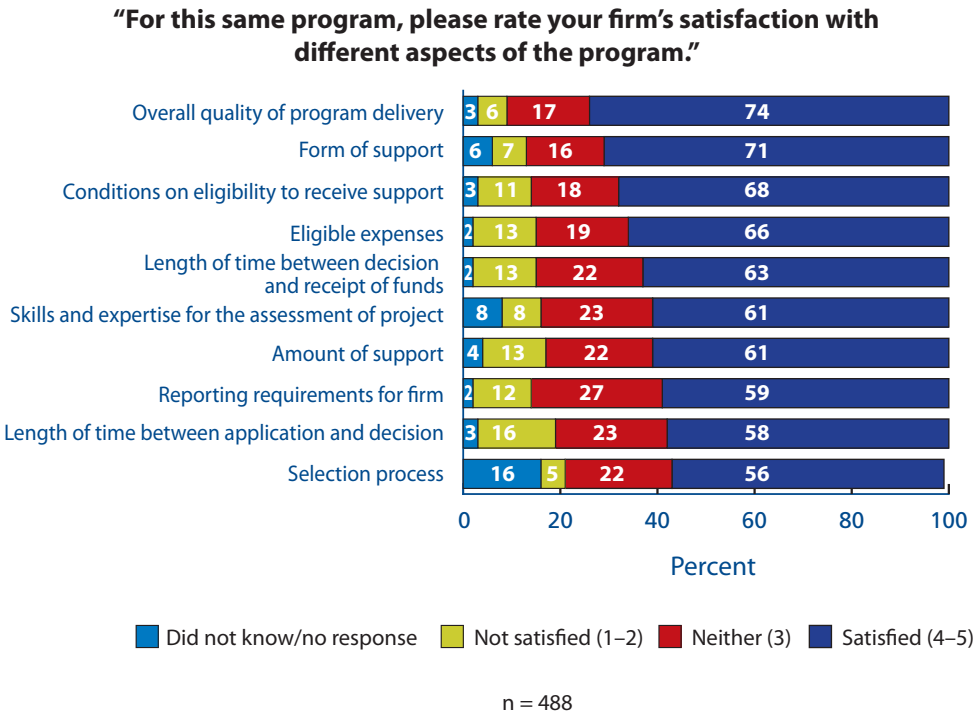


n = 488

Source: Results from a survey of firms conducted for the Panel by EKOS Research Associates Inc., 2011.

improve the impact of federal direct support programs for business innovation. Of foremost importance, the Government of Canada must build a focal point for direct support programming — a new funding and delivery agency for business innovation support.

Figure 5.4 Satisfaction with Various Aspects of the Program



Source: Results from a survey of firms conducted for the Panel by EKOS Research Associates Inc., 2011.

Recommendation 1

Create an Industrial Research and Innovation Council (IRIC), with a clear business innovation mandate (including delivery of business-facing innovation programs, development of a business innovation talent strategy, and other duties over time), and enhance the impact of programs through consolidation and improved whole-of-government evaluation.

The Vision of the Panel

Federal programs to foster business innovation must play the central role in the government's strategy to boost Canada's lagging productivity growth so as to ensure ongoing prosperity for Canadians. Programs to promote business innovation should be designed to address a specific problem for which a government initiative is needed as part of the solution. They should have a scale appropriate for the problem at hand, be well known to business, be easy and timely to access and use, be delivered in coordination with other federal and provincial initiatives, and have clear performance measures to track progress and success.

Getting There

To realize this vision, the Panel recommends the following.

1.1 Industrial Research and Innovation Council (IRIC) — Create an arm's-length funding and delivery agency — IRIC — with a clear and sharply focussed mission to support business innovation. IRIC should become the common service platform for all appropriate federal business innovation support programs. Over time, it should take on at least the following industry-facing activities, as further elaborated in Recommendations 1.2 through 1.4:

- delivery of the Industrial Research Assistance Program (IRAP) and a commercialization vouchers pilot program (1.2)
- delivery of a national concierge service and related web portal (1.3)
- development of a federal business innovation talent strategy (1.4).

In addition, the IRIC could take on the following activities: (i) in partnership with the federal granting agencies, joint oversight of appropriate business-facing programs administered by those agencies, (ii) technical assessment of the innovation element of project proposals submitted to the regional development agencies and (iii) oversight of federal support for business-oriented collaborative research institutes (see Recommendation 4, Chapter 7).

Industrial Research and Innovation Council

Stakeholders consulted by the Panel complained about the fragmentation of the system of federal innovation programming and suggested a streamlined approach whereby programs are overseen and/or delivered by a single entity. Other jurisdictions, including the UK, Australia and New Zealand, have benefited from using common delivery agents for suites of business-facing programs. For example, the UK delivers its innovation programming through a central point — the Technology Strategy Board (TSB) — which reports to the Department for Business, Innovation and Skills. The TSB operates at arm's length from government, sets national priorities, and invests in programs and projects. The Confederation of British Industry told the Panel that British businesses are pleased with the one-stop-shop approach. It is also notable that previous expert panels in Canada — specifically, the Expert Panel on Commercialization and the Competition Policy Review Panel — have recommended increased coordination at the federal level, suggesting it could be brought about through creation of a body mandated to oversee and provide advice from a whole-of-government perspective (see Annex B).

In view of the foregoing, the Panel recommends the creation of the IRIC, an arm's-length funding and delivery agency reporting to Parliament through the minister responsible for innovation (see Chapter 8). The IRIC would drive a change in the governance of industry-facing programs, providing an integrated and responsive entity to foster business innovation and competitiveness. The Panel envisages IRIC as a national delivery agency for federal business innovation programming. It would be demand driven, with clear performance metrics, a whole-of-government orientation and a strong ethos of partnership with the provinces and territories as well as with the existing federal granting agencies — namely, the Natural Sciences and Engineering Research Council (NSERC), the Canadian Institutes of Health Research (CIHR) and the Social Sciences and Humanities Research Council (SSHRC). The IRIC, subject to a performance review every five years, should also be expected to operate according to a number of fundamental principles ensuring a commitment to quality, cooperation and transparency in program design and delivery (Box 5.1).

Box 5.1 Operating Principles of the Proposed Industrial Research and Innovation Council

1. Be mandated to stimulate Canadian economic growth and to foster a culture of innovation by encouraging and supporting business innovation in Canada through an optimal mix of programs.
2. Provide a single point of contact for Canadian businesses seeking to undertake R&D/innovation activities, and guide business "clients" to the program and service providers that best meet the timelines and supports that the industry client needs. This will reduce the confusion of multiple points of entry.
3. Be industry sector agnostic and emphasize that innovation occurs in all sectors of the economy, in urban and rural areas, and within micro, small, medium and large Canadian companies, and that innovation can be enabled by talent from a range of service providers.
4. Work collaboratively with businesses, the federal and provincial governments as well as the Canadian research community to design new programs and remove existing barriers and impediments in order to improve Canada's commercialization outputs, competitiveness and productivity. Encourage, as appropriate, cross-sector, cross-platform, cross-disciplinary collaboration.
5. Use common definitions, a common program/project application form, and offer clear and consistent advice to Canadian business from coast to coast.
6. Enable and encourage novel program design and delivery. Where appropriate, solicit outside program delivery agents through a competitive process designed to maximize program outcomes. In such cases, IRIC must ensure clear lines of accountability with these delivery agents, allowing them to compete and avoiding any conflict of interest in which IRIC competes with delivery agents for program funding.
7. Require that businesses put "skin in the game" for programs/projects commensurate with the level of return to the partner. Generally, as projects are further downstream toward the market in the innovation chain, businesses must be required to increase the proportion of their own investment.
8. Maintain an uncompromising focus on quality. Where appropriate, peer review should be used to determine research funding to ensure that the right problem and audience are being targeted with the right methodology.
9. Respect stakeholder timelines and commitments. For example, peer review processes must be designed to ensure against protracted delays in either starting projects or releasing business contributions.
10. Track, measure and report to the proposed Innovation Advisory Committee (IAC, described in Chapter 8) and the public on outcomes and indicators for all business-facing R&D programs offered by the Government of Canada. Where needed, develop new metrics, approved by the IAC, and keep a scorecard of performance. Create lines of accountability to the IAC for program outcomes and delivery.

Over time, IRIC would become the common service platform for all appropriate business innovation support programs of the federal government. Eventually, and with increased industry participation and contribution to these programs, IRIC would play a lead role in developing new initiatives that directly assist firms with their business innovation needs, including joint initiatives with the provinces and territories, where warranted. The key distinction between programs administered by IRIC and those administered by NSERC and other existing granting councils is that the former would focus on demand-driven support — typically in response to initiatives from, or directly related to, businesses — while the latter would continue to focus on supply-push support — for example, funding for commercially oriented projects initiated within academic institutions. In this regard, there is also a need to distinguish between (i) the support by NSERC and CIHR of solution-driven research and (ii) their support of basic discovery research, ensuring that both receive adequate funding and are evaluated using appropriate and relevant metrics.[2]

Given IRIC's central role for federal initiatives supporting business innovation, it should be involved in a substantive and strategic way with the risk capital and procurement programming set out in Chapter 7. That said, the legal and financial responsibility for delivery and financial management should remain with the Business Development Bank of Canada and Public Works and Government Services Canada, respectively. The IRIC should also assume responsibility for the technical assessment of all proposals submitted to regional development agency (RDA) programs that support business innovation.[3]

In fulfilling its role, the IRIC would need to adopt an overall portfolio view of its suite of programs, consolidate similar programs, identify gaps, set clear outcomes for each program and monitor programs to ensure they are meeting objectives. The IRIC would ensure that intended program outcomes are relevant and responsive to program users. Moreover, a commitment to federal–provincial collaboration would be a constant feature of all of the IRIC's operations.

While ongoing costs for the IRIC would be partly offset through the transfer of existing employees from other organizations, its creation would take time and entail up-front incremental cost, arising from both the transfer of the range of programs and the set-up of the new organization itself. Creation of this new organization and the transfer of existing programs to the IRIC framework should be staged to minimize stakeholder and program disruption.

Industrial Research Assistance Program and Commercialization Vouchers

As noted, the Panel's consultations revealed that IRAP is widely regarded as an effective, well-run initiative that facilitates R&D and commercialization activity by small and medium-sized enterprises (SMEs). This finding is corroborated by evidence collected through the Council of Canadian Academies' 2006

[2] In an opinion piece published in *Nature*, Dr. Indira Samarasekera, President of the University of Alberta, argues the need for a new social contract that "would involve establishing a review, approval and funding process for solution-driven research that sits parallel to processes for basic research, and has the nimbleness and urgency desired in the outcomes, without compromising the cautions that validate and protect the quality of the work" (Samarasekera 2009, p. 161).

[3] The assessment of proposals to support innovation should be based on broad criteria of commercial success, taking into account the overall competitive landscape both nationally and globally. This requires expertise and specific skills that are difficult to maintain across a variety of small programs and delivery organizations. Consolidating assessment of the innovativeness and commercial potential of business innovation projects in the IRIC, as a "back office" function provided for the RDAs, would allow IRIC to develop common definitions, standards and assessment processes across Canada to ensure consistently high standards. The IRIC should also facilitate the sharing of best practices among RDAs and work with them on partnering more effectively with provincial governments.

assessment of Canada's strengths and weaknesses in science and technology. A survey conducted as part of that assessment found that IRAP was considered to be the federal government's strongest program of direct support for the commercialization or translation of research into applications that benefit the economy or society (CCA 2006).

The Panel's consultations further revealed that many stakeholders believe the federal portfolio of business innovation support places an emphasis on R&D and that there is an ensuing need to provide complementary assistance for non-R&D activities along the path from idea to market success, particularly those related to commercialization. The Panel was also frequently told that many companies, especially SMEs, lack awareness of the range of post-secondary education, government, non-profit and other commercialization facilities, assets and skilled personnel available across the country. It was suggested that such issues could be addressed through the introduction of a "vouchers" program — that is, government funding support would be delivered via vouchers provided to qualifying businesses and used to defray part of the cost of acquiring approved commercialization services from approved providers. A vouchers approach has already been adopted by other jurisdictions (e.g., the Netherlands, Hungary, the UK and Ireland) as well as by provincial governments, including Alberta, Newfoundland and Labrador, and Nova Scotia. Vouchers are a relatively new form of delivering direct assistance to firms. Their underlying objective is to help build relationships between SMEs and innovation partners by eliminating obstacles that have traditionally been barriers to such relationships — for example, the relatively high fixed costs required for SMEs to identify a suitable partner.

Recognizing that IRAP plays a central role in enabling SMEs to conduct R&D and to innovate, and that vouchers would help SMEs better connect to commercialization partners, the Panel recommends the following.

1.2 Resources for IRAP and commercialization vouchers — Increase IRAP's budget to enable it to build on its proven track record of facilitating innovation by SMEs throughout Canada, and create a national commercialization vouchers pilot program, delivered within the suite of existing support mechanisms offered through IRAP, to help SMEs connect with approved providers of commercialization services in post-secondary, government, non-profit and private organizations.

Funded IRAP projects must have strong commercialization potential and represent significant contributions to the development and use of leading-edge technologies. In view of IRAP's well-known and respected "brand," it is also important for the program to retain its identity under the IRIC umbrella.

The national commercialization vouchers program should be established as a five-year pilot initiative and delivered collaboratively with provinces in cases where there is provincial interest. Clear principles, common definitions and consistent outcome indicators should be put in place for this pilot program. The business beneficiary of a voucher-related project should be required to contribute as well in order to demonstrate commitment to the project.

Concierge Service

Canada's landscape of programs that support business innovation is densely populated by initiatives spanning many departments and agencies at both the federal and provincial levels. This leaves many businesses bewildered by the array of choices. A corollary is that many programs are not as well known to businesses as they should be. The Panel therefore recommends the following.

1.3 Innovation concierge service — Establish a national "concierge" service and associated comprehensive web portal to provide companies with high-quality, timely advice to help identify and access the most appropriate business innovation assistance and programs for the individual firm.

The concierge service would serve the dual purpose of (i) providing a single access point for businesses to obtain individualized assistance in navigating the complex program landscape through well-informed guidance on the most appropriate programs and (ii) generating awareness of programs by directing clients to initiatives they might not have otherwise identified.

In order to ensure that businesses benefit from high-quality, personalized assistance on a case-by-case basis, client service personnel in the concierge offices should be appropriately trained to provide services ranging from initial client referrals to specialized sectoral advice, drawing on all Government of Canada resources as well as relevant provincial programs. The associated web portal should be developed in collaboration with the provinces to constitute a "one-stop" online orientation to the full range of government programs in support of business innovation. The new concierge service should build on the existing capacity of Canada Business, which provides access to information and tools for Canadian businesses and entrepreneurs through service centres and an online delivery channel.

Talent

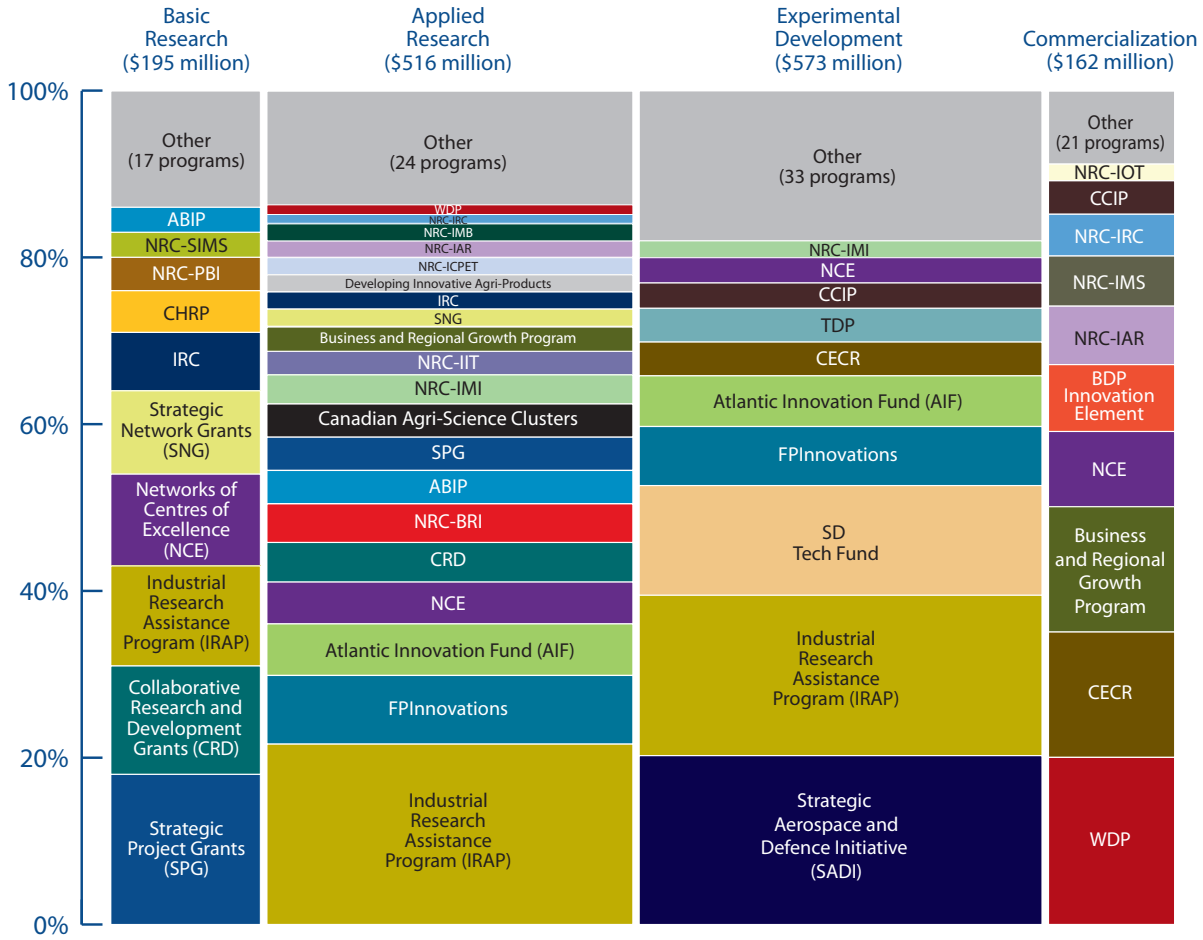
A talented and adaptable workforce is at the heart of innovative economies. Every part of the economy therefore has a stake in educating, training and effectively integrating highly qualified and skilled Canadians into the workforce, and in attracting and retaining talented individuals to Canada. While the development of talent is the responsibility of the provinces, the Government of Canada plays an important role through the granting councils and can have a particular focus on the deployment of talent in support of business innovation. Unfortunately, federal efforts are unorganized, and federal programs are subscale and uncoordinated. The Panel therefore recommends the following.

1.4 Talent — IRIC should lead the development of a federal business innovation talent strategy, working closely with the provinces and relevant federal departments and agencies, focussed on increasing business access to, and use of, highly qualified and skilled personnel.

Guided by this strategy, IRIC should work with federal partners to consolidate federal industrial internship and youth employment programs, creating a larger, more flexible program open to all senior undergraduate and graduate students and post-doctoral fellows from across our post-secondary educational institutions. The strategy should address gaps in the current suite of business-oriented talent programs, such as creating opportunities for entrepreneurship mentoring, addressing Canada's underperformance in deploying our most highly skilled and highly trained PhD graduates, and developing the full range of industrially relevant research, development and commercialization skills for trainees, including both technical and professional "soft" skills.

The strategy should be designed to meet clearly defined objectives, over time, centring on the increased use by business of highly qualified and skilled personnel. The Panel also recommends that the strategy make use of proactive and flexible delivery mechanisms by engaging stakeholders and civil society in the design and delivery of its talent initiatives, where appropriate.

Figure 5.5 Direct Spending Portion of the Envelope, by Activity Supported, 2010–11[a]



[a] Within each activity supported, programs are ordered according to the size of their expenditures, starting from the largest at the bottom and progressing through to the smallest at the top. Expenditures for each program are roughly proportional to the area of the rectangles representing the program. Some programs (for example, IRAP) are present in more than one activity. Three percent of direct expenditures within the review envelope are unclassified and are not represented in this figure. See Annex A for the full name of programs represented by acronyms.

Source: Based on figures collected from federal departments and agencies.

Program Consolidation

As documented in Chapter 3, there are many small-scale business R&D and commercially oriented R&D programs in the federal suite. (Figure 5.5 portrays the portfolio of direct expenditure programs by activity supported.) Recent work by the OECD suggests that ". . . the policy mix needs to avoid inefficiencies arising from operating too many schemes at too small a scale. This is a real concern, since

instruments can develop constituencies of support and a degree of autonomy, making them less amenable to change or cancellation, even where this would be sensible. In some cases, there may be ways to streamline the range of instruments and programmes, reduce complexity, enhance transparency and lower administration costs" (OECD forthcoming, p. 9).

Internationally, jurisdictions such as Finland and the UK, and domestically both Alberta and Ontario, have reduced the number of business innovation programs offered and have rationalized their program suites into a set of mutually exclusive programs, thus providing coverage for areas of government intervention in the innovation system. The UK government has consolidated its business support programs, reducing their number very substantially in the new Solutions for Business program launched in April 2011. The Panel believes that the government must seize opportunities for program consolidation, and therefore recommends the following.

1.5 Program consolidation — Over time, consolidate business innovation programs focussed on similar outcome areas into a smaller number of larger, more flexible programs open to a broader range of applicants and approaches.

Through a more streamlined suite of programs, the government could reduce overhead costs, increase impact, enhance client awareness and improve the usability of business innovation programs.

Comparative Program Evaluation

The Panel was asked to provide advice on which federal programs in support of business innovation are most effective. However, as noted earlier, the tools needed to assess *comparative* effectiveness have not yet been developed — there is no agreed-upon definition, framework or methodology for comparative evaluation, no common performance indicators and no common database of the programs. Management of $1.5 billion in direct program spending requires better management tools to be put in place, together with a process to apply these tools in a comprehensive, consistent and ongoing way. A common, outcomes-focussed framework for performance management and public evaluation of business and commercially relevant R&D programs would improve comparability among programs and inform decisions to reallocate funding strategically within the overall portfolio. It would make Canada a leader in managing for results. Accordingly, the Panel recommends the following.

1.6 Program evaluation — Build a federal capacity to assess the effectiveness of new and existing business innovation programs to enable comparative performance evaluation and to guide resource allocation going forward.

To this end, it is possible to conceive of a whole-of-government evaluation approach whereby sets of "intermediate outcomes" are applied as performance measures to categories of like forms of support, regardless of the department or agency providing that support. A schematic example of this approach is illustrated in Figure 5.6, which could potentially serve as a basis for discussion between the IRIC and the federal evaluation community, working with the Treasury Board Secretariat.

Figure 5.6 Performance Indicators for Comparison of Categories of Like Forms of R&D Support

Category of Support Program	Outcomes	Possible Indicator(s)
A Firm R&D and commercialization	Increased business investment in innovation, including R&D	• Increased firm expenditures on R&D • Increased firm expenditures on intangibles (e.g., intellectual property)
	Increased ability to perform and manage R&D	• Increased number of R&D managers
	Improved firm performance	• Increased profits from cost savings resulting from productivity improvements • Increased profits from sales/revenues of new products and services
B R&D partnerships	Increased adoption of knowledge and technology by firms	• Percentage of projects resulting in technology transfer • Number of new firms entering R&D activity/number of repeat firms
	Strengthened networks and linkages	• Increase in SME clients served by post-secondary education service providers • Increase in co-publications • Increase in the intensity of collaboration (value of private sector R&D expenditures on contracts with the public sector)

Figure 5.6 Performance Indicators for Comparison of Categories of Like Forms of R&D Support (cont.)

Category of Support Program	Outcomes	Possible Indicator(s)
C Commercially oriented R&D	Advancement of technology/knowledge	• Increased number of prototypes • Increased number of patents, licences and disclosures • Increased number of publications
	Increased commercialization of public research	• Number of spin-off companies • Spin-off company revenues and R&D expenditures
D Training in industry	Increased supply of talented people	• Increase in number of students/researchers with industry experience prior to graduation • Increased retention rates of highly qualified and skilled personnel in Canadian enterprises

Chapter

6

Program Mix and Design

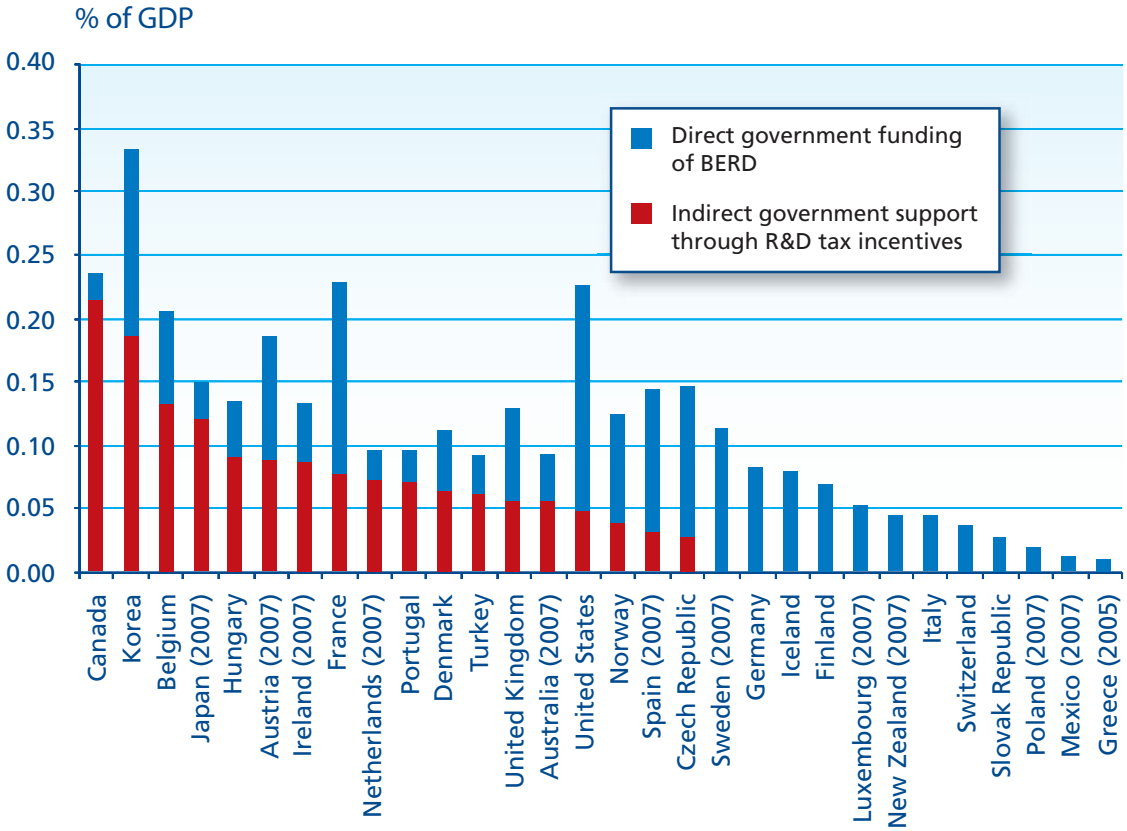
This chapter addresses the second question in the government's charge to the Panel: "Is the current mix and design of tax incentives and direct support for business research and development (R&D) and business-focussed R&D appropriate?"

In its forthcoming report on business innovation policies, the Organisation for Economic Co-operation and Development (OECD) emphasizes the importance of striking the right balance in the mix of programs to support business innovation. It notes, for example, the requirement to have a set of instruments that is sufficiently differentiated to meet the needs of complex innovations systems while at the same time avoiding the inefficiencies of operating too many schemes at too small a scale — an issue that was addressed in the previous chapter.

The mix between direct and indirect measures is another important consideration, notably because each form of support offers certain advantages and disadvantages (Box 6.1). In its *State of the Nation* reports, the Science Technology and Innovation Council (STIC 2009, 2010) notes that, as a percentage of gross domestic product (GDP), government support for business R&D in Canada is among the most generous in the world, but underscores that, relative to comparator countries, Canada's support is heavily weighted toward tax incentives as opposed to direct support measures. Of particular note, as seen in Figure 6.1, the United States (US) spends significantly more on direct support measures relative to support through tax incentives. However, there is a trend among OECD countries to make greater use of R&D tax incentives (OECD forthcoming).

The Panel has concluded that the OECD data in Figure 6.1 to some extent overstate federal reliance on indirect support because (i) these data do not capture the full range of direct programs in Canada and (ii) the measurement of direct support varies across countries, making international comparisons problematic. Specifically, the Panel's mandate includes support not only for "direct government funding of business expenditure on research and development (BERD)," as depicted in Figure 6.1, but also for commercially relevant R&D performed by public and non-profit institutions — for example, support through programs that seek to help build links between academia and industry. The addition of these expenditures to the "direct" support mix would slightly increase Canada's ratio of direct to indirect support relative to the picture in Figure 6.1. There are also differences among countries in the calculation of certain items of direct government support that have the effect of increasing the reported direct expenditures of some countries relative to Canada — for example, their inclusion of loans to business and government procurement of R&D services as direct support measures. It should also be noted that the refundable Scientific Research and Experimental Development (SR&ED) tax credit is

Figure 6.1 Direct and Indirect Government Support of Business R&D, 2008 (except as noted)
(percentage of GDP)[a]



[a] The data illustrated in this figure do not include R&D tax incentives provided by sub-national governments — an important consideration, as in Canada provinces also provide tax support.

Source: OECD (2010b).

in effect a cash transfer to qualifying smaller companies to help fund their R&D activity, and thus has something in common with a "direct expenditure" program. On the other hand, the SR&ED credit, whether refundable or not, is quite unlike the direct spending programs reviewed by the Panel, since the latter have targeted criteria and are subject to assessment of the merit of the proposed business innovation project, while the SR&ED program has neither constraint.

Although one might debate the fine points of "direct versus indirect" spending ratios, it is abundantly clear from the program data presented in Chapter 3 that the federal government's mix of R&D support is very heavily weighted to tax incentives — the SR&ED program accounts for about 70 percent of the value of the support provided by the 60 programs reviewed by the Panel. International comparisons of tax incentive programs for R&D also demonstrate that the Canadian system is among the most generous in the world, particularly for small businesses (Figure 6.2). Comparisons including the sub-national level indicate, moreover, that the

Box 6.1 Direct Support Versus Indirect Support

The OECD (2010a, p. 76) defines direct and indirect funding as follows: "Government direct R&D funding includes grants, loans and procurement. Government indirect R&D funding includes tax incentives such as R&D tax credits." In practical terms, the main distinction between direct and indirect support is that the latter is open ended and is available to all firms, whereas the former is limited in overall funding and is allocated by program administrators to specific projects, industries or regions. Direct support can therefore be targeted to specific areas, contrary to more neutral indirect measures.

It follows that the principal advantage of direct instruments lies in the ability to focus support on actors or activities considered more likely to achieve high social returns or to advance specific policy goals. Notwithstanding the benefits associated with this ability to strategically target resources, there are also some drawbacks to direct support measures. In particular, they generally involve more rigorous selection and evaluation processes, which can translate into higher administration costs for government and compliance costs for beneficiaries. Moreover, they can raise some concerns around the desirability of governments "picking winners" in the marketplace.

Conversely, indirect measures are advantageous for the opposite reason. Since they are non-discriminatory and widely available across firms, sectors, fields and activities, they more closely conform to market rationality. Indirect measures are also generally easier and cheaper to implement. The flip side, however, is that they are less amenable to being steered toward specific policy objectives.

combination of federal and provincial tax credits in Canada provides much higher subsidy rates for R&D than are available, for example, in US states.

The question therefore is whether Canada is relying too heavily on "indirect" tax expenditure in its overall mix of business innovation/R&D support. The great advantage of a tax-based approach is that, once basic eligibility criteria are met, it does not discriminate on the basis of sector, region or specific opportunity. Since the SR&ED program is based on the tax system, it operates "automatically." The tax incentive stimulates R&D generally, but leaves project selection decisions to individual firms. The government does not try to pick the winners — the companies do. The strength of the program is also potentially its weakness. The tax credit is a blunt instrument. Not every R&D project will generate the same rate of social return; not every R&D performer is equally in need of stimulus or equally likely to be successful; and governments will often be well justified in seeking to promote, through targeted support, certain domains of innovation and R&D for strategic purposes.

Changing the Mix: More Direct Support

The SR&ED program plays a fundamental role in lowering the costs of industrial R&D for firms, enhancing investment in R&D, and making Canada a more attractive place to locate R&D activity. However, a key implication of this heavy reliance on the program is that federal support for innovation may be overweighted toward subsidizing the cost of business R&D rather than other important aspects of innovation. In particular, the Panel believes the federal

Figure 6.2 Tax Subsidy Rates on Investment in R&D for Selected Countries, 2009[a]

Country	Large Firms (%)	Small Firms (%)	Combined Large/Small (%)	Combined Ranking	BERD Intensity Ranking in the OECD (2008)
France	38.6	47.6	40.2	1	14
Spain	34.1	36.9	34.5	2	24
Canada	26.9	46.0	30.2	3	18
India	29.3	31.7	29.7	4	— [b]
Brazil	28.9	33.0	29.6	5	— [b]
Ireland	26.2	26.1	26.2	6	19
United Kingdom	21.1	22.8	21.4	7	16
Japan	18.0	23.2	18.9	8	4
China	17.4	18.8	17.7	9	— [b]
Norway	15.9	24.6	17.4	10	22
Australia	14.2	15.5	14.4	11	12
Korea	12.1	14.2	12.4	12	5
Netherlands	10.0	12.2	10.3	13	21
United States	9.1	10.0	9.2	14	7
Italy	4.9	17.5	7.0	15	25
Finland	3.1	3.4	3.1	16	2
Sweden	2.1	3.2	2.3	17	3
Germany	1.6	3.3	1.9	18	10
Switzerland	0.4	2.6	0.8	19	6
Russian Federation	0.2	0.6	0.3	20	— [b]
Unweighted average	15.7	19.7	16.4		
Median	15.1	18.2	15.9		

[a] The data in this table include income tax deductions. They also include R&D tax incentives provided by sub-national governments.

[b] Not a member country of the OECD.

Source: Department of Finance (2009); and OECD (2011) for the rankings for BERD intensity (BERD as a percentage of GDP) in 2008.

government needs to focus its innovation support more sharply on the strategic objective of growing innovative firms into larger enterprises — a key means of achieving the scale required to realize the Panel's vision of a Canadian business sector that stands shoulder-to-shoulder with the world's innovation leaders.

For this reason, coupled with stakeholder calls for increased direct support, the Panel believes the government should rebalance the mix of direct and indirect funding by decreasing spending through the SR&ED program and directing the savings to complementary initiatives strategically focussed on serving

the needs of innovative Canadian firms, especially small and medium-sized enterprises (SMEs), to help them grow and prosper. These complementary initiatives include those recommended in Chapter 5: (i) shored-up support for the Industrial Research Assistance Program (IRAP) to provide advice, mentoring and funding in support of R&D and commercialization projects by SMEs; (ii) a new commercialization vouchers pilot program to help SMEs connect with innovation partners; (iii) a new concierge system to improve client service; and (iv) increased access to a highly skilled and entrepreneurial workforce. They also include other measures discussed in the next chapter: (i) using procurement and related programming to foster demand for business innovation, particularly by SMEs; and (ii) improving federal support for risk capital at the start-up and later stages of growth to help small firms become larger ones, while retaining a significant presence in Canada as they grow. The end result of this rebalanced program mix would be a substantial increase in the range and sophistication of federal support for SMEs.

Overview of the SR&ED Program

The SR&ED tax incentive program is designed to encourage Canadian businesses of all sizes and in all sectors to conduct R&D in Canada that will lead to new, improved or technologically advanced products or processes (Box 6.2).

The SR&ED program generally provides a 20-percent tax credit to Canadian businesses, with an enhanced 35-percent federal tax credit available to qualified small businesses that are Canadian-controlled private corporations (CCPCs).[1] The enhanced credit is fully refundable up to an expenditure limit, which is to say that the enhanced credit is payable regardless of the tax position of the company. The refundability feature for small companies means, for example, that many young companies that have little or no taxable income receive cash to help finance their R&D and potential growth.

The current expenditure limit to access the 35-percent credit with full refundability is $3 million, which at this limit can generate an annual tax credit of just over $1 million.[2] The $3-million expenditure limit is gradually reduced to zero as prior-year taxable income rises from $500 000 to $800 000 or as prior-year capital assets rise from $10 million to $50 million. Spending above the expenditure limit qualifies for a 20-percent credit that is 40-percent refundable but, once taxable income exceeds $800 000 or capital assets exceed $50 million, CCPCs receive the standard non-refundable 20-percent SR&ED tax credit.

In 2007 — the most recent year for which such data are available — some 20 000 small businesses that were CCPCs received about $1.3 billion in SR&ED tax credits (Figure 6.3). (By way of contrast, 1082 SMEs received a total of $69.1 million in funding from IRAP in 2007.) About 3900 other firms earned roughly $2.0 billion in SR&ED tax credits in 2007. The average credit value for small businesses was about $65 000, compared with an average claim of approximately $700 000 for larger corporations. The number of qualified small businesses increased by more than 25 percent between 2004 and 2007, compared with a very modest growth for large businesses. Part of the

[1] To have access to the 35-percent credit, the claimant needs to be incorporated as well.

[2] Only current expenditures are eligible for full refundability; capital expenditures, which account for about 4 percent of total costs, are eligible for a 40-percent refund. Access to full refundability is restricted to CCPCs with prior-year taxable income up to a maximum of $500 000, which is gradually reduced to zero as capital assets increase from $10 million to $50 million.

Box 6.2 Key Parameters of the SR&ED Tax Incentive Program

Nature and Purpose

The SR&ED program seeks to encourage Canadian businesses of all sizes and in all sectors to conduct R&D in Canada that will lead to new, improved or technologically advanced products or processes. The program offers two types of incentives:

- **Income tax deductions** — All allowable SR&ED expenditures, including capital, may be deducted from taxable income in the year incurred at the taxpayer's discretion; unused deductions may be carried forward indefinitely. R&D spending is generally considered to be an investment — that is, the spending is undertaken in one period with the expectation of generating revenues in future periods — so allowing immediate deductibility of capital and current expenditures provides a significant benefit to firms.
- **Investment tax credits** — Earned as a percentage of qualified SR&ED expenditures, investment tax credits can be used to reduce the amount of income taxes otherwise payable. They can be carried back up to three years and forward up to 20 years to reduce income taxes otherwise payable in those years. Credits earned in a year but not used are partially or fully refundable (that is, redeemed for cash) for smaller businesses.

Eligibility

- **Participants:** corporations, proprietorships (individuals), partnerships and trusts
- **Costs:** Salaries and wages, overhead expenses, materials, capital equipment expenses, contracts and payments to third parties such as post-secondary institutions
- **Projects:** experimental development, basic and applied research, and support work (such as engineering design and operations research) carried out for the purpose of achieving technological advancement or advancing scientific knowledge.

Administration

Administration is the responsibility of the Canada Revenue Agency (CRA), while governing legislation (*Income Tax Act*) is the responsibility of the Department of Finance. Firms file a SR&ED claim for their eligible expenditures incurred. The CRA reviews the claim, and aims to process 90 percent of refundable claims within 120 days of receipt and 90 percent of non-refundable claims within 365 days of receipt. The CRA offers a preclaim advisory service to help businesses identify the eligibility of projects. It is available at no cost before claims are filed. As noted on the CRA website, the preclaim service is "neither an advanced income tax ruling nor a pre-approval of a SR&ED claim. A final determination on any SR&ED claim must be based on the actual work done and can only be made after the claim is filed."

growth in the number of small CCPCs in 2007 may have been due to an increase of the taxable income threshold that allows a company to qualify for the enhanced credit. Due to their higher credit rate and refundability, small CCPCs claimed about 40 percent of total credits while performing about 30 percent of qualifying R&D in 2007.

The SR&ED program, unlike grant programs, is not subject to assessment of the quality of any particular business project. Businesses that do not qualify for a refundable credit nevertheless

Figure 6.3 Tax Expenditures, by Type of Corporation

	Value of Credit ($ million)				Number of Corporations (units)			
	2004	2005	2006	2007	2004	2005	2006	2007
Small CCPCs	1 043	1 119	1 128	1 298	15 482	16 917	17 712	19 806
Large firms	1 944	1 448	1 471	1 822	2 452	2 448	2 728	2 599
Others[a]	137	170	208	136	1 259	1 510	1 920	1 310
Total	3 123	2 737	2 807	3 256	19 193	20 875	22 360	23 724

[a] Includes CCPCs in expenditure limit phase-out range and small non-CCPCs.

Source: Department of Finance.

face "tax risk" in that they must have sufficient tax payable in order to fully benefit from the credit. This has the significant advantage of "targeting success" — that is, the (non-refundable) benefit is available only to companies that are sufficiently profitable — while making the credit less open ended than it initially appears. Although businesses can carry unused credits to future years, delayed use reduces the value of the benefit. With the almost 50-percent reduction in the federal statutory corporate tax rate since 2000, businesses now find it more difficult to fully utilize the SR&ED tax credit generated in a current year against federal tax otherwise payable, putting further downward pressure on the average expected effective tax credit rate. In contrast, the criterion for "targeting success" does not apply to the small CCPCs that receive a fully refundable tax credit.

Net Public Benefit

In 2007, the Department of Finance conducted a thorough benefit–cost analysis of the SR&ED program (Parsons and Phillips 2007). It concluded that the public benefit of the program — the part due to the incremental R&D investment stimulated by the SR&ED subsidy and the estimated social return on that incremental investment (i.e., extra output generated in the economy as a whole) — exceeded its full costs. These costs include not only administrative and compliance costs, but also the cost to the economy of having to raise additional tax revenues to finance the credit. This type of benefit–cost analysis relies on key parameter estimates — particularly of the extra R&D performed per dollar of tax credit provided and of the social rate of return on business R&D expenditure — which are subject to considerable estimation error. These measurement problems, together with the difficulty of applying the methodology to other innovation support programs — for example, to business network and internship programs — have led the Panel to conclude that the calculation of net public benefit is not sufficiently precise at this time to permit a benefit–cost ranking of the government's business R&D support programs, nor to fine-tune the mix between SR&ED and the portfolio of direct expenditures.

The estimation of net public benefit of innovation programs is nevertheless an excellent goal and should be included, as it is developed and refined, within the suite of program evaluation tools, as referred to in Chapter 5 on program effectiveness. What can be said, in any event, is that the net public benefit of a support program declines as administration and compliance costs increase, and as the subsidy

rate for the program increases beyond a certain threshold. Some level of subsidy is of course needed to stimulate the behaviour that a program is trying to encourage. But an increasing subsidy obviously raises the "cost" side of the equation directly and also steadily increases the likelihood that projects with poorer expected returns will be undertaken, or that businesses with poor prospects will be sustained longer than they otherwise would be. Either of these outcomes reduces the added benefit contribution of the program. At some point, the additional cost of a higher subsidy will exceed the additional social benefit that more generously subsidized projects induce. Were this to occur, the subsidy rate should be reduced. When subsidies associated with several different programs are combined to support a given project, the risk of excessive subsidization obviously increases. This is why it is important to take an overall portfolio approach to a suite of R&D programs and to establish close cooperation between federal and provincial governments in this regard.

As noted in Chapter 5, the SR&ED program is both lauded and criticized. In the latter regard, its complexity results in excessive compliance costs, unpredictability about qualification and firms having to resort to retaining consultants, the cost of which diminishes the benefit. Compliance costs are currently estimated to be approximately 14 percent of the value of credits earned by small firms and 5 percent for large firms.[3] At the same time, the program's enhanced benefit for small firms may be richer than necessary, particularly given the compounded effect of provincial credits and other government support programs. Figure 6.4 shows the impact of combining the R&D tax credits provided by individual provinces with federal SR&ED credits. Box 6.3 provides

Figure 6.4 Federal and Provincial Tax Credit Rates (%)

Provinces	Provincial Tax Credit	Federal Plus Provincial[a]	
		CCPCs	Other Firms
Alberta and British Columbia	10	42	28
Manitoba	20	48	36
New Brunswick, Newfoundland and Labrador, Nova Scotia, Saskatchewan and Yukon	15	45	32
Northwest Territories and Prince Edward Island	0	35	20
Ontario (small/large firms)	10/4.5	42	24
Quebec (small/large firms)[b]	37.5/17.5	48	27

[a] The federal credit is 35 percent for small CCPCs and 20 percent for other firms. The base for the federal credit is reduced by the amount of provincial credits.

[b] The Quebec credit is paid on wages and salaries plus 50 percent of contracts. The federal–provincial rate is expressed as a percentage of R&D costs eligible for the SR&ED credit.

Source: PricewaterhouseCoopers (2011) and calculations undertaken for this review.

[3] These estimates are based on a web-based survey undertaken in May and June 2011 on behalf of the Panel.

Box 6.3 Stacking of R&D Support

Firms undertaking R&D in Canada have access to a wide range of federal and provincial support programs, and can frequently obtain financial support for the same project from more than one program. For example, in 2007, some 86 percent of small firms claiming the SR&ED credit made use of at least one other (federal and/or provincial) R&D support program. In that year, approximately 70 percent of all small firms received financial assistance amounting to 40–50 percent of their spending on R&D and almost 10 percent of small firms (about 1600) received assistance amounting to more than 50 percent of their R&D spending.

Within the federal government, the key constraint on "stacking" — that is, the use of two or more programs to support a given initiative — is a Treasury Board requirement that funding from all government sources (federal, provincial and municipal), including tax credits, cannot exceed 100 percent of the eligible costs of a project. However, lower limits are typically established for individual programs. For example, the stacking limit for IRAP projects is 75 percent of eligible costs, which consist of wages, contract expenses and overhead. Programs also limit the proportional amount of funding that can be provided by the program itself to support any one project. In the case of IRAP, this "stand-alone" limit is also 75 percent, but the base is smaller because of the exclusion of overhead expenses.

It is important to bear in mind that IRAP does not automatically provide the maximum subsidy to firms — some firms may receive the maximum, but this would be the exception, given that the average subsidy rate is actually closer to 20 percent.[a] But as stated above, a substantial number of firms are able to obtain government assistance that exceeds half of their spending on R&D.

The Panel believes that the government should undertake a comprehensive study of the appropriate level of public support for a project, including the maximum allowable stacking rate. Over-subsidization is a potential concern because, beyond a certain point, subsidization no longer generates a net benefit for the economy as a whole.

[a] This number is based on a web-based survey undertaken in May and June 2011 on behalf of the Panel.

information on how firms are able to "stack" benefits from tax credits and direct assistance. It also illustrates the present limits on stacking.

The research and consultation undertaken by the Panel point to both the need and opportunity to improve several aspects of the SR&ED program in ways that would increase the net public benefit of the program. It is likely that fiscal savings could thus be obtained while increasing the net benefit that is currently being delivered by the program. The savings would be available to finance the incremental costs of implementing the Panel's recommendations, which are directed primarily toward SMEs, as outlined in other chapters. The following recommendation in respect of the SR&ED program constitutes the Panel's advice with regard to a more appropriate mix and design of tax incentives and direct support.

Recommendation 2

Simplify the SR&ED program by basing the tax credit for SMEs on labour-related costs. Redeploy funds from the tax credit to a more complete set of direct support initiatives to help SMEs grow into larger, competitive firms.

The Vision of the Panel

The SR&ED tax credit is the flagship of federal support for innovation, allowing almost 24 000 firms across all economic sectors and regions of the country to make individual, market-driven decisions about the industrial R&D they need in order to compete and succeed. It is essential for this highly valued program to be made simpler, more predictable and more cost effective in promoting innovation through business R&D spending. Much more information on the costs and benefits of the SR&ED program needs to be provided on a regular basis to enable future program adjustments and to ensure that the program continues to contribute cost effectively to business innovation in Canada.

Getting There

To realize this vision, the Panel makes the following recommendations.

2.1 Simpler compliance and administration — The tax credit benefiting small and medium-sized Canadian-controlled private corporations (CCPCs) should be based on labour-related costs in order to reduce compliance and administration costs. Because the credit would be calculated on a smaller cost base than at present, its rate would be increased. Over time, the government should also consider extending this new labour-based approach to all firms, provided it is able to concurrently provide compensatory assistance to offset the negative impacts of this approach on large firms with high non-labour R&D costs.

2.2 More predictable qualification — Improve the Canada Revenue Agency's preclaim project review service to provide firms with pre-approval of their eligibility for the credit.

2.3 More cost effective — Reduce the amount of SR&ED tax credit assistance by introducing incentives that encourage the growth and profitability of small and medium-sized enterprises (SMEs) while decreasing the refundable portion of the credit over time. Redeploy the savings to fund new and/or enhanced support for innovation by SMEs, as proposed in the Panel's other recommendations.

2.4 More accountable — Provide data on the performance of the SR&ED tax credit on a regular basis to permit evaluation of its cost-effectiveness in stimulating R&D, innovation and productivity growth.

2.5 Phased implementation and consultation — Adopt the proposed changes through a phased-in approach to give the business sector time to plan and adjust smoothly. There should be early consultations with the provinces on the proposed changes, given that they may want to consider adopting the same base as the federal government.

Simpler Compliance and Administration

The base for the SR&ED tax credit currently comprises — in addition to the direct labour cost of researchers — overhead expenses, materials, capital equipment expenses, contracts and payments to third parties such as post-secondary institutions. This Canadian definition of the tax credit base is broader than that in most other countries. Four developed countries (the US, Japan, Australia and Singapore) exclude

capital costs from the base. The US also excludes overhead expenses, while the credit in the Netherlands is based on wage costs only.

The calculation of non-labour costs can be complex, particularly for expenditures on capital and materials. This complexity imposes costs on R&D performers by increasing their compliance effort and, particularly for SMEs, leads to increased reliance on third-party consultants to prepare R&D claims. Recall that compliance costs for the SR&ED program are currently estimated to average approximately 14 percent of the value of credits earned by small firms and 5 percent for large firms.

The program could be greatly simplified by moving to a program cost base comprised of (i) direct labour costs, (ii) the labour component of contracts (assumed to be 50 percent, the same as for in-house R&D) and (iii) payments to third parties (such as post-secondary institutions), much of which are labour based. Moving to a labour cost base will reduce compliance costs by eliminating all of the calculations related to capital, materials and overheads.

Since high compliance costs mainly affect SMEs and since switching to a labour cost base would adversely affect large firms in industries where material inputs and equipment are a large fraction of the cost of doing research, it is recommended that this new labour-based approach immediately apply only to the tax credits for the CCPCs. Thereafter, the government should consult with the business community and the provinces on the possibility of applying the approach to all firms. Such universal application should be pursued on the condition that initiatives are developed to address the potentially negative impacts of a labour-based approach on large firms with capital-intensive R&D activity.

More Predictable Qualification

The CRA does not review all filed claims, but instead uses a risk management approach, reviewing some claims for both their financial content and scientific aspects (that is, whether the R&D expenditures are eligible for the tax credit). Businesses must be able to demonstrate that their projects meet the SR&ED eligibility criteria, and must identify the particular costs associated with the eligible project. Businesses therefore face "eligibility risk" should the project not qualify as SR&ED in the view of CRA, or should the costs allocated to the eligible SR&ED project be determined by CRA to be less than originally expected.

Box 6.4 Claiming Overhead Expenses through the SR&ED Program

Firms claiming the SR&ED tax credit currently have the option of claiming overhead expenses (administrative and financial support, utilities, etc.) either directly or through the proxy method. Under the proxy method, firms forgo claiming their actual overhead costs, but instead gross up their wage costs by 65 percent. Almost all firms choose the proxy method, but the reasons for this are unclear to the Panel. For example, for some firms, the reduced compliance costs in using the proxy method may justify its use, even when the actual overhead is greater than 65 percent of wage costs. In other cases, firms may find their overhead costs are less than 65 percent and so the proxy method provides a net benefit. The Panel believes that the proxy method is justified, but it is unclear what the appropriate rate should be. Therefore, the Panel advises the government to undertake a study of the true overhead costs borne by firms for their eligible R&D activities and to establish the proxy rate that best reflects these costs.

Budget 2008 announced $10 million in annual funding to enable the CRA to implement an action plan to improve the administration of the SR&ED program by increasing the agency's scientific capacity and by improving its services to claimants (Department of Finance 2008, p. 87). Since then, CRA has undertaken several initiatives, some of which are still under way. For example, it has increased the number of technical reviewers who determine program eligibility and provide claimant services. The CRA also provides First-Time Claimant, Preclaim Project Review and Account Executive services. These free services are demand-driven and are intended to improve claimants' access to the program.[4] The Panel heard evidence from stakeholders that CRA's existing "pre-approval" service is not achieving its objective of improving the speed and predictability of the claims process. One factor contributing to this outcome is that third-party preparers — who are involved in more than half of all claims — may be reluctant to communicate to their clients the availability of CRA's free services.

With its existing services, clients can obtain an informal ruling on eligibility from CRA, which can be useful to firms seeking loans and using tax credits as security. A formal ruling, particularly one that is available at any stage of the R&D process, would evidently be more valuable to R&D performers and would reduce the incentive to make use of contingency fee arrangements with third parties. A more predictable eligibility determination process would also reduce the current tension between CRA and taxpayers when projects are determined not to qualify *ex post*, which sometimes imposes substantial costs on the company performing the R&D. In addition, the proposed labour base for the credit would remove a great deal of uncertainty for the CCPCs regarding qualifying expenditures.

More Cost Effective

Analysis by the Department of Finance of start-ups created over the 2000–2004 period indicates that, within five years following incorporation, approximately 2 percent of innovative start-ups grow into large firms that continue to undertake R&D. This outcome suggests that the enhanced SR&ED tax credit is a blunt instrument for supporting the "gazelles" among the many start-ups that are eligible for the enhanced SR&ED credit and that a shift in assistance for SMEs to other more targeted programs could be more supportive and cost effective. Furthermore, calculation of the net public benefit undertaken for this review indicates that the SR&ED credit for small companies likely does not generate a positive net benefit because of the high subsidy rate and compliance costs relative to the estimated spillover benefit.

The effectiveness of the SR&ED program would be improved if its parameters could be adjusted to target more of the benefit toward those firms that have a greater probability of achieving high R&D-based growth and profitability. If the program were to adopt the proposed labour cost base set out in Recommendation 2.1, the prevailing 35-percent rate for small companies would have to be increased to compensate for the new narrower cost base of the tax credit. The Panel is not in a position to recommend new rate parameters to be applied to the labour cost base. That will require considerable technical analysis, which is the purview of the Department of Finance. But it is evident that, in readjusting the parameters, there is an opportunity to retarget the benefit. Specifically, the refundable portion of the credit for CCPCs should be reduced over time so that a portion of the benefit would be claimed only if the company is profitable and therefore has tax owing against which the non-refundable

[4] More information on the services the CRA provides to SR&ED claimants is available from the CRA website at: http://www.cra-arc.gc.ca/txcrdt/sred-rsde/srvcs-eng.html.

portion of the credit could be applied. In other words, all relevant parameters of the SR&ED tax credit regime applied to CCPCs should be changed to enable implementation of the Panel's vision of a new approach to CCPC refundability that better "targets success" and thus contributes to the objective of increasing the number of small, innovative Canadian businesses that become larger, globally competitive enterprises.

The resulting savings will depend on the extent of the shift to only partial refundability for small businesses. As discussed above, the Panel is recommending that these savings be used to finance increases in direct programs that will deliver more "bang for the buck" and serve other needs of SMEs, including providing support in certain areas that are not currently covered under the SR&ED program. The enhanced direct spending programs being recommended are discussed in more detail in Chapters 5 and 7.

The Panel wishes to emphasize that these recommendations — savings from the SR&ED tax credit regime, on the one hand, and increases in direct program spending to benefit SMEs, on the other — are intended to be directly linked. That is, any savings through the SR&ED program for CCPCs must necessarily be contingent upon a commensurate increase in direct program spending benefiting SMEs, particularly to increase the likelihood that a small innovative company will succeed in the transition to becoming a large Canadian enterprise.

More Accountable

To facilitate broader assessments of the SR&ED program, the government should publish data on use of the tax credit, subject to respecting taxpayer confidentiality. More detailed information could also be submitted by taxpayers on their costs of compliance, including in particular the use of contingency fee arrangements and consulting costs in order to assess the effectiveness of Panel recommendations related to reducing complexity and improving effectiveness.

A main stumbling block to date has been the lack of data from taxpayers and the reluctance of CRA to insist that taxpayers provide quality data on the program apart from what is directly relevant to the audit function. Taxpayers would understandably be reticent to provide more detailed information on their projects if there were any concerns about confidentiality and response burden. Confidentiality must be assured, and firms must understand that the additional efforts requested are in their interest. To this end, a dialogue should be undertaken with major industry associations on the rationale for the information collected, including a clear indication of how it would be used and protected.

Phased Implementation and Consultation

The Panel is aware that changing the base for the federal credit has implications for provincial governments with tax credits that (except for Quebec) use the federal base with only minor modifications. Consultation will be required with these provinces before changing the federal base pursuant to Recommendation 2. During its consultations, many stakeholders also advised the Panel that it should take account of the potentially disruptive effect of making changes to programs, especially the larger ones. The government should therefore adopt a phased approach to the implementation of the proposed changes, so businesses will have ample time for transition planning and adjustment. In particular, given that the move to a more performance-based approach for CCPCs would represent a major change in philosophy for the SR&ED regime, the reduction of refundability for existing small businesses should be phased in gradually, in tandem with the gradual redeployment of funds for enhanced

direct support measures benefiting SMEs, as recommended in other chapters of this report.

It is also important to note that about 650 newly-created start-ups apply for SR&ED credits for the first time each year. Lack of adequate financing is a constraint on the growth of most start-ups, and the current SR&ED tax credit helps to address this problem through the 35-percent refundable tax credit. Our recommendations will provide start-ups, as well as established SMEs, with a wider range of support to help them bring their innovations to market through an expanded IRAP program, a new commercialization vouchers pilot program, a new concierge service, greater access to a highly skilled and entrepreneurial workforce, enhanced procurement programming, and improved access to risk capital at the start-up and later stages of growth. While the enhanced direct support measures that we are recommending would provide alternative sources of finance for start-ups and a portion of the SR&ED credit would still be refundable, some start-ups might receive a lower level of support through these measures. In view of this, the government may wish to investigate the administrative feasibility and budgetary consequences of providing a fully refundable labour-based tax credit for a fixed number of years for start-ups to ensure continued support for Canadian entrepreneurs who take on the risks of establishing new firms.

Chapter 7

Filling the Gaps

This chapter addresses the third and final question in the charge to the Panel: "What, if any, gaps are evident in the current suite of programming, and what might be done to fill these gaps?"

The Panel is firm in its belief that the key to addressing Canada's well-documented business innovation challenges — including the significant commercialization gap — is to strategically target efforts to support the growth of innovative firms into larger enterprises. It is only by growing Canada's innovative firms that the country's business sector will achieve the scale required to become an innovation leader on the world stage.

Although many gaps can be identified in a policy area as broad as the support of business innovation, an overriding consideration of the Panel is to ensure that programs respond to industry's "demand-pull" as a primary means of helping innovative firms grow and prosper — a challenge that was raised repeatedly in the Panel's consultations. Three issues in particular stood out. How can the federal government's own procurement needs be used to foster innovation? How can business imperatives be addressed through large-scale, business–academic–government research collaborations? And how can risk capital be structured to respond to the needs of innovative firms at all stages of their development? Stakeholders told the Panel that addressing these issues would help meet the needs of firms seeking to innovate and create value.

Consistent with these views, an analysis by the Organisation for Economic Co-operation and Development (OECD forthcoming) of the innovation systems of several countries identifies weaknesses in Canada related to limited public–private research collaboration, difficulty in transforming knowledge into commercial applications, and a low volume of venture capital activity. Threats identified include a declining trend in the funding of entrepreneurial ventures. The same study also notes the dearth of "demand-side" measures — such as those that aim to strengthen the private sector's utilization of innovation inputs — in Canada's mix of innovation instruments. Procurement is the major demand-pull stimulus available to governments to complement the large existing array of supply-side programs.

Broadly similar findings have been reported by other panels that have examined the innovation *problematique* in Canada. The Council of Canadian Academies highlighted the need to "improve the climate for new ventures so as to better translate opportunities arising from Canada's university research excellence into viable Canadian-based growth businesses" (CCA 2009, p. 12). It also noted that Canada ranks low internationally for "government procurement of advanced technological products" (CCA 2009, p. 78). The Expert Panel

on Commercialization (2006a; see also Annex B) made several recommendations to expand federal programs that support start-up firms in proving their business ideas and generally to increase the commercialization involvement of small and medium-sized enterprises (SMEs). That panel also recommended improved access to early-stage angel financing and expertise, as well as improvements in Canada's expansion-stage venture capital market.

The fact that the same shortcomings in respect of procurement, large-scale research collaboration and risk financing were identified in the Panel's consultations and through international comparative investigations as well as in prior studies of innovation in Canada is convincing evidence that these are the program gaps — and therefore the opportunities — most in need of focussed attention.

The Procurement Gap

The underlying premise of the procurement provisions of international and domestic trade agreements is that unrestricted competition for government purchases spurs business productivity and provides the best value for the taxpayer's dollar. Why, then, would governments want to adopt policies that favour certain types of suppliers for their purchases of goods and services? The general answer is that governments have a huge, ongoing need for an array of goods and services across a broad range of activities — for example, defence, health, and information and communication technologies. SMEs that supply sophisticated new products and services can potentially meet these requirements but may need to be nurtured by governments until they reach a point where they can compete without assistance. Also, procurement programs more geared to acquiring innovative products promise to boost public sector productivity and thereby lower the cost of providing public sector services.

The strategic use of public sector procurement can contribute to the viability and growth of firms, particularly of innovative SMEs, in a number of ways. For instance, when governments are demanding and sophisticated customers for innovative solutions to their needs, their purchases — and the prospects for follow-on sales — facilitate equity and debt financing for firms. Moreover, firms supplying governments as lead users can then showcase their products and thus market them more successfully to customers in Canada and abroad. For these reasons, successful initial purchases are key to ongoing procurement and the building of critical mass for economies of scale and future growth. In the case of defence and security-related procurement specifically, governments may favour domestic suppliers in order to maintain capability for at least some self-supply of these sensitive assets.

While there are good policy reasons to use public sector procurement to help build domestic economic muscle, these will always have to be balanced in the context of value-for-money, trade obligations, and the risk of fostering supplier dependency and possibly disadvantaging other domestic competitors. Assessment of the balance of benefits and costs of using procurement to develop the innovation capabilities of SMEs will depend on the specific circumstances. Good judgment will always be required, since definitive data on the full extent of benefits and costs are rarely available.

Notwithstanding this caveat, Canada's use of procurement to enhance industrial innovation has been very modest by international standards, although recent federal initiatives like the Canadian Innovation Commercialization Program (CICP — see Box 7.2)[1] and a revised

[1] More information on the CICP is available from Public Works and Government Services Canada at: http://buyandsell.gc.ca/initiatives-and-programs/canadian-innovation-commercialization-program.

Box 7.1 Use of Procurement to Support SME Innovation

The US Small Business Innovation Research (SBIR) program mandates, by legislation, that federal agencies with more than $100 million annually in external R&D contracts set aside 2.5 percent for small businesses. This translates into annual expenditures of $2–3 billion, with the Department of Defense and National Institutes of Health (NIH) as the largest users. The program provides fully funded contracts for phase I proof of principle studies ($150 000 over six months) and for phase II R&D ($1 million over two years). Phase III is funded through conventional services, with just under half of projects reaching the marketplace for either government or business uses.

The implementation of SBIR varies widely in practice among US federal agencies, depending on their individual motivation for conducting intramural R&D. For some like the NIH, the SBIR set-aside is mainly a source of R&D funding. For others, like Defense and Energy, the set-asides are used for the actual first-user procurement of products developed with SBIR funding assistance.

The success of SBIR has inspired similar programs in countries such as Japan, Australia, the UK, Sweden, Finland, South Korea and the Netherlands. In the UK, the Small Business Research Initiative (SBRI) was launched in 2001 and is today administered by the Technology Strategy Board — the UK equivalent of the Industrial Research and Innovation Council (IRIC) proposed by the Panel in Chapter 5 (Recommendation 1.1). Like SBIR in the US, the program provides fully funded development contracts between SMEs and government departments, but on a voluntary basis, not mandatory as in the US.

Industrial and Regional Benefits (IRB) policy suggest a new recognition of opportunities. The use of procurement to stimulate innovation has been a long-standing practice in other countries, particularly the US, with its enormous defence expenditures. The US has also led the way internationally with respect to promoting small businesses with vigorous programs, including procurement set-asides. The quintessential initiative in this regard is the US Small Business Innovation and Research program (SBIR — see Box 7.1),[2] now almost 30 years old. Recognizing that Canada can learn from the use by other governments of procurement to support innovation by SMEs, the Panel believes there is an opportunity for greater application of this kind of policy tool to promote innovation by Canadian business.

Recommendation 3

Make business innovation one of the core objectives of procurement, with the supporting initiatives to achieve this objective.

The Vision of the Panel

The government's procurement and related programming must be used to create opportunity and demand for leading-edge goods, services and technologies from Canadian suppliers, thereby fostering the development of innovative and globally competitive Canadian companies while also stimulating innovation and greater productivity in the delivery of public sector goods and services.

[2] More information on the SBIR program is available at: http://www.sbir.gov.

Getting There

To realize this vision, the government should incorporate the following practices in its procurement initiatives.

3.1 Innovation as an objective — Make the encouragement of innovation in the Canadian economy a stated objective of procurement policies and programs.

In practice, this broad recommendation requires the government to regard any significant acquisitions of goods and services as opportunities to build SME innovative capabilities and thus to strengthen both the base of suppliers for future procurement and, more generally, the innovation capacity of the Canadian economy. This will require the government over time to undertake a comprehensive review of procurement policies and activities to ensure that they are supporting innovation and that departments have the flexibility to work with private sector solution providers and then acquire and deploy the resulting solutions. As first steps for action, the Panel further makes the following recommendations.

3.2 Scope for innovative proposals — Wherever feasible and appropriate, base procurement requests for proposals on a description of the needs to be met or problems to be solved, rather than on detailed technical specifications that leave too little opportunity for innovative proposals.

The use of procurement to foster the innovation capacity of Canadian companies requires a revised approach to value-for-money based on outcomes-oriented specifications. Procurement on the basis of the outcomes desired sets a challenge for industry and thus motivates innovative solutions from potential suppliers. This has the dual benefit of bringing forward better products for the buyer and developing an innovation-focussed mindset in the supplier communities. The use of an outcome-oriented procurement specification does not need to be an invariable rule, since there will be cases where more detailed technical specifications for a particular procurement would be clearly appropriate and would not be inconsistent with the intent of this recommendation.

3.3 Demand-pull — Establish targets for departments and agencies for contracting out R&D expenditures, including a subtarget for SMEs, and evolve the current pilot phase of the Canadian Innovation Commercialization Program (CICP) into a permanent, larger program that solicits and funds the development of solutions to specific departmental needs so that the government stimulates demand for, and becomes a first-time user of, innovative products and technologies.

Federal departments and agencies, including those of major industry relevance, such as the Department of National Defence, undertake most non-regulatory R&D internally. According to Statistics Canada (2010a), federal in-house R&D is projected at $1.9 billion in 2010–11, while R&D contracted to businesses is projected to amount to $272 million or only about 15 percent of the in-house R&D total. More than 80 percent of the amount of R&D contracted to businesses is accounted for by two agencies — the Canadian Space Agency at $167 million and the Department of National Defence at $59 million. Setting specific department-by-department targets for external R&D contracts would promote business innovation while potentially improving outcomes for contracting departments and strengthening their ability to deliver on their mandates.

The current CICP pilot is "supply-push" in the sense that the applicants submit proposals to provide innovative solutions for trial and testing, though not as responses to explicitly identified needs of a particular department or agency (Box 7.2). A new pilot element is needed that

Box 7.2 Canadian Innovation Commercialization Program (CICP)

The CICP is a $40-million, two-year pilot program announced by the federal government in 2010 and administered by Public Works and Government Services Canada. The program was created to help Canadian businesses bridge the pre-commercialization gap by procuring and testing innovations. The current calls for proposals require innovations to be valued at $500 000 or less, to have yet to be sold commercially, to be provided by Canadian bidders, and to include at least 80 percent Canadian content. The products must fit into one of the following categories: environment, safety and security, health and enabling technologies. Innovations are pre-selected based on their degree of innovation, the testing plan and the commercialization strategy. They are matched to federal departments that then test them and provide feedback on their operation. The program covers the costs of the innovation, delivery, installation and maintenance services, as well as any other direct costs required to test the innovative product. The program's process is fully competitive and consistent with trade agreements.

would provide incentives for solving operational problems identified by departments. Making the revised CICP a permanent program, once performance of a revised pilot can be evaluated, would help change the procurement culture.

3.4 Globally competitive capabilities — Plan and design major Crown procurements to provide opportunities for Canadian companies to become globally competitive subcontractors.

The currently planned procurement of defence and security-related equipment and services presents a significant opportunity to greatly increase the technological readiness of Canadian industry.[3] There is a need for the Department of National Defence to be more proactive in promoting a defence industrial capability domestically. The key is to implement a long-term technology capability plan for each major procurement, jointly developed by government and industry and supported by tailored programs. For the Department of National Defence, this would mean accelerating its Project ACCORD with industry as well as Defence Research and Development Canada's Technology Demonstration Program.[4] As the experience of other countries has shown, even concerted efforts to promote global supply chain participation takes many years to produce results. Canada therefore needs to start immediately. It is emphasized that incremental investment for such improved long-term capability is scalable. Decisions on amounts should be relative to opportunities.

While the recent Industrial Research Benefits (IRB) policy enhancements — with multipliers for investments in innovation — are largely untested, an additional incentive to invest in technology commercialization would help increase global value chain participation for

[3] The *Canada First* Defence Strategy sets out a new long-term funding framework for the Canadian Forces, with projected purchases of $240 billion of equipment, infrastructure, and operations and maintenance services between 2008–09 and 2027–28.

[4] Project ACCORD is a Department of National Defence mechanism to bring together industry, academia and government in identifying Canadian Forces deficiencies and proposed approaches to solutions. Defence Research and Development Canada's Technology Demonstration Project funds contracted out R&D in collaboration with private sector partners, valued at $25.5 million in 2010–11.

forthcoming defence purchases, especially by SMEs. (The commercialization model developed by Sustainable Technology Development Canada might be emulated.) There is urgency in this since, if Canadian capabilities were to remain underdeveloped at the time of contracting, IRB offsets would be directed more toward traditional "build to print" work, rather than leading-edge technology development and commercialization. In order to achieve critical mass quickly, the government could consider some form of matching formula with the prime contractors. It is emphasized that taking full advantage of Crown procurements depends on government and business investments early on, in order to get the desired innovation capacity-building leverage from an IRB, whose costs are borne by prime contractors. This might involve sharper focus of existing programs, rather than additional resources.

3.5 Working collaboratively — Explore avenues of collaboration with provincial and municipal governments regarding the use of procurement to support innovation by Canadian suppliers and to foster governments' adoption of innovative products that will help reduce the cost and improve the quality of public services.

Annual procurement by provinces and municipalities across Canada substantially exceeds federal procurement because of their responsibilities for health care, education and transportation infrastructure, among other public services. All orders of government should collaborate to develop and share best practices in the use of procurement to foster innovative Canadian companies and, where feasible, to develop joint strategies to enhance the leverage of public procurement in certain sectors.

The Large-Scale Research Collaboration Gap

The basic research performed by universities and other laboratories generates disruptive technologies that open up whole new industries. At colleges, polytechnics and universities, there is also a broad range of applied research relevant to both the business and non-profit sectors. This applied research can include business-oriented areas such as finance, regulation/legislation and organizational behaviour, and also covers the domains of applied science and technology — for example, forestry and geosciences, engineering, computer science and information systems, nanotechnology, chemistry, life sciences, and health research. Much of this research, even when investigator initiated and funded by government or non-profit agencies, is relevant to industry and is taken up in various ways. Reflecting the benefit of this system to industry, business-sponsored research in Canada's universities currently totals more than $785 million a year (Canadian Association of University Business Officers 2010). Across the country, there is an array of *ad hoc* small-scale, needs-based collaborations under way between the business and post-secondary sectors, assisted by the network and collaboration programs discussed in Chapter 5.

In recognition of the vital role that post-secondary education institutions play in our system of innovation — foremost, as the primary source of highly qualified and skilled personnel and, secondly, as a source of leading-edge ideas and knowledge — the Government of Canada has substantially increased its support for higher education R&D over the past 15 years. Given the foundational role that a strong post-secondary education sector plays in the Canadian system of innovation, this Panel (like the Expert Panel on Commercialization before it) urges the government to commit to investing in basic research at internationally

competitive levels, and also to review and modernize the support for the total institutional costs of research.[5]

Currently, federal support for industry–academic research collaboration is delivered through programs that fund projects with universities, colleges and polytechnics. The current suite of programs is mainly (but not exclusively) focussed on investigator-led "idea-push" projects, and the Panel's recommendations in Chapter 5 are oriented toward addressing this issue. However, there remains a gap with respect to collaborative R&D and innovation projects that are large scale, industry facing, demand driven and outcome oriented. Such projects can result in breakthroughs and can build capacity in existing and emerging industry sectors. Some may require longer time spans, others may require specialized equipment or personnel, and still others may require an extensive, ongoing collaboration between business, academia and government.

Reflecting this, other structures have emerged to partly fill this gap in the innovation system. For instance, FPInnovations for the forest industry, the National Optics Institute (INO) or the Consortium for Research and Innovation in Aerospace in Québec (CRIAQ) provide significant non-profit sector examples. Other countries have also established wider and more developed examples, including most famously the Fraunhofer system of institutes in Germany (Box 7.3).

The National Research Council (NRC) has the potential to play a similar role for Canada (Box 7.4). That said, in its present form the NRC has an overly broad — and therefore unfocussed and fragmented — mandate. Started in 1916 as a basic science entity, the NRC was a source of great pride at a time when Canadian universities were performing relatively little fundamental science. The NRC created, and then spun out, institutions as varied and important to Canadian innovation as the Natural Sciences and Engineering Research Council (NSERC) and the Canadian Space Agency. The research mandate of the NRC has been reshaped by the emergence of the federal granting councils and the growth of Canadian universities as the principal locus of basic research. Today, the NRC still performs basic research, runs the Canada Institute for Scientific and Technical Information, performs public policy services such as metrology, has "cluster" initiatives to spur regional economic development through innovation, engages in substantial industry research collaborations, manages Canada's investment in major science infrastructure, and has a national network of industrial technology advisers that deliver the Industrial Research Assistance Program (IRAP) to support SMEs with their business R&D projects. The sheer diversity of these activities raises the question of what is the most appropriate mission of the NRC. It is also unclear what the primary performance metrics of NRC institutes are. Should performance be measured in terms of the number of peer-reviewed publications in top journals, the number of patents and copyrights issued, licensing revenues from patents and copyrights or private research contracts, SME client satisfaction or the number of regional jobs created? Furthermore, other organizations now also provide basic research, regional economic development, support federal science policy mandates, and deliver business innovation assistance.

As part of clarifying NRC's mandate and promoting its evolution, the Panel has already recommended that IRAP should be placed under the aegis of the proposed Industrial Research and Innovation Council (IRIC). There is now also the clear opportunity for the NRC to address

[5] The Expert Panel on Commercialization noted that "publicly funded research across all disciplines is essential and must be funded at internationally competitive levels, along with the institutions and infrastructure that provide the capacity to conduct this research" (2006b, p. 16).

Box 7.3 Germany's Fraunhofer-Gesellschaft[a]

The Fraunhofer-Gesellschaft (F-G) organization operates 60 Fraunhofer institutes in Germany. These customer-oriented, applied research institutes strive to transform scientific findings into useful innovations. The institutes' focus on application-oriented research is situated within the broader spectrum of the German research system — a spectrum that includes, at one end, the publicly funded, basic research-oriented Max Planck Society and, at the other end, privately funded industrial research.

The F-G's threefold mission is (i) to promote and undertake research in an international context of direct utility to private and public enterprise and of wide benefit to society as a whole, (ii) to reinforce the competitive strength of the economy by developing technological innovations and novel systems solutions for their customers and (iii) to provide a platform that enables staff to develop the necessary professional and personal skills to assume positions of responsibility within their institute, in industry and in other scientific domains. As institutes are encouraged to work with industry, only about a third of base funding comes from government. Institutes must secure the remaining revenue from other sources, which typically comes in roughly equal proportions from industry and public contracts and project funding.

The Fraunhofer institutes provide highly specialized expertise that may be too expensive for any mid-sized company to build up and may also be beyond the scope of consulting companies. By connecting with universities and technical institutes/universities of applied science, and by applying for competitive research grants, the F-G institutes retain an edge in science and technology. Indeed, the grants are used for advanced work that is well ahead of the marketplace but has been identified as potentially important to client companies in the years to come.

In summary, the Fraunhofer institutes are characterized by (i) professional R&D services to industry, (ii) demand-driven research combined with scientific excellence, (iii) strong integration with academia and (iv) autonomy combined with simple corporate rules and a strong brand.

[a] Information drawn from the Fraunhofer website at: www.fraunhofer.de; and Panel consultations.

Canada's large-scale research collaboration gap by evolving the majority of its current institutes into a national network of institutes focussed on large-scale collaborative research motivated by industrial needs. To achieve this vision, great care will be needed to establish a process that, over time and in dialogue with partners, enables the NRC to focus on this opportunity without losing the value for Canada from its other activities.

The Panel's consultations elicited statements of strong support for IRAP's role in supporting R&D and innovation by SMEs but, notably, there was not comparable testimony regarding the relevance and role of the NRC's institutes. This, together with the other considerations outlined above, suggests that there is both the need and opportunity to focus and reorganize the NRC's national assets to more effectively and strategically support innovation in Canada. The Panel endorses the plans currently under way to reorient certain NRC institutes to place greater

Box 7.4 Institutes of the National Research Council within the Review

Total appropriations for the 17 NRC institutes within this review averaged almost $290 million annually over the four fiscal years, 2007–08 through 2010–11. The institutes referred to the Panel are:

- Biotechnology Research Institute
- Canadian Hydraulics Centre
- Centre for Surface Transportation Technology
- Industrial Materials Institute
- Institute for Aerospace Research
- Institute for Biodiagnostics
- Institute for Biological Sciences
- Institute for Chemical Process and Environmental Technology
- Institute for Fuel Cell Innovation
- Institute for Information Technology
- Institute for Marine Biosciences
- Institute for Microstructural Sciences
- Institute for Ocean Technology
- Institute for Research in Construction
- National Institute for Nanotechnology
- Plant Biotechnology Institute
- Steacie Institute for Molecular Sciences

emphasis on industry priorities and collaboration, but believes that an even more comprehensive reform is needed.

Recommendation 4

Transform the institutes of the National Research Council (NRC) into a constellation of large-scale, sectoral collaborative R&D centres involving business, the university sector and the provinces, while transferring NRC public policy-related research activity to the appropriate federal agencies.

The Vision of the Panel

Canada needs a fundamentally new approach to building public–private research collaborations in areas of strategic importance and opportunity for the economy. Over the next five years, several of the NRC institutes must evolve to become a core constellation of research and technology centres, mandated to collaborate closely with business in key sectors and focussed on achieving measurable progress in this mission. Individual institutes should become focal points for the development of R&D and innovation strategies for key sectors, for major enabling technologies and for regional clusters.

Getting There

To realize this vision, the Panel recommends the following.

4.1 Evolution of the NRC — Charge the NRC to develop a plan for each of its existing institutes and major business units that would require their evolution over the next five years into one of the following:

(a) an industry-oriented non-profit research organization mandated to undertake collaborative R&D and commercialization

projects and services, funded by amounts drawn against existing NRC appropriations together with revenue earned from collaborative activities

(b) an institute engaged in basic research to be affiliated with one or more universities and funded by an amount drawn against existing NRC appropriations together with contributions from university and/or provincial partners

(c) a part of a non-profit organization mandated to manage what are currently NRC major science initiatives and potentially other such research infrastructure in Canada

(d) an institute or unit providing services in support of a public policy mandate and to be incorporated within the relevant federal department or agency.

4.2 IRAP — Transfer the Industrial Research Assistance Program to the proposed Industrial Research and Innovation Council (IRIC).

4.3 Structure and oversight — Institutes could be established as independent non-profit corporations, with the federal government's share of funding managed and overseen by the proposed IRIC for industry-oriented institutes in category (a) above, and by the Natural Sciences and Engineering Research Council (NSERC) or Canadian Institutes of Health Research (CIHR) for categories (b) and (c) above. (Apart from functions in category (d), any residual activities of NRC, or institutes that are unable to secure adequate funding, would be wound down according to an appropriate transition plan.)

The model of arm's-length, non-profit research institutes is key to putting in place appropriate incentives to develop high-quality R&D programs that would compete for required funding (beyond federal core funding) from industry and from government programs. The Panel envisions institutes of sufficient scale to have significant long-term impact on business innovation capacity. Some of these institutes — by virtue of their expertise in specific sectors and integration with related local partners — could play an important role as focal points for the development and implementation of sectoral research and innovation strategies. Such strategies are paramount to addressing Canada's innovation deficit, since different sectors face different challenges across an array of issues such as access to financing, regulatory restrictions and intellectual property rules, among others (Box 7.5).

The Panel's proposal would allow for the redeployment of institutes that are not actively engaged in business-related research to universities whose research capacity has vastly improved in recent years. It is not proposed that the separate industry-facing institutes should be grouped organizationally under the proposed IRIC, but it would be logical and appropriate for IRIC to have financial authority over the federal contributions to the institutes by managing the funding agreements between the institutes and the Government of Canada. Moreover, it would also be appropriate for NSERC or CIHR to manage any needed funding agreements with institutes fitting in categories (b) and (c) in Recommendation 4.1.[6] Those institutes that provide services in support of a public policy mandate — for example, activities such as those concerned with public health and safety — should be transferred to appropriate federal departments and agencies, with no reduction in current resources.

[6] Scientists in the academic-facing institutes would be able to apply for granting agency funding in line with others at the universities.

The budgetary implications of the proposed model permit considerable flexibility regarding cost sharing between the federal government and the external partners. That said, the institutes proposed here would have to develop robust transition plans to ensure initially that each individual institute is achieving fiscal balance. These plans would also outline appropriate metrics of success, the ongoing realization of which would be a necessary condition for continued federal contributions to their operation. The key to success would be requirements that (i) the governance of the business-facing institutes be dominated by the industry they are intended to serve, (ii) the core federal support be long term and sufficient to ensure dependability and quality and (iii) the funding contributed by business be a sufficiently large proportion of the total budget of each institute to ensure business buy-in and commitment.

The devolution of certain of the NRC's basic research activities to the university sector would need to be accompanied by ongoing federal support, but presumably not significantly different from the current and anticipated amounts. There would also be significant one-time costs associated with the transition to the new structure. But these costs should be viewed as a necessary long-term investment in much-improved outcomes for business innovation, driven by more leveraged financing of commercially relevant R&D.

The Risk Capital Gap

The term "risk capital" as used in this review refers to funding of innovation-focussed businesses from start-up through to maturity, when the company is ready to access public financial markets or is acquired by another firm (Figure 7.1).

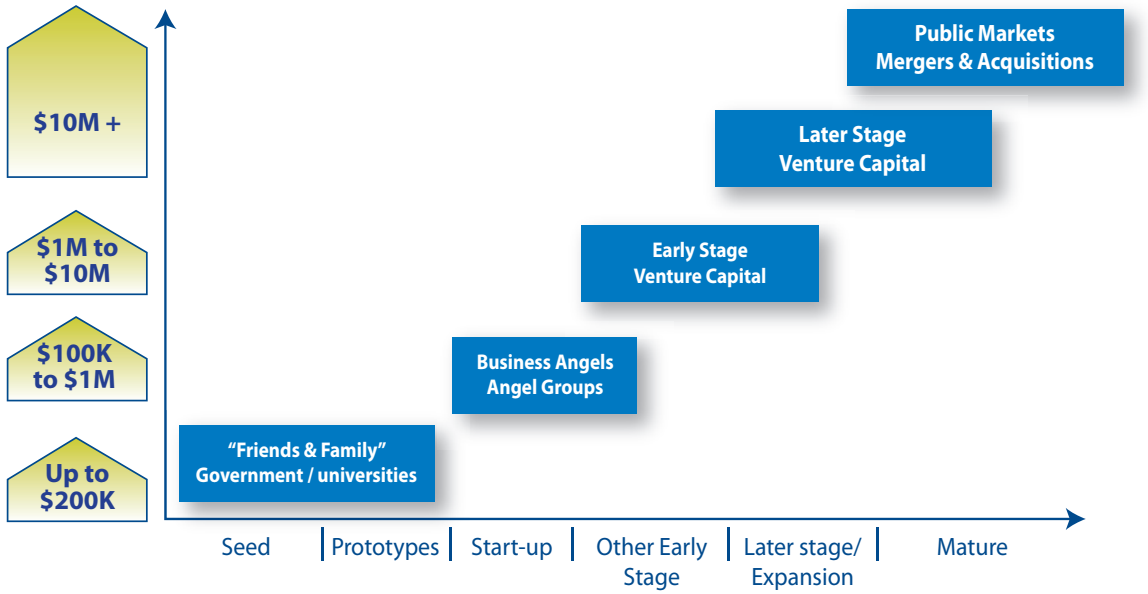
Box 7.5 Sectoral Research and Innovation Strategies

The collaborative R&D institutes proposed in Recommendation 4 would have the potential to play important roles for tailored, industry-led sector strategies. The CCA's report on innovation and business strategy (CCA 2009) underscores that no Canadian sector in Canada is "average." Each sector is characterized by a wide array of features stemming from a multiplicity of social, economic, cultural, historical and other factors. To illustrate, the report includes case studies of four sectors that highlight the great diversity of circumstances. Each of the case studies can be summarized in a phrase as follows.

- **Auto sector** — "weak R&D, but strong productivity"
- **Life sciences** — "great promise, but mixed results"
- **Banking** — "balancing stability versus radical innovation"
- **Information and communication technologies** — "a catalytic role for government."

Just as there is no average sector in Canada, there is no "one size fits all" remedy to Canada's innovation challenges. Sector-specific expertise and initiatives are paramount, and the Panel's proposed large-scale, industry-directed and co-funded institutes could potentially serve as a catalyst in that respect.

Figure 7.1 Funding Chain by Stage of Development and Size of Investment



Source: The Panel.

The nature, the causes and even the existence of a risk capital gap in Canada are the subject of considerable debate. The Panel's consultations nevertheless revealed a strong consensus within the community of venture capitalists and entrepreneurs in R&D-based and technologically advanced sectors that gaps exist along the funding chain. Some recurring themes from the consultations included the following:

- there is a need to improve access to seed capital
- angel networks in Canada are not as well developed as in the US
- Canadian companies are not as well financed as their US counterparts
- foreign funds are present in a disproportionate share of Canadian exits
- Canadian firms are often forced to, or choose to, go public too early.

Interviews with managers of venture capital funds and entrepreneurs, conducted on behalf of the Panel, highlighted the problems caused by the relatively small size of Canadian venture capital investment funds. Subscale size limits the ability of Canadian fund managers to follow firms through to maturity as the size of successive financing rounds increases. This adversely affects financing opportunities for innovative firms in Canada and hurts the performance of Canadian venture capital funds. Moreover, in the EKOS survey conducted for the Panel (see Chapter 5), lack of access to sources of finance was most frequently identified as the main obstacle to firms' R&D activities.

Such concerns are identified in the Business Development Bank of Canada's (BDC) *Venture Capital Industry Review*, released in February 2011.[7] That review concluded that the Canadian venture capital industry was "broken." Low returns have caused private investors to leave the venture capital market and, according to the BDC, it will take substantial changes to encourage re-entry. As shown in Figure 7.2, the report identified a "vicious" cycle in the Canadian venture capital industry that contributes to its poor performance, including:

- a shortage of serial entrepreneurs who become angel investors
- subscale venture capital funds
- limited pool of experienced, high-quality venture capital fund managers
- over-investment in early-stage and inadequate follow-on investment
- weak linkages to global experts, markets and businesses.

Others consulted by the Panel argue that the industry is in a cyclical downturn and investors are avoiding early-stage technology companies because the risk-adjusted returns are better elsewhere. The BDC has concluded that simply injecting additional capital would not improve the industry's performance and that the key to restoring faith in venture capital as an asset class is to bring the industry to a state of profitability.

Some economists have attributed the poor performance of the private venture capital market to "crowding out" by the labour-sponsored venture capital funds (LSVCFs) (see, for example, Cumming and MacIntosh 2006; and Brander, Egan and Hellmann 2008). LSVCFs, which accounted for about 20 percent of venture capital investments in 2010 (CVCA 2010), are funded by small "retail" investors who receive tax incentives from the federal and some provincial governments. Recognizing that they vary in performance, some LSVCFs have poor management incentive structures and have exhibited poor performance,[8] perhaps due in part to overly broad mandates encompassing multiple objectives such as regional development. Investment activity by retail funds has been scaled back in many provinces and restructured in others in order to promote better outcomes. High-growth firms can also obtain funding through the TSX Venture market, and this may reduce the number of high-quality investments that seek venture capital funding in Canada, contributing also to the low rate of return in the venture capital industry (Carpentier, Cumming and Suret 2010).

The issues affecting the performance of the risk capital markets in Canada are complex, and it will take time to resolve them. Government intervention should be undertaken in a cautious and carefully structured manner to yield positive outcomes for the industry and avoid unintended harm — an issue that is taken up below. The next section reviews in more detail the issues facing the angel investment and later-stage venture capital segments of the risk capital market.

[7] The BDC is a financial institution owned by the Government of Canada. Its mission is to "help create and develop Canadian businesses through financing, venture capital and consulting services, with a focus on small and medium-sized enterprises" (http://www.bdc.ca). Note that the BDC is not the federal government's sole mechanism to supplement venture capital markets. The Export Development Corporation (EDC), in fulfilling its mandate to help Canadian exporters and investors expand their international business, manages a portfolio of equity investments focussed on next-generation exporters, with a total investment value of $298 million. Farm Credit Canada, a Crown corporation, established FCC Ventures in 2002 and since then has provided over $70 million in venture capital financing to small and medium-sized businesses in areas such as agricultural biotech.

[8] For the latest performance data for captive/evergreen funds, which consist primarily of LSVCFs, see the press release of Canada's Venture Capital & Private Equity Association dated May 24, 2011 (available at: http://www.cvca.ca/news/).

Figure 7.2 Many Gaps Have Resulted in a "Vicious" Cycle in the Canadian Venture Capital Industry

1 Shortage of serial entrepreneurs and skilled management with global networks

2 General partners are subscale and lack strong capabilities and experience compared with US general partners

Significant investments made by government and retail funds with objectives and constraints (e.g., region focus, pacing requirements) may hurt returns

Angel network not well developed

3 Over-investment in early stage without adequate follow-on capital, leading to dilution

Undercapitalized and sometimes dysfunctional syndicates make follow-on investment difficult

General partners lack experience and networks to develop companies to potential

Foreign general partners capture a disproportionate share of exit value

4 Exits have been mediocre, as public markets place a discount on Canadian venture capital-backed companies

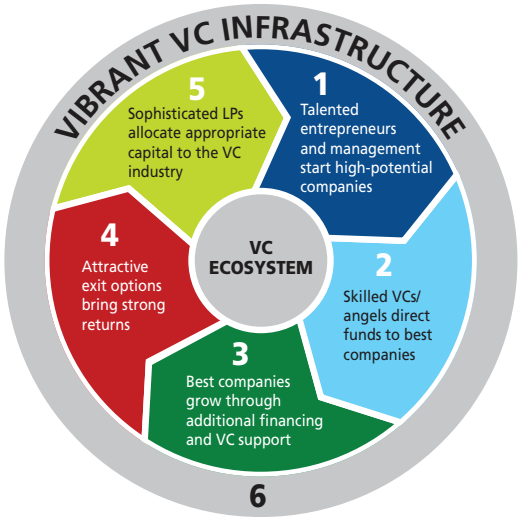
Relatively low listing requirements on the TSX Venture Exchange can be counterproductive

5 Total funding to venture capital-eligible companies was proportionately higher in Canada than in the US at the turn of the decade but has significantly decreased in recent years

Current capital supply crunch, as institutional limited partners and retail funds have significantly reduced investments

Government-sponsored funds made up half of all available limited partner capital, with allocation sometimes driven by public policy and misaligned incentives

Bottom-quartile funds receive largest share of capital; the fund natural selection process is broken



6 Lower level of non-dilutive capital from government and other sources prior to first venture capital investment

Lack of commercialization focus in R&D investment

Relatively low effectiveness of Technology Transfer Offices in commercializing technology

Lack of connectivity to global markets, reducing opportunities for syndication, business development and exits

Source: Adapted from BDC (2011).

Angel Investment

At the earliest stage — perhaps even before a company is formed — an entrepreneur typically relies on informal sources of capital from "friends and family" and later from angel investors. There are two structural obstacles that limit the supply of angel financing: (i) the very high cost of evaluating and then monitoring a prospect, relative to the size of the embryonic business and (ii) the novelty and technological complexity of the new business idea, which makes it difficult for an outside investor to accurately determine the potential for success. As a result, angel investors target a high rate of return to compensate for the risk they face and often require entrepreneurs to invest a substantial fraction of their own wealth in the project, both of which may prevent viable projects from going forward. Knowledgeable and experienced investors are needed for capital markets to function well, but there is also a role for government in promoting an efficient angel investment market segment.

There are few reliable data on the supply–demand conditions in this informal market in Canada. In the US, where the market is well developed, rates of return to angel investor groups are high. A 2007 survey by the Angel Capital Education Foundation (now called the Angel Resource Institute) found that returns to angel investors in groups averaged 27 percent (Wiltbank and Boeker 2007), which was well above the average 10-year return of 18.3 percent on overall venture capital investments in 2007 (National Venture Capital Association 2008). Industry participants describe the angel investment segment as underdeveloped in Canada, reflecting in part a relatively young risk capital industry. As a result of this shortage of supply of financing relative to demand, it would be expected that similar rates of return to those in the US should be available to angel investors in Canada.

Venture Capital Financing

Those high-growth businesses that survive the seed and angel-financed stage of development usually then turn to the venture capital market, which is an important form of financing until the business goes public, is bought out or is able to access conventional financing.

The "modern" venture capital industry came into being in the US in the late 1970s (Lerner 2009). The Canadian venture capital industry, by contrast, is relatively young and small, having gotten a second start in the 1990s, just before the technology bubble burst. Venture capital investment in Canada experienced a post-bubble peak of $2 billion in 2007; since then it has averaged $1.2 billion a year (BDC 2011). In 2010, about 350 companies in Canada received venture capital funding, with an average investment of $3.2 million and a total investment of $1.1 billion (CVCA 2011). Meanwhile, venture capital investment in the US in 2010, at $21.8 billion, was about 20 times the Canadian total, and the average deal size was about twice as large (SSTI 2011).

The smaller relative scale of Canadian venture capital funds has two main consequences. First, in order to create enough diversity in their portfolios, fund managers must keep investment per project relatively low. The small deal size spreads fixed costs — for example, evaluation and monitoring of investments — over a smaller investment base, which hurts returns. Second, smaller-scale Canadian funds are less able to participate in later-stage financing, since these involve a larger average deal size. Canadian funds therefore find it difficult to adopt the typical US strategy of financing firms from early

stage to exit. As a result, foreign funds, particularly from the US, are often dominant in later-stage financing in Canada — for example, over the 2004–09 period the average venture capital investment by foreigners in Canadian firms was $3.8 million, compared with $1.0 million on average by Canadian investors.[9] Although foreign partners invest in only about 10 percent of Canadian venture capital deals, they account for about 30 percent of exits and almost 45 percent of exit proceeds (BDC 2011). This situation appears to be hurting returns of Canadian funds and is contributing to a financing gap in later-stage investments.

Interviews with managers of venture capital and growth equity funds indicate that access to financing for firms that have revenues but are not yet profitable is particularly difficult. The typical deal size here is $10–20 million, with fewer than 10 percent of deals greater than $40 million. Canadian participation in this segment is limited. From 2003 to 2011, private venture capital funds disclosed 255 technology-related deals over $10 million.[10] About a quarter of these deals were undertaken by purely Canadian funds, and foreign participants dominated all of the funding syndicates. Canadian-only funds accounted for about a third of the deals in the $10–20 million range and none of the deals above $40 million. Fund managers indicated that, since there are very few Canadian funds actively investing, there are many examples of good Canadian companies struggling to obtain financing.

The relative lack of participation from Canadian funds at the critical late stage of development of a business can have a number of adverse effects. First, either too many worthy firms are not getting financing, or they are being financed by US funds, which can affect where the intellectual property developed by the firm is ultimately exploited. While financing by US funds is preferable to no financing, overcoming barriers to full participation by Canadian private equity funds would result in greater benefits for Canada.

Second, in downturns, US funds will tend to invest closer to home, which amplifies the decline in "peripheral" markets like Canada. Third, the required return on a foreign investment may be higher than that on domestic investments, especially if the investment is not in a current "hot spot" and the company is further away from breakeven. This increases the probability that a good Canadian company will not be properly financed.

On the other hand, US funds bring not only capital but also expertise and networks, which result in higher exit values. Technology companies that obtain quick access to global markets and meet international standards attract the attention of global acquirers or are able to make an initial public offering on foreign stock exchanges. Foreign funds appear to prefer to co-invest with a local investor but, given the small size of Canadian funds, this is not always possible. This observation reinforces the point made earlier that small fund sizes are hurting returns in Canada.

Such considerations were the motivation for funding — with the support of BDC, Teralys Capital and others — the Tandem Expansion Fund, a $300-million private equity fund specializing in late-stage investments over $10 million. This fund was established in recognition of the fact that "many Canadian venture-backed companies are unable to access later-stage funding from any private source, which causes them to seek out foreign funds, strategic buyers or public market alternatives earlier than they should" (BDC 2009).

[9] The data in this paragraph and the following paragraph were compiled using the Thomson Reuters venture capital database (except as noted).

[10] There is no requirement to disclose deals.

With the foregoing in mind, the Panel is recommending programs to facilitate investment in the two parts of the risk capital market where the most crucial gaps exist: angel investment and late-stage venture capital and growth equity.

Recommendation 5

Help high-growth innovative firms access the risk capital they need through the establishment of new funds where gaps exist.

The Vision of the Panel

Innovative, growing firms require risk capital, yet too many innovative Canadian firms that have the potential for high growth are unable to access the funding needed to realize their potential. The Government of Canada can play an important role by facilitating access by such firms to an increased supply of risk capital.

Getting There

To realize this vision, the Panel recommends the following.

5.1 Start-up stage — Direct the Business Development Bank of Canada (BDC) to allocate a larger proportion of its portfolio to start-up stage financing, preferably in the form of a "sidecar" fund with angel investor groups.

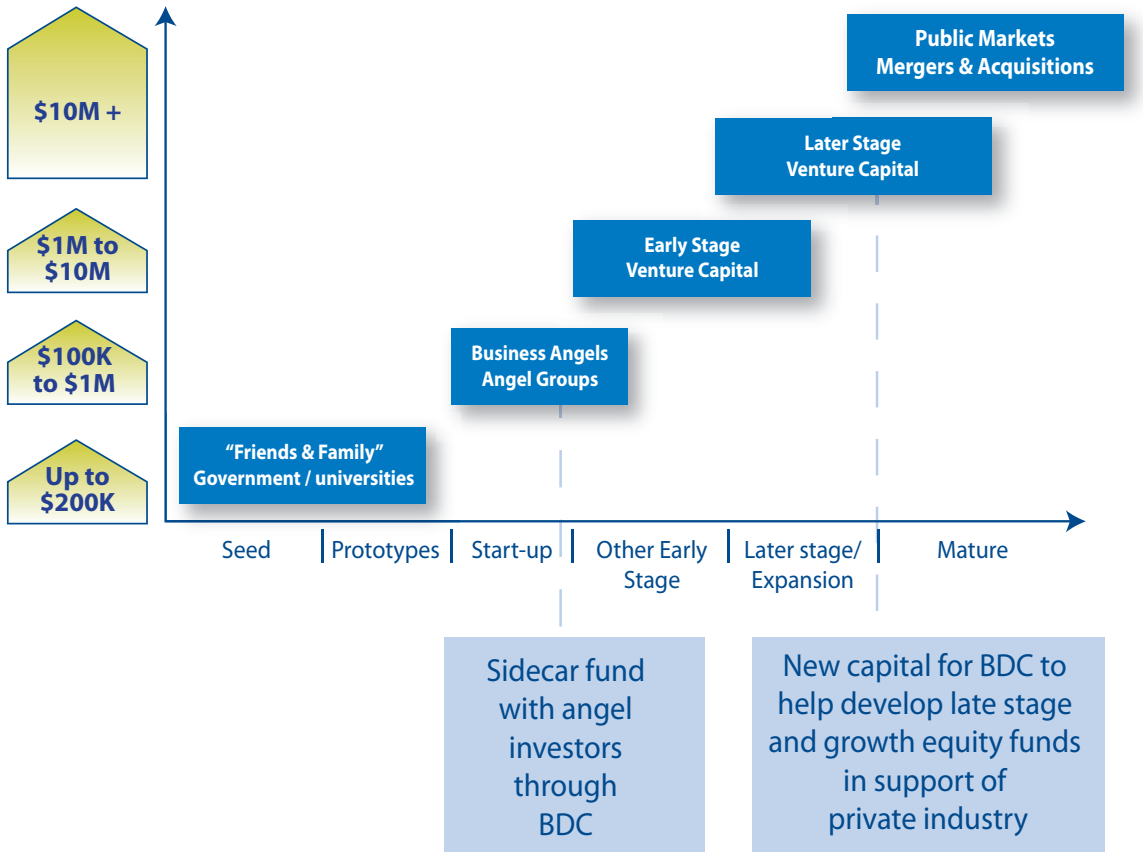
5.2 Late stage — Provide the BDC with new capital to support the development of larger-scale, later-stage venture capital funds and growth equity funds in support of the private venture capital and equity industry. These funds would specialize in deal sizes of $10 million and above that are managed by the private sector and subject to appropriate governance practices.

The foregoing recommendations, depicted in Figure 7.3, reflect the Panel's views on where the weaknesses in the financing chain are found. However, as pointed out by Josh Lerner, a respected US analyst of the venture capital market, government intervention has to be carefully structured in order to be effective (Lerner 2009).[11] The recommendations are therefore developed with the following considerations in mind.

- **Government intervention should be structured to address market failures and to create a net benefit for society.** The purpose of intervening in the venture capital market is to improve rates of return on financial capital through a reallocation among sectors. The purpose is not to subsidize the production of R&D — that is the role of R&D support programs. As a result, if market forces are appropriately harnessed to allocate funding, successful intervention will not require a large subsidy. In most circumstances, the government will be able to make a positive return on its investment. Setting up appropriate governance structures for the funds is an important determinant of their effectiveness and will help ensure that the intervention generates a net economic benefit. Governance structures have to be carefully developed to ensure that private incentives are appropriately aligned with the public interest and that the scope for self-serving behaviour is constrained.

[11] The title of Lerner's recent book on venture capital is highly revealing — *Boulevard of Broken Dreams* — and the subtitle even more so — *Why Public Efforts to Boost Entrepreneurship and Venture Capital Have Failed and What to Do about It.*

Figure 7.3 Proposal to Support High-Growth Firms



Source: The Panel.

- **The market should determine the allocation of financing.** Governments should co-invest with private venture capitalists and allow the private investors to determine the investment strategy. For this to work, a substantial amount of funds should come from non-public sources, and the government cannot micromanage the funds in terms of investment location and types of investment. It is important to allow fund managers to develop strong linkages to global experts, markets and businesses.

- **Additional support for the industry has to be paced in recognition of limits on the supply of talented and experienced managers as well as on the supply of high-quality firms needing financing.** While there is a minimum scale of intervention required for effectiveness, care should be exercised not to exceed the capacity of the industry to successfully manage the additional funds. As for other programs, the capacity to evaluate outcomes should be built in and the government should be prepared to make adjustments to improve performance, while at the same time avoiding rules that cause fund managers to focus excessively on short-term results.

Bearing this in mind, the Panel recommends that the BDC set up a national angel investment "sidecar" fund — that is, a pool of committed capital that "rides along with" or invests following the lead of an investment group. Working with groups (instead of individuals) results in economies of scale and promotes higher-quality investments through access to a broader range of expertise. BDC's contribution to the fund would come from its existing resources, with each dollar of BDC funding matched by at least 50 cents in funding from angel groups, although the appropriate funding ratio is likely to vary by sector. In order to encourage adequate participation, it may be necessary to provide an attractive financial structure to secure private/institutional partners and to induce private sector fund managers to invest in high-growth, innovative Canadian firms. One option is for the government to offer its partners a leveraged return in exchange for taking on more risk. This approach has been adopted by a number of countries.

- **The New Zealand Venture Investment Fund, the Russian Venture Company and the new Israeli Heznek Fund** (all of which were inspired by Israel's The Yozma Group fund) give private sector partners an option (but not the requirement) to purchase the government's position after a certain length of time at a price that would generate a predetermined rate of return to the government. With this structure, the government is exposed to the same downside risk as in a standard co-investment model, but has less upside potential, which reduces the expected return on its investment. Nevertheless, if market forces are appropriately harnessed to allocate funding, the government should be able to obtain a positive return on its investment. This approach raises the expected return to private investors without affecting the risk of loss. It therefore helps align private incentives with the public interest by giving the fund managers an incentive to invest in firms that have substantial upside potential rather than using government funds to offset losses on poor investments. Fund managers also have an incentive to work closely with funded companies because, once the minimum return has been achieved, fund managers are able to keep all of the additional return from their extra effort.
- In the US, the **Small Business Investment Company (SBIC)** program lends money to venture capitalists. The interest on the government loan is paid semi-annually and the principal must be repaid before capital is returned to private investors. These arrangements increase both the expected return and the risk for private investors. The government faces some risk: if the fund performs poorly enough, the loan principal will not be repaid.
- **Enterprise Capital Funds** in the UK have adopted a variant on the SBIC approach, with the government absorbing more of the risk of loss and gain by accepting repayment of capital on an equal footing with its partners and negotiating a share of the profits.

To improve access to later-stage venture capital, the Panel recommends having the government invest in private sector funds on terms that encourage larger fund sizes. The current state of the risk capital market suggests that the government may have to adopt a financial structure that encourages private/institutional co-investment by improving the risk–reward trade-off these investors face, as discussed above. The government should establish funds with the intention of leveraging private funds on at least a dollar-for-dollar basis.

The intention is not to create one large fund; rather, it is to encourage more and larger private funds supporting late-stage venture capital. Interviews with fund managers indicate that, while the optimal fund size varies by sector, larger fund sizes are more efficient because

firms can be financed through early and late stages while a diversified portfolio is still being built. But these economies of scale and scope appear to be exhausted relatively quickly: the best returns in the US are obtained on funds in the $200–300 million range (BDC 2011, p.13). The Panel's interviews with pension fund managers further indicated that it is more efficient to focus funds on particular sectors. The government should deploy the additional funding in stages in order to assess periodically the effectiveness of support.

Chapter 8

Leadership for Innovation

Countries around the world are sustaining and even accelerating their investments in business R&D and innovation, and are continuously improving the programs through which they provide this support in order to achieve more innovative, productive and competitive economies. In a study of innovation policies, the Organisation for Economic Co-operation and Development (OECD forthcoming) identifies a number of international trends regarding the mix of policy instruments being employed to support business innovation.

- **A growing attention to demand-side policies.** The increasing focus on demand-side policies (such as innovation-oriented public procurement) reflects a recognition in many OECD countries that their primary innovation challenges lie not in the generation of knowledge and ideas but in their commercial penetration.
- **A growing use of indirect support for innovation, notably R&D tax incentives.** Twenty-two OECD member countries now provide some form of R&D tax incentive, up from 12 in 1992 and 18 in 2004.
- **Shifting emphasis in direct support for innovation.** Direct support measures are increasingly emphasizing partnerships and collaboration, venture capital and start-up firms.
- **A growing attention to policy evaluation.** The need to assess the efficiency and impact of public policies in support of business innovation has become a particularly important focus in the wake of the economic downturn and resulting pressures on public spending.

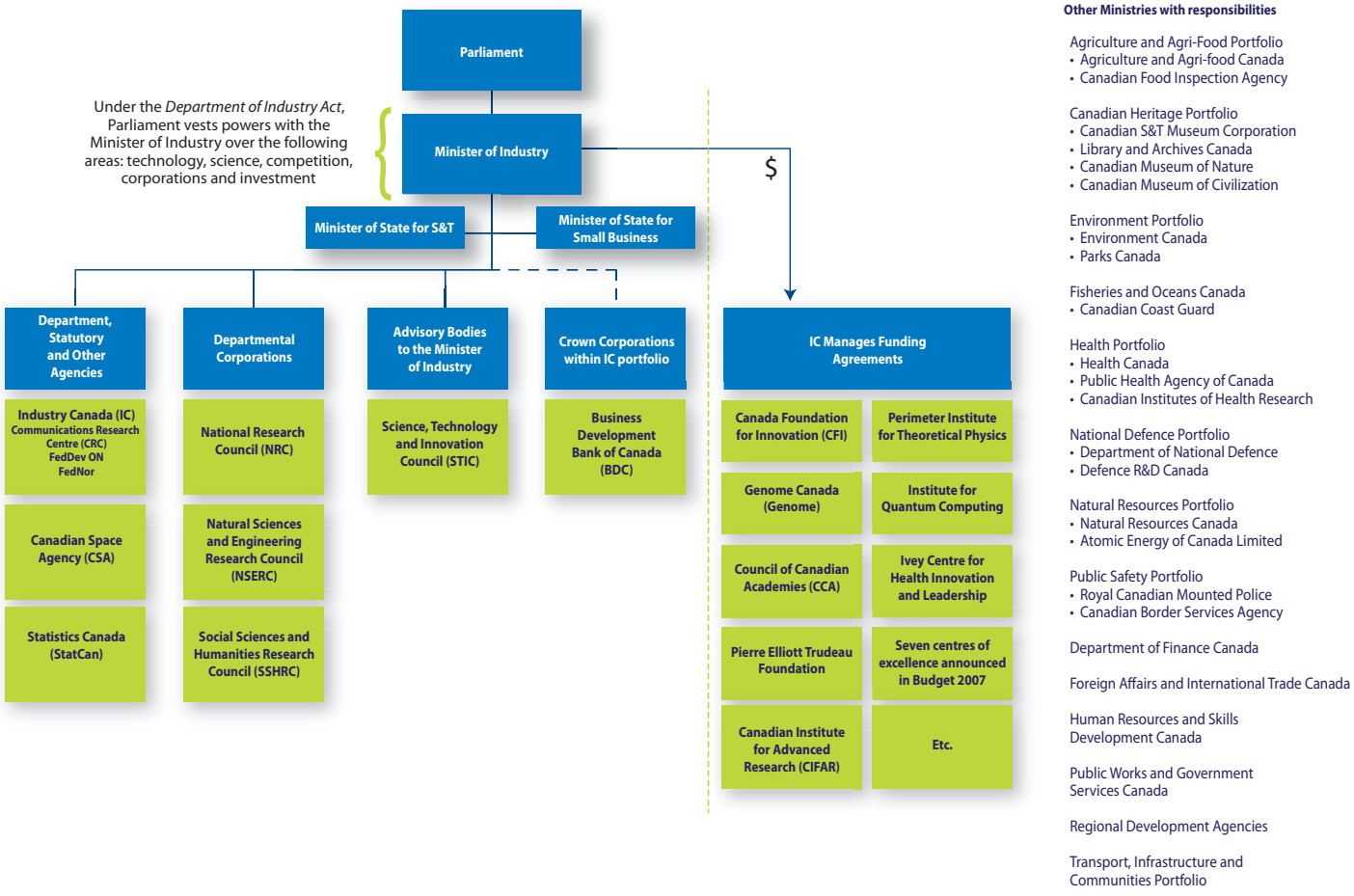
The Panel believes that it is essential for Canada too to continuously improve how government supports business innovation in order to encourage a more productive and competitive private sector. The recommendations of this review will deliver on this belief and are entirely consistent with the above-noted areas of contemporary emphasis in business innovation policy. In the foregoing chapters, the Panel has made recommendations that address the issues highlighted by the OECD.

- Create an Industrial Research and Innovation Council (IRIC), with a clear business innovation mandate (including delivery of business-facing innovation programs, development of a business innovation talent strategy, and other duties over time), and enhance the impact of programs through consolidation and improved whole-of-government evaluation.
- Simplify the Scientific Research and Experimental Development (SR&ED) program by basing the tax credit for small and medium-sized enterprises (SMEs) on labour-related costs. Redeploy funds from the tax credit to a more complete set of direct support initiatives to help SMEs grow into larger competitive firms.

- Make business innovation one of the core objectives of procurement, with the supporting initiatives to achieve this objective.
- Transform the institutes of the National Research Council (NRC) into a constellation of large-scale, sectoral collaborative R&D centres involving business, the university sector and the provinces, while transferring NRC public policy-related research activity to the appropriate federal agencies.
- Help high-growth innovative firms access the risk capital they need through the establishment of new funds where gaps exist.

What a federal government business innovation strategy now needs is the leadership to be the focal point of Canada's innovation system. To date, innovation has been regarded within the federal government primarily as one more "silo," which has in turn been fragmented within many sub-silos in various departments and agencies. While the Minister of Industry and the Minister of State for Science and Technology are regarded as having the lead responsibility for innovation, many others in government also have roles to play (Figure 8.1).

Figure 8.1 The Government of Canada's Innovation Machinery



Source: Based on information provided by Industry Canada.

The appropriate concept of innovation, as the Panel has emphasized in Chapter 2, far transcends science and technology and R&D. Business innovation is the principal source of productivity growth in the long run and thus lies at the heart of Canada's economic prosperity. The responsibility to foster innovation cuts across many functions of government and requires a system-wide perspective. In fact, the plethora of government programs to promote innovation, many of which are subscale and partly overlapping, is in large part due to a growing awareness of the importance of business innovation, but without adequately mandated leadership to develop and oversee a broad strategy. This contrasts with the direction being taken by a number of other jurisdictions, including other federal countries like Australia and some provinces (Box 8.1).

Box 8.1 Innovation Policy Advisory Bodies

International Perspectives

In 2007, Australia established Innovation Australia, an independent statutory body that took over the administration of business innovation and venture capital programs. The organization's board is drawn from business and academic communities and is accountable to the Minister of Innovation, Industry, Science and Research for the programs and their funding. In addition to its role in program delivery, Innovation Australia reviews and provides advice on innovation programs and proposals being developed in the government — for example, on commercialization and tax credits. It also performs a coordinating role among players in the Australian innovation system.

The United Kingdom also in 2007 established the Technology Strategy Board as an executive non-departmental body sponsored by the Department for Business, Innovation and Skills and funded by various departments and agencies. As in Australia, the board's senior management is drawn from business and academia, and it delivers a range of innovation programs.

Views from Canada

At the provincial level in Canada, there are several instances where innovation strategies are being delivered by semi-autonomous, business-led entities. Although governments provide funding and policy direction and oversight, they are not directly involved in case-by-case decision making.

Previous expert panels in Canada have made recommendations concerning the need for increased system coordination at the federal level, suggesting it can be done through the creation of a body mandated to oversee and provide advice from a whole-of-government perspective. For example, the Expert Panel on Commercialization (2006a) recommended the creation of a Commercialization Partnerships Board reporting to the Minister of Industry to make recommendations and serve an oversight role for federal commercialization initiatives. A few years later, the Competition Policy Review Panel (2008) recommended that the federal government establish an independent Canadian Competitiveness Council under the Minister of Industry. Mandated to examine, report on and advocate for measures to improve Canadian competitiveness, the council's board of directors would include a majority of non-governmental members. To date, these recommendations have not been acted upon.

Recommendation 6

Establish a clear federal voice for innovation, and engage in a dialogue with the provinces to improve coordination and impact.

The Vision of the Panel

The Government of Canada must assume a leadership role by establishing business innovation as a whole-of-government priority and consequently restructuring the governance of its business innovation agenda, while developing a shared and cooperative approach with provincial and business leaders.

Getting There

To realize this vision, the Panel recommends the following.

National Leadership

A comprehensive innovation policy must encompass a suite of policies that address research and invention, technology, service sector strategy, financial capital and talent, among other domains. A narrow science and technology policy will not adequately promote innovation by Canadian businesses. Canada needs a whole-of-government innovation policy that encompasses research, development, commercialization and business support strategies. This principle implies the following need.

6.1 Assign responsibility — Identify a lead minister responsible for innovation in the Government of Canada together with a stated mandate to put business innovation at the centre of the government's strategy for improving Canada's economic performance.

The Prime Minister might assign responsibility and accountability to a single minister to lead the challenge function in government for business innovation and to work with provincial and territorial governments to undertake a national innovation dialogue focussed on objectives and guiding principles. The same lead minister should be charged with developing outcome-oriented performance objectives to enable comparisons of program effectiveness across all federal departments. This might be facilitated via a Cabinet committee on innovation, chaired by the lead minister.

In addition, the designated minister could provide leadership in helping clarify mandates for existing and new entities, including the three granting councils — Natural Sciences and Engineering Research Council (NSERC), Social Sciences and Humanities Research Council (SSHRC) and Canadian Institutes of Health Research (CIHR) — and the many related third-party organizations currently being funded by the government to support business innovation. The granting councils have played a pivotal role in developing both talent and ideas for Canada's innovation agenda. Their core *raison d'être* has been and remains investigator-initiated research of both a basic and applied nature, and each needs to continue to be generously supported. However, there has been mission drift for the granting councils, as they have responded to pressure from government to be more business facing. While some business-facing programs might appropriately be under the aegis of the granting councils going forward, there is a need to clarify their mandates, taking into account the other changes being recommended by the Panel, such as the creation of the IRIC and the evolution of the NRC. In this regard, the designated minister will need to play a leadership role in establishing the IRIC and seeing the NRC through to its recommended end state. Recall that the IRIC, under the purview of the minister responsible for

innovation, would have financial authority over the federal contributions to the evolved NRC institutes through management of related funding agreements (Recommendation 4.3 in Chapter 7).

Oversight

The innovation support system implemented by the Government of Canada should have clear objectives, with measurable outcomes and results. Regular whole-of-government evaluation is needed to ensure an outcome-driven approach. This evaluation should ensure that the federal program funding is always able to shift resources from programs that are no longer effective to those that serve new priorities and needs in the innovation system. There should be regular public reports on the outcomes of individual programs and on the system-wide performance of the innovation policies.

To give effect to these principles, the Panel recommends the following.

6.2 Whole-of-government advice — Transform the Science, Technology and Innovation Council (STIC) to become the government's external Innovation Advisory Committee (IAC), with a mandate to provide whole-of-government advice on key goals, measurement and evaluation of policy and program effectiveness, the requirement for new initiatives responding to evolving needs and priorities going forward, and all other matters requiring a focussed external perspective on the government's innovation agenda. The IAC should act though through two standing subcommittees: a Business Innovation Committee (BIC) and a Science and Research Committee (SRC).

At present, the STIC, reporting to the Minister of Industry, provides policy advice to the government on issues related to science, technology and innovation. The Panel proposes to transform and broaden that mandate to encompass whole-of-government advice on innovation goals related to business, science and social innovation, as well as all aspects of business innovation policy and programming — for example, benchmarking, measurement and comparative evaluation of existing policies and programs across federal departments, as well as advice on the need for new programs and new areas of focus for Canadian innovation. Unlike the STIC, whose policy advice is confidential, the new IAC's advice should be made public.

In taking on this broadened mandate, the IAC would be assisted by two standing subcommittees — the SRC, focussed on "supply-push," and the BIC, focussed on "demand-pull." The BIC membership would include a cross-section of business leaders, the granting councils and representatives of the institutes formerly of the NRC, and would draw on the advice of Canadian and international experts on innovation policies. The BIC could play an important role in advising the proposed IRIC on appropriate metrics, indicators and methodologies to guide the IRIC's role as a business-facing, demand-driven national program delivery agency (recall Recommendation 1.1 in Chapter 5). To ensure efficient use of resources, the IAC's subcommittees could co-include existing members of the governing councils of SSHRC, NSERC and CIHR, as well as IRIC, once it is established. Over time, all relevant advisory functions across the government should also be consolidated into the IAC and its two subcommittees to the greatest extent possible.

Federal–Provincial Dialogue

Canada is a federation with two jurisdictions of political and legislative authority. The division of powers between each order of government assigns certain domains exclusively to one order of government, while other domains are shared jurisdictions. In the domain of R&D and innovation, both federal and provincial governments are important players. The existence of two orders of government providing active programming in the same domain creates opportunities for coordination and collaboration. Conversely, it can also create the possibility of overlap and duplication of effort. That is why there is a need for an ongoing national dialogue on innovation. The Panel therefore recommends the following.

6.3 National dialogue on innovation — Through the minister responsible for innovation, engage provincial and business leaders in an ongoing national dialogue to promote better business innovation outcomes through more effective collaboration and coordination in respect of program delivery, talent deployment, sectoral initiatives, public sector procurement, appropriate tax credit levels and the availability of risk capital.

The need for a dialogue of this sort is amplified by the fact that Canada has a small population spread over a large and geographically diverse land mass. It is therefore particularly important to work toward better integration, coordination and unity of effort, while respecting federal and provincial jurisdictions.

In addition to addressing the federal–provincial dimensions of the advice put forward in this report, important objectives of the national dialogue would also include setting new goals and standards, monitoring international benchmarks and best practices, and reducing overlap and duplication in these fiscally constrained times.

Chapter 9 Conclusion

We are honoured to have been given the opportunity to undertake the Review of Federal Support to Research and Development — an initiative launched at a critical time that is a nexus of global economic instability and rapid emergence of new powers. In this context of opportunity and challenge, the countries most likely to succeed are those that understand that business innovation holds the key to rising living standards and to a more creative economy and society. In this regard, we are optimistic that our recommendations — implemented in tandem with equally important enhancements to marketplace frameworks — can play a central role in helping Canada to become one of the world's innovation leaders. We have no doubt that this goal is attainable.

That said, addressing a decades-long trend of poor innovation performance will not be easy. Concerted action will be needed in multiple arenas. Our recommendations — which affect only a limited part of the wider innovation picture — will also present challenges. Their implementation will require collaboration, cooperation and dialogue across several federal departments and agencies, as well as with the provinces, the business sector and post-secondary institutions. This process cannot succeed without renewed focus and leadership in government. That is why we have recommended governance changes aimed at establishing business innovation as a whole-of-government priority.

Below is an overview of what we see as the "end game" of our advice — a brief snapshot of our recommendations boiled down to their essence.

The End Game

Guided by strong leadership and sound principles, and through concerted action, the end result of our recommendations will be:

- A rebalanced, more effective system of federal assistance for business innovation that helps innovative firms grow and prosper with ready access to:
  - R&D and commercialization funding
  - highly qualified and skilled personnel
  - ideas, knowledge and research capacity through collaboration with innovation partners
  - capital to grow from start-ups to world-competitive, large firms
  - procurement opportunities that stimulate demand for innovative goods, services and technologies
  - an improved Scientific Research and Experimental Development program that is simpler, more effective, more predictable and more accountable.

- A commitment to measurable outcomes, increased effectiveness, heightened efficiency and enhanced collaboration put into effect through a whole-of-government approach to governance that includes:
  - an improved performance management system for federal business innovation programs
  - an external Innovation Advisory Committee that advises on key goals, on the measurement and evaluation of policy and program effectiveness, and on new opportunities and approaches
  - a common delivery platform for business innovation programs — the Industrial Research and Innovation Council — that delivers the Industrial Research Assistance Program and a new commercialization vouchers pilot program, provides a single-window "concierge" and web portal for business innovation programs, develops a federal business innovation talent strategy, partners with the federal granting agencies on joint oversight of appropriate business-facing programs administered by those agencies, performs the technical assessment of regional development agency innovation proposals, and oversees the federal funding of large-scale sectoral collaborative research institutes.
- A national constellation of world-class research institutes that are formed by streamlining the institutes of the National Research Council (NRC), through a five-year plan, into one of four types of organization:
  - industry-oriented, non-profit research organizations mandated to undertake collaborative R&D and commercialization projects and services, funded by amounts drawn against existing NRC appropriations together with revenue earned from collaborative activities
  - institutes engaged in basic research to be affiliated with one or more universities and funded by an amount drawn against existing NRC appropriations together with contributions from university and/or provincial partners
  - parts of non-profit organizations mandated to manage what are currently NRC major science initiatives and potentially other such research infrastructure in Canada
  - institutes or units providing services in support of a public policy mandate and to be incorporated within the relevant federal department or agency.

The Way Forward

Going forward, the Panel welcomes the opportunity to meet with government officials, business leaders and post-secondary institutions to discuss our recommendations. Our end game is ambitious, but so too is our vision — a Canadian business sector that stands shoulder-to-shoulder with the world's innovation leaders. While this is a long-term goal, government action must be swift and decisive, because the impact of the initiatives begun today may take years, even decades, to be fully realized.

The longest journey begins with the first step, so the time to act is now.

Annex

Programs in the Review

A

Department or Agency	Initiative/Institute
Agriculture and Agri-Food Canada (AAFC)	Agricultural Bioproducts Innovation Program (ABIP) Growing Forward – Canadian Agri-Science Clusters Growing Forward – Developing Innovative Agri-Products Growing Forward – Supporting the Innovative Capacity of Farmers
Atlantic Canada Opportunities Agency (ACOA)	Atlantic Innovation Fund (AIF) Business Development Program (BDP)
Business Development Bank of Canada (BDC)	BDC Venture Capital
Canada Economic Development for Quebec Regions (CED-Q)	Business and Regional Growth Program
Canadian Institutes of Health Research (CIHR)	Industry-Partnered Collaborative Research Program Proof of Principle Program (POP)
Canadian Space Agency (CSA)	Space Technologies Development Program (STDP)
Defence Research and Development Canada (DRDC)	Technology Demonstration Program (TDP)
Department of Finance Canada (FIN) and Canada Revenue Agency (CRA)	Scientific Research and Experimental Development (SR&ED) Tax Incentive Program
Federal Economic Development Agency for Southern Ontario (FedDev ON)	Applied Research and Commercialization Program Investing in Business Innovation Technology Development Program
Industry Canada (IC)	Automotive Innovation Fund Strategic Aerospace and Defence Initiative (SADI)

Department or Agency	Initiative/Institute
Industry Canada portfolio	Automotive Partnerships Canada (APC)
Industry Canada/Federal Economic Development Agency for Northern Ontario (FedNor)	Northern Ontario Development Program
National Research Council Canada (NRC)	Biotechnology Research Institute (NRC-BRI) Canadian Hydraulics Centre (NRC-CHC) Centre for Surface Transportation Technology (NRC-CSTT) Industrial Materials Institute (NRC-IMI) Industrial Research Assistance Program (IRAP) Institute for Aerospace Research (NRC-IAR) Institute for Biodiagnostics (NRC-IBD) Institute for Biological Sciences (NRC-IBS) Institute for Chemical Process and Environmental Technology (NRC-ICPET) Institute for Fuel Cell Innovation (NRC-IFCI) Institute for Information Technology (NRC-IIT) Institute for Marine Biosciences (NRC-IMB) Institute for Microstructural Sciences (NRC-IMS) Institute for Ocean Technology (NRC-IOT) Institute for Research in Construction (NRC-IRC) National Institute for Nanotechnology (NINT) Plant Biotechnology Institute (NRC-PBI) Steacie Institute for Molecular Sciences (NRC-SIMS) Technology Clusters Program
Natural Resources Canada (NRCan)	Contributions to FPInnovations
Natural Sciences and Engineering Research Council of Canada (NSERC)	Collaborative Health Research Projects (CHRP) Collaborative Research and Development Grants Program (CRD) College and Community Innovation Program (CCIP) Engage Grants (EG) Idea to Innovation Program (I2I) Industrial Postgraduate Scholarships (IPS) Industrial R&D Fellowships (IRDF) Industrial Research Chairs (IRC) Industrial Undergraduate Student Research Awards (I-USRA) Interaction Grants (IG) Partnership Workshops Program (PWP) Strategic Network Grants (SNG) Strategic Project Grants (SPG)

Department or Agency	Initiative/Institute
Sustainable Development Technology Canada (SDTC)	NextGen Biofuels Fund SD Tech Fund
Tri-Council (the three granting councils: NSERC, SSHRC and CIHR)	Business-Led Networks of Centres of Excellence (BL-NCE) Centres of Excellence for Commercialization and Research (CECR) Industrial R&D Internship Program (IRDI) Networks of Centres of Excellence (NCE)
Western Economic Diversification Canada (WD)	Western Diversification Program (WDP)

Annex

The Advice of Other Panels

B

In recent years, the federal government has struck panels that have touched upon issues of relevance to the Review of Federal Support to Research and Development. In particular, the Competition Policy Review Panel and the Expert Panel on Commercialization both explored topics that warrant attention in the context of this review.

Competition Policy Review Panel (2008)

The formation of the Competition Policy Review Panel was announced jointly by the ministers of Industry and Finance in July 2007. The panel was mandated to review Canada's competition and foreign investment policies, and to provide related recommendations on how to improve Canada's productivity and competitiveness. In its final report, *Compete to Win*, released in June 2008, the panel recommended the establishment of an independent Canadian Competitiveness Council under the Minister of Industry. Staffed by a chief executive officer and a small core staff overseen by a board of directors, the proposed council's mandate would be "to examine and report on, advocate for measures to improve, and to ensure sustained progress on, Canadian competitiveness" (p. 133). It would not enforce laws and regulations but would have a public voice, including the power to publish and advocate for its findings. The Competition Policy Review Panel also put forward a range of other recommendations grouped under various rubrics, two of which stand out as particularly pertinent to this review.

Innovation and Intellectual Property

The report made the following recommendations (2008, p. 133).

- "The federal government should monitor the scientific research and experimental development tax credit program annually in order to ensure that business investment in research and development and innovation in Canada is effectively encouraged.
- As a matter of priority, the federal government should ensure that new copyright legislation will both sufficiently reward creators while stimulating competition and innovation in the Internet age. Any prospective changes to Canada's patent law regime should also reflect this balance. The federal government should assess and modernize the Canadian patent and copyright system to support the international efforts of Canadian participants in the global economy in a timely and effective manner.
- Before December 2009, the federal government should strengthen counterfeit and piracy laws to ensure that intellectual property rights are effectively protected.

- Canada's post-secondary education institutions should expedite the transfer of intellectual property rights and the commercialization of university generated intellectual property. One possible method to achieve this would be to move to an 'innovator ownership' model to speed commercialization."

Attracting and Developing Talent

The report made the following recommendations (2008, pp. 128–129).

- "Governments should continue to invest in education in order to enhance quality and improve educational outcomes while gradually liberalizing provincial tuition policies offset by more student assistance based on income and merit.
- Post-secondary education institutions should pursue global excellence through greater specialization, focusing on strategies to cultivate and attract top international talent, especially in the fields of math, science and business.
- Governments should use all the mechanisms at their disposal to encourage post-secondary education institutions to collaborate more closely with the business community, cultivating partnerships and exchanges in order to enhance institutional governance, curriculum development and community engagement.
- Federal and provincial governments should encourage the creation of additional post-secondary education co-op programs and internship opportunities in appropriate fields, to ensure that more Canadians are equipped to meet future labour market needs and that students gain experiences that help them make the transition into the workforce.
- Governments should provide incentives and undertake measures to both attract more international students to Canada's post-secondary institutions and send more Canadian students on international study exchanges.
- Governments should strive to increase Canada's global share of foreign students, and set a goal of doubling Canada's number of international students within a decade.
- Governments, post-secondary education institutions and national post-secondary education associations should undertake regular evaluations, measure progress and report publicly on improvements in business–academic collaboration, participation in co-op programs, and the attraction and retention of international talent.
- Reforms to Canada's immigration system should place emphasis on immigration as an economic tool to meet our labour market needs, becoming more selective and responsive in addressing labour shortages across the skills spectrum.
- Canada's immigration system should develop service standards related to applications for student visas and temporary foreign workers, and should be more responsive to private employers and student needs by fast-tracking processing and providing greater certainty regarding the length of time required to process applications.
- In order to ensure that Canada is able to attract and retain top international talent, and respond more effectively to private employers, Canada's immigration system should fast-track processing of applications for permanent residency under the new Canadian Experience Class for skilled temporary foreign workers and foreign students with Canadian credentials and work experience."

Expert Panel on Commercialization (2006)

The Minister of Industry struck the Expert Panel on Commercialization in May 2005, asking it to identify how the federal government could help ensure continuous improvements to Canada's commercialization performance. The panel's final report, *People and Excellence: The Heart of Successful Commercialization*, was released in April 2006.

The report called for the creation of a Commercialization Partnership Board reporting to the Minister of Industry as his or her lead advisory body on commercialization. Among other activities, it was suggested that the board could: serve in an oversight role for federal commercialization policies, initiatives and investments; provide an annual public report evaluating their effectiveness, integration and impacts; and call on the Minister of Industry to respond publicly to the report. In addition, the report made a series of recommendations organized in relation to three "themes for action."

Talent

- **Increase business demand for talent through the development of a new Canada Commercialization Fellowships Program.** The program would "support businesses in all sectors that are building or renewing a commitment to commercialization by supporting exchanges with post-secondary institutions" (2006a, p. 12). These fellowships would (i) encompass the broad range of disciplines that support commercialization and (ii) occur at all stages of a research career — that is, from undergraduate studies through to the workforce.
- **Spur employer hiring of highly qualified personnel with commercialization talents.** This would be achieved by: "expanding the existing Canadian Institutes of Health Research (CIHR) programs that focus on industry–university partnerships; expanding the existing Natural Sciences and Engineering Research Council of Canada (NSERC) programs that provide research experience in industrial settings; creating a new Social Sciences and Humanities Research Council of Canada (SSHRC) commercialization and innovation fellowship program emphasizing disciplines such as business, design and human behaviour; and providing funds to these organizations based on a competition overseen by the new Commercialization Partnership Board" (2006a, p. 13).
- **Encourage and celebrate young Canadians who aim for success in business, science and technology.** This would be achieved by providing "substantial, guaranteed and long-term support for initiatives that promote and celebrate excellence in science, technology and business by young people" (2006a, p. 14).
- **Develop and retain talent for success in the global marketplace.** This would be achieved by: creating prestigious scholarships on par with the Rhodes and Fulbrights; enabling foreign research and teaching collaborators to serve as distinguished visiting chairs; providing matching grants for collaborative research projects with researchers in centres of excellence in other countries; supporting short-term exchanges of researchers between Canadian and foreign universities; and significantly increasing the number of Canadian students conducting studies and research at foreign universities (2006a, p. 15).

Research

- **Create a Commercialization Superfund to address key commercialization challenges.** This fund would support large-scale, private–public sector research and training partnerships in targeted sectors, while expanding existing programs and initiating new ones to train highly qualified personnel (2006a, p. 18).
- **Expand federal programs that support seed and start-up firms in proving their business ideas.** This would be achieved as a first step by (i) increasing funding to programs such as NSERC's Idea to Innovation program, CIHR's Proof of Principle program and the Industrial Research Assistance Program and (ii) providing funds for SSHRC to establish a program similar to these three in order to encourage, where applicable, the commercialization of the research it funds. As a second step, funding would grow, based on evidence of success (2006a, p. 19).
- **Increase the commercialization involvement of small and medium-sized enterprises (SMEs), through a Canadian SME Partnerships Initiative.** The objective of this initiative would be to make SMEs more globally competitive through two channels: (i) Partnerships Initiative — Research Funding, through which federal science-based departments and agencies would compete for five-year funding for research above and beyond their existing budgets and (ii) Canadian SME Partnerships Initiative — Program Support, which would include efforts such as support for technology acquisition and R&D partnerships with firms and research bodies in other countries (2006a, p. 21).

Capital

- **Improve access to early-stage angel financing and expertise.** This would be achieved through two initiatives: (i) Funding Excellence in Building Angel Investor Networks, which would develop angel investor networks and enhance the support they provide to early-stage firms through a competitive process to fund non-governmental organizations that mobilize the resources within communities and (ii) a New Angel Investor Co-Investment Fund Program that would establish community based funds, capitalized by the federal government, which would invest alongside angel investors in seed and start-up companies (2006a, p. 24).
- **Review the expansion-stage venture capital market in Canada.** This would be accomplished by launching a comprehensive review, potentially with the involvement of the provinces and territories, "of policies, programs and other factors influencing the role of the venture capital markets on companies during their expansion stage. This review would involve the venture capital community and include assessing current initiatives and capital supply and demand considerations, including factors for firms seeking financing" (2006a, p. 26).
- **Remove barriers to foreign venture capital investment.** This would be achieved through the following measures: "eliminate the withholding tax on capital gains made by foreign investors in the equity of private Canadian companies; cover limited liability corporations that are venture capital funds or private investment funds under Canada's income tax treaties and exclude them from withholding tax; extend rollover provisions to cross-border mergers, allowing companies to get access to strategic partnerships with foreign companies without triggering taxation; and eliminate the requirement for non-Canadian investors to file a Canadian income tax return" (2006a, p. 27).

Annex C

Biographies of Panel Members

Thomas Jenkins

P. Thomas Jenkins is executive chairman and chief strategy officer of Open Text Corporation of Waterloo, Ontario, the largest independent software company in Canada. He has served as a director of Open Text since 1994 and as its chairman since 1998. From 1994 to present, Mr. Jenkins was president and then chief executive officer and then chief strategy officer of Open Text. Mr. Jenkins has also held several executive positions with DALSA Inc., an electronic imaging manufacturer based in Waterloo, Ontario. Prior to these positions, Mr. Jenkins was employed in technical and managerial capacities at a variety of information technology-based companies in Canada.

In addition to his Open Text responsibilities, Mr. Jenkins is the chair of the federal centre of excellence Canadian Digital Media Network (CDMN). He is also an appointed member of the Social Sciences and Humanities Research Council of Canada (SSHRC), past appointed member of the Government of Canada's Competition Policy Review Panel, which reported in June 2008, and past appointed member of the Ontario Commercialization Network Review Committee (OCN), which reported in February 2009. Mr. Jenkins is also a member of the board of BMC Software, Inc., a software corporation based in Houston, Texas. He is also a member of the University of Waterloo Engineering Dean's Advisory Council, a director of the C. D. Howe Institute, a director of the Canadian International Council (CIC) and a director of the Canadian Council of Chief Executives (CCCE).

Mr. Jenkins received an MBA in entrepreneurship and technology management from Schulich School of Business at York University, an M.A.Sc. in electrical engineering from the University of Toronto and a B.Eng. & Mgt. in engineering physics and commerce from McMaster University.

Bev Dahlby

Dr. Bev Dahlby is a professor and fellow at the Institute for Public Economics at the University of Alberta.

Dr. Dahlby has published extensively on tax policy and fiscal federalism. Dr. Dahlby's book, *The Marginal Cost of Public Funds: Theory and Applications*, was published by MIT Press in 2008. In 1998–1999, he held a McCalla Research Professorship at the University of Alberta. He has been a visiting scholar at the Economic Policy Research Unit at the University of Copenhagen, the Australian Taxation Studies Program at the University of New South Wales, the Graduate School of Economics at Getulio Vargas Foundation in Rio de Janeiro, the Department of Public Economics at the University of Innsbruck, and the Department of Economics at Marburg University. He has served as a policy adviser to the federal and provincial governments in Canada on the reform of business taxation, the fiscal equalization

program, tax credits for television and film industry, taxation of inbound foreign direct investment, and saving non-renewable resource revenues in Alberta. His international experience includes advisory work on tax reform in Malawi for the International Monetary Fund, in Thailand for the Thailand Development Research Institute in Bangkok, and in Brazil for the World Bank. In May 2010, Dr. Dahlby was awarded the Doug Purvis Memorial Prize by the Canadian Economics Association for a work of excellence relating to Canadian economic policy.

Dr. Dahlby has a B.A. from the University of Saskatchewan, an M.A. from Queen's University and a Ph.D. from the London School of Economics. He joined the Department of Economics at the University of Alberta in 1978 after completing his Ph.D.

Arvind Gupta

Dr. Arvind Gupta is a professor of computing science at the University of British Columbia, and is chief executive officer and scientific director of the Mathematics of Information Technology & Complex Systems group (MITACS), a national research network that connects academia, industry and the public sector to develop tools for Canada's knowledge-based economy. He also chairs the MITACS Research Management Committee and is a member of the MITACS Board of Directors and Executive Committee.

Prior to joining MITACS, Dr. Gupta helped found the Pacific Institute for the Mathematical Sciences and the Banff International Research Station for Mathematical Innovation and Discovery.

Dr. Gupta is a member of a number of research organizations, including the Association of Computing Machinery, the European Association of Theoretical Computer Science, the Institute of Electrical and Electronics Engineers, and a fellow of the Advanced Systems Institute. He is also a member of the Natural Sciences and Engineering Research Council of Canada's International Strategy Advisory Committee, the British Columbia Natural Resource and Applied Science Endowment Fund Advisory Committee, and the Banff International Research Station.

Dr. Gupta is the editor of two book series on industrial mathematics and is currently the President of the 2011 International Congress on Industrial and Applied Mathematics. Dr. Gupta has a B.Sc. from McMaster University, an M.Sc. from the University of Toronto and a Ph.D. from the University of Toronto.

Monique F. Leroux

Since 2008, Monique F. Leroux, FCA, FCMA, has been chair of the board, president and chief executive officer of Desjardins Group. As elected president, she represents all Desjardins caisses and leads the largest cooperative financial group in Canada and the sixth largest in the world, with assets of more than $175 billion.

From 2001 to 2008, Ms. Leroux held various positions within Desjardins Group, including chief financial officer of Desjardins Group, and president of Desjardins Financial Corporation and chief executive officer of its subsidiaries. Prior to joining Desjardins Group, Ms. Leroux was senior executive vice president and chief operating officer at Quebecor Inc., senior vice president, Quebec Division, at RBC Royal Bank, and senior vice president, finance, at the head office of the Royal Bank Financial Group. Ms. Leroux began her career at Ernst & Young, ultimately becoming managing partner of services to the Quebec financial industry, and managing partner in charge of auditing and consulting for national and international companies.

Ms. Leroux has been active on a number of corporate boards as well as a member of several national and international organizations and

committees. She is currently a vice president and a member of the board of directors of the International Confederation of Popular Banks, a member of the board of directors of the Conference Board of Canada and of the European Association of Co-operative Banks, while also sitting on the executive committee of this last organization. In addition, she is a member of the Global Agenda Council of the World Economic Forum, the HEC Montréal council of governors, and the governing board of Montréal International. Ms. Leroux has been president of the Ordre des comptables agréés du Québec and governor of the Canadian Institute of Chartered Accountants.

Her expertise and accomplishments in the areas of management, finance, accounting and governance have been widely acknowledged, including honorary doctorates from Université du Québec à Chicoutimi, Concordia University and Bishop's University. Ms. Leroux has also received numerous leadership awards, such as her recent selection as one of 25 transformational Canadians by the *Globe and Mail* and as one of the 2011 honourees of the Public Policy Forum. In addition, she generously lends her time as a host of charitable organizations. She is, for example, acting as president of the Canada Summer Games to be held in Sherbrooke in 2013.

David Naylor

Dr. David Naylor was appointed the 15th president of the University of Toronto in 2005. He holds an MD from the University of Toronto and earned his D.Phil. in the Faculty of Social and Administrative Studies at Oxford University in 1983, where he studied as a Rhodes scholar. A fellow of the Royal College of Physicians and Surgeons (Internal Medicine), Dr. Naylor joined the Department of Medicine of the University of Toronto in 1988, where he was promoted to full professor by 1996. He was founding chief executive officer of the Institute for Clinical Evaluative Sciences (1991–1998), before becoming dean of medicine and vice provost for relations with health care institutions of the University of Toronto (1999–2005).

Dr. Naylor is the co-author of approximately 300 scholarly publications, spanning social history, public policy, epidemiology and biostatistics, and health economics, as well as clinical and health services research in most fields of medicine. He has advised governments in Canada and abroad on policy issues over the course of more than 20 years, and was chair of the National Advisory Committee on SARS and Public Health in 2003. David Naylor is a fellow of the Royal Society of Canada and the Canadian Academy of Health Sciences, a foreign associate fellow of the US Institute of Medicine, and an Officer of the Order of Canada. He is also the recipient of various national and international awards for research and leadership in medicine, health care and education.

Nobina Robinson

Since May 2009, Mrs. Nobina Robinson has held the position of chief executive officer of Polytechnics Canada, a national alliance of the leading research-intensive, publicly funded colleges and institutes of technology. She has held progressive appointments in the federal government and non-profit sectors since 1990.

Mrs. Robinson began her public service career in 1990, when she joined the Treasury Board Secretariat as a management trainee. Two years later, she became a foreign service officer and was posted as a political officer to the Canadian Embassy in Havana from 1994 to 1997.

In 1998, Mrs. Robinson joined the Canadian Foundation for the Americas (FOCAL), an independent, non-partisan think tank dedicated to strengthening Canadian relations with Latin America and the Caribbean. She served as the foundation's executive director between 1999 and 2002. Mrs. Robinson promoted civil society

engagement with the governments of the Americas at all major hemispheric events, and co-led the summit of non-governmental organizations at the 2001 Québec City Summit of the Americas.

Before joining Polytechnics Canada, Mrs. Nobina Robinson was the Ottawa-based senior government relations adviser for Seneca College, with a principal responsibility for federal advocacy for one of Canada's largest colleges.

Mrs. Nobina Robinson has a B.A. from Amherst College, Massachusetts, an M.A. from Oxford University (Commonwealth Scholar 1985–1988), and has pursued post-graduate study at Yale University.

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