Expert Panel Consultation Paper

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Section 1

WHY A REVIEW?

Innovation by business is a vital part of maintaining a high standard of living in Canada and building Canadian sources of global advantage. The Government of Canada plays an important role in fostering an economic climate that encourages business innovation, including by providing substantial funding through tax incentives and direct program support to enhance business research and development (R&D). Despite the high level of federal support, Canada continues to lag behind other countries in business R&D expenditures (see Figure 1), and this is believed to be a significant factor in contributing to the country's weak productivity growth. Recognizing this, Budget 2010 announced a comprehensive review of federal support to R&D in order to maximize its contribution to innovation and to economic opportunities for business.

By providing background information and putting forward specific consultation questions, this paper is intended to assist public consultations undertaken by the Expert Panel on R&D. The Panel has launched a request for submissions from all interested parties through its website (www.rdreview-examenrd.ca). The deadline for submissions is February 18, 2011.

FIGURE 1: Business Expenditures on R&D (BERD), 2008[1]

	GDP ($US billions, current PPP)	BERD ($US billions, current PPP)	BERD Intensity (BERD as % of GDP)
Canada	1,300.2	13.0	1.00%
US	14,369.4	289.1	2.01%
OECD	40,145.9	653.1	1.63%
G7	29,112.3	535.2	1.84%

Background

Canadians enjoy an enviable standard of living, but sustaining our prosperity will depend on maintaining economic competitiveness in an increasingly challenging global context. The relaxation of trade barriers, significant advances in telecommunications, and improved transportation networks and infrastructure have created world markets for skilled workers, ideas, investment, and materials, thereby increasing competition and requiring businesses to develop new strategies to survive and prosper. Companies are re-organizing production across national boundaries and into global value chains, thus taking maximum advantage of opportunities to penetrate new growth markets. Emerging economies – notably Brazil, China,

India and Russia – are leveraging their labour, resources, and creativity to challenge traditional economic leaders.

Concurrent with these developments, significant advances in areas such as advanced materials, health, environmental sciences, and information and communications technologies (ICT) are creating major opportunities for innovative applications.

Canada's ability to prosper in this context, filled with opportunity and challenge, rests on a capacity to improve productivity and business innovation – "new or better ways of doing valued things."[2]

However, there is some evidence to suggest that Canada is not well positioned to be an innovation leader. In-depth analyses of the Canadian economy's weak performance in business innovation and productivity growth indicate that Canadian BERD intensity – a key indicator of innovation activity – is lagging significantly behind comparator countries.[3]

The Canadian economy's relatively weak BERD intensity in turn influences the country's rate of productivity growth. Reflective of a long-standing problem, Canada's annual growth rate of labour productivity averaged 0.6 percent for the 2000-2009 period, which is less than half the average of 1.5 percent among member countries of the Organisation for Economic Cooperation and Development (OECD).[4] In addition, relative labour productivity in Canada's business sector has fallen from approximately 93 percent of the United States (US) level in 1984 to approximately 71 percent in 2009 – a quarter-century of relative decline that cannot be explained by temporary or one-off factors.[5]

At the same time, as noted in Budget 2010:

> The Government of Canada provides substantial support for research and development (R&D) in the education, private and not-for-profit sectors, estimated at more than $7 billion in 2009. This includes about $4 billion in direct federal support for R&D undertaken by post-secondary researchers, the private sector, not-for-profit organizations and other research performers. . . In addition, Canada's Scientific Research and Experimental Development Tax Incentive Program is the single largest federal program supporting business R&D in Canada, providing over $3 billion in tax assistance in 2009.[6]

To ensure that federal funding is yielding maximum benefits for Canadians, Budget 2010 set out a commitment to conduct a review of federal support for R&D, aimed at improving its contribution to innovation and to economic opportunities for businesses.

Defining R&D

The *Frascati Manual* (2002) is the basis for the OECD definition of R&D, which is said to encompass 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" (p. 30).

Observers have suggested that these definitions of R&D need to be updated to capture the changing nature of the Canadian economy, given the rise of the "new economy," the shift from manufacturing to service industries, and activity in the resources and energy sectors. See the text box on page 5 for the OECD definition of innovation.

The Panel's mandate

On October 14, 2010, the Government of Canada, following its Budget 2010 commitment, established an independent expert panel to lead the Review of Federal Support to R&D. Building on the foundational work of the Council of Canadian Academies (CCA) and the Science, Technology and Innovation Council (STIC), the Panel has been asked to oversee an assessment of key programs within the government's portfolio of initiatives in support of R&D. Specifically, the Panel has been asked to review three types of federal R&D initiatives:

- Tax incentive programs such as the Scientific Research and Experimental Development (SR&ED) program.
- Programs that support innovative business R&D, including: (1) general support (e.g., the Industrial Research Assistance Program); (2) sector support (e.g., the Strategic Aerospace and Defence Initiative); and (3) regional support (e.g., the Atlantic Innovation Fund).
- Programs that support business-focused R&D through federal granting councils and other departments and agencies, including basic research performed in universities and colleges that fosters support to business R&D (e.g., the Centres of Excellence for Commercialization and Research).

The Panel will also have the latitude to consider other federal initiatives relevant to the Review's scope. However, the Review will not include research conducted in federal laboratories to fulfill their regulatory mandates or basic research conducted in institutions of higher education that is not intended to foster support to business R&D.

Three primary questions

The Panel has been asked 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-focused R&D appropriate?
- What, if any, gaps are evident in the current suite of programming, and what might be done to fill these gaps?

In addition, the Panel's mandate specifies that its recommendations not result in an increase or decrease to the overall level of funding required for federal R&D initiatives.

Reviewing federal initiatives

Consistent with its mandate, the Panel's activities may focus on any and all federal programs that have an impact on business or commercially oriented R&D. To that end, the Panel may conduct in-depth reviews of specific programs, including consideration of how they fit within the larger innovation context, which is discussed in Section 2. In undertaking this work, the Panel will take account of the important contribution of the provinces and territories to research and innovation.

The Panel's approach

In order to provide recommendations to the government by October 2011, the Panel intends to undertake the following activities:

- a review of previous reports related to the Panel's mandate;
- focused research, where appropriate;
- an assessment of specific federal initiatives that support business and commercially oriented R&D; and
- consultations with stakeholders, including the use of tools such as a potential web survey to seek views.

For further information about the topics covered in Section 1, please refer to the Reference Documents that will posted on the Panel's website from time to time, starting in January 2011 (www.rdreview-examenrd.ca).

Section 2

PUBLIC POLICY AND BUSINESS INNOVATION

The rationale for public support of business R&D

Public support for business R&D has been justified on the basis that the benefits of such activities often extend beyond individual firms, generating positive outcomes for the entire economy.

This justification is most compelling in instances where the activity is not likely to yield immediate profits or other benefits that can be limited to the individual R&D-performing firm, yet holds potential for longer-term benefits for society at large. Thus, the justification for government intervention is strongest in the case of basic research activities. The strength of the justification declines as research activities progress through the various stages leading to commercialization – i.e., from basic research through to applied research, experimental development, and commercialization. The benefits of these successive activities are progressively more likely to be captured by the R&D performer, and there is correspondingly less likelihood of "spill-over" to the larger economy.

Business innovation

Examining the effectiveness of federal support for business R&D activity requires an understanding of the wider context in which business innovation occurs. The CCA's model on business and innovation strategy is very helpful in this regard.[7] Figure 2, below, is a modified version of that model. It illustrates that a range of factors influence a company's choice to adopt innovation as a competitive strategy – a choice that compels it to seek inputs in support of its innovation activity.

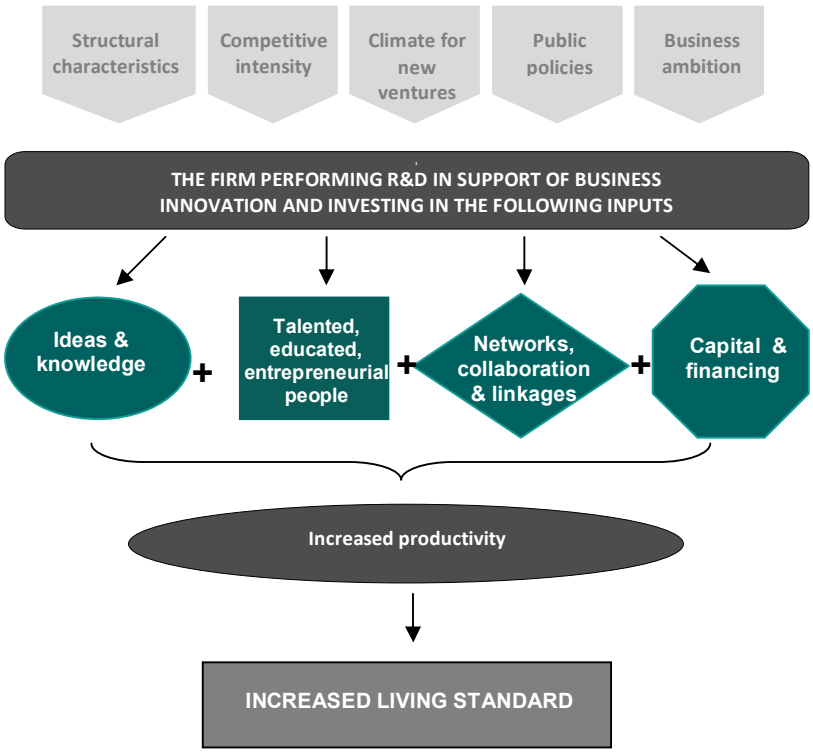
Defining innovation

The *Oslo Manual* (2005) is the basis for the OECD definition of innovation: "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" (p. 46).

FIGURE 2: Business Innovation

These factors influence businesses to choose innovation as a competitive strategy

Federal support for business R&D helps businesses develop or access these inputs, which are used in their innovation activities



Factors influencing business strategies for innovation

The CCA outlines five principal factors that influence a business's decision to compete on the basis of innovation – factors whose relative importance varies from sector to sector and according to the specific circumstances of each individual firm. As depicted in the above illustration, they are the following:

- **Structural characteristics.** For example, is the firm in a sector that is traditionally innovation-oriented 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?

- **Competitive intensity.** For example, 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 foreign market, where global competition might be intense? Is the firm subject to foreign competition in Canada?

- **Climate for new ventures.** For example, 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 and synergistic characteristics?

- **Public policies.** For example, are legal and regulatory frameworks and policies – e.g., in areas such competition, corporate taxation, bankruptcy, and intellectual property – conducive to business innovation?

- **Business ambition.** For example, what is the "corporate culture" of the firm? Is it risk-averse? Is it dedicated to expansion?

While this Review is focused on federal support to business and commercially oriented R&D, these factors help explain the overall innovation context and can have a bearing on the effectiveness of federal R&D support. This is because a business's investment in R&D will depend, first and foremost, on its prior commitment to an innovation-oriented strategy for which R&D is an important enabler – i.e., the "demand" for R&D originates in business strategy.

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, with presumably greater spill-over benefits for the economy at large. R&D incentives may even be sufficiently attractive to induce a shift in a business's strategy, moving it toward a much greater focus on innovation. Perhaps more likely, R&D incentives may induce an innovation-focused company to reallocate activity – for example, by expanding its innovation-related expenditures – to take advantage of the incentives.

Inputs to business innovation

The foregoing factors, in various combinations, generate the pressures and opportunities for innovation. Once a company chooses to adopt innovation as a competitive strategy, it seeks out the necessary enabling inputs: (1) ideas and knowledge; (2) talented, educated, and entrepreneurial people; (3) networks, collaborations, and linkages; and (4) capital and financing. Federal support for business R&D takes the form of specific initiatives that help businesses develop or access each of those four inputs. As such, understanding the larger Canadian context for each input is essential to examining the role and effectiveness of the initiatives at the core of this Review.

Ideas and knowledge

Ideas and knowledge are key inputs to business innovation. Companies can acquire ideas and knowledge – for instance, by purchasing or licensing intellectual property. They can also develop ideas and knowledge in support of their innovation strategies by performing in-house R&D. Canada's business sector lags behind comparator countries in the amount of R&D it performs relative to the size of its economy (as seen in Figure 1, above).

That said, BERD intensity varies considerably across firms, regions, and industry sectors. In absolute terms, private sector R&D spending is weighted toward a relatively small number of large firms in a limited number of sectors. However, while the vast majority of smaller businesses do not perform R&D, those that do tend to be more research-intensive than larger firms – i.e., they spend more on R&D as a percentage of company revenue. Specifically, Statistics Canada's preliminary data for 2007 indicates that R&D expenditures among the largest R&D-performing companies (revenues exceeding $400 million) represent one percent of their

revenues. In contrast, for the smallest R&D-performing companies (revenues of less than $1 million), the figure stands at almost 40 percent.[8]

From a regional perspective, there are also significant differences in BERD intensity, with the two most BERD intensive provinces (Ontario and Québec) accounting for roughly 80 percent of Canada's business R&D spending.[9] Moreover, BERD intensities vary considerably across industry sectors, with approximately 80 percent of R&D focused in sectors that account for approximately 25 percent of GDP.[10] Some of the most BERD intensive manufacturing sectors include: office accounting and computing machinery; radio, television, and communication equipment; and pharmaceuticals.

Given the integration of Canada's economy with that of the US, the evolution of the Canada-US BERD gap is of particular interest (see Figure 3, below, for a sectoral breakdown of the gap in the most recent year for which comparable data is available). The CCA conducted a sector-by-sector analysis of the gap over the 16-year period beginning in 1987. The analysis concluded the following:

> The most significant drivers of the long-run trend have been (i) a sharp reduction in the contribution of the manufacturing sector to the Canada-US gap, implying that Canada has been making some progress in manufacturing innovation; and (ii) an offsetting increasing gap in business services R&D (particularly in wholesale and retail trade). The broad shift of output and employment toward services and the application of ICT in service sectors have been occurring more rapidly in the United States than in Canada.[11]

The analysis also considered the effect of two key factors in contributing to the gap: variations in the sectoral composition of the Canadian and US economies, and 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."[12] In other words, relative to the US, there is a pervasive weakness in BERD intensity across many sectors in Canada.

The R&D commercialization ecosystem

Inventions are not considered to be business "innovations" until they achieve significant commercial penetration. Commercialization is a multifaceted, complex, and non-linear process that involves any or all of the following activities: business planning, identifying customer needs, basic and applied research, experimental development, market engagement and testing, and financing.

The roles of the various players in Canada's commercialization ecosystem are equally complex. Government laboratories conduct science in support of public policy mandates and, in cases like the National Research Council, contribute to commercially-oriented R&D. Universities, colleges, and polytechnics provide a high-quality supply of graduates to renew and enrich the labour force.[15] Supported by the federal granting councils and other funders, these institutions also perform R&D, with universities undertaking a significant amount of basic research, though basic and applied research activities are increasingly intertwined. As for R&D-performing colleges and polytechnics, research is often focused on helping companies address commercialization challenges by turning those challenges into student-led applied research problems. With respect to private sector R&D activities, most research performed by firms is applied and explicitly developed for business purposes, primarily commercialization.

FIGURE 3: BERD Intensity Gap by Sector, US and Canada, 2003[13]

	Sector share of business GDP (%)		BERD intensity (%)		Contribution to gap
	Canada	US	Canada	US	Gap†
BUSINESS SECTOR *	**100.0**	**100.0**	**1.86**	**2.90**	**1.045**
MANUFACTURING	**25.4**	**21.4**	**4.51**	**8.20**	**0.611**
Motor vehicles and parts	3.3	2.0	2.07	13.31	0.199
Phamaceuticals	0.6	1.1	25.10	21.12	0.081
Aircraft and spacecraft	0.7	0.7	16.95	28.05	0.070
Chemicals, excluding pharmaceuticals	1.4	1.5	2.24	6.68	0.068
Machinery and equipment, n.e.c‡	1.6	1.4	3.86	6.69	0.028
Rubber and plastics products	1.3	0.9	0.43	2.75	0.020
Food products, beverages, and tobacco	3.2	2.4	0.62	1.29	0.011
Electrical machinery and apparatus, n.e.c‡	0.4	0.7	5.63	4.25	0.010
Other non-metallic mineral products	0.7	0.7	0.84	1.05	0.001
Coke, refined petroleum products, and nuclear fuel	0.5	0.6	3.59	3.35	0.000
Fabricated metal products, except machinery and equipment	1.8	1.5	1.25	1.29	-0.003
Textiles, textile products, leather, and footwear	0.8	0.6	1.17	0.75	-0.005
Radio, TV, and communication equipment	0.8	1.0	43.68	33.60	-0.008
Office accounting and computing machinery	0.1	0.3	55.91	13.93	-0.016
Basic metals	1.4	0.6	2.54	1.38	-0.028
Wood, paper, printing, and publishing	5.3	3.6	2.45	1.49	-0.075
Other manufacturing§	1.3	2.0	4.16	16.10	0.259
BUSINESS SERVICES	**52.9**	**66.2**	**1.21**	**1.72**	**0.496**
Wholesale and retail trade	17.3	20.1	0.52	1.91	0.294
Other services	14.6	24.1	2.90	2.92	0.279
Financial intermediation	10.9	12.5	0.36	0.17	-0.018
Transport, storage, and communications	10.1	9.5	0.86	0.29	-0.059
MINING & QUARRYING	**9.5**	**2.1**	**0.51**	**0.08**	**-0.046**
UTILITIES	**4.1**	**3.2**	**0.43**	**0.07**	**-0.015**
CONSTRUCTION	**8.1**	**7.2**	**0.07**	**0.07**	**-0.001**

* Excludes agriculture, primary forestry and fishing and real estate services.

† Gap is defined as the "sector share of BERD intensity times sector share of GDP."

‡ n.e.c = not elsewhere classified.

§ An omnibus group of subsectors (including medical precision instruments, among others) that is not further broken down in the source database.

In a forthcoming report on business innovation policies, the OECD underlines a renewed focus in many OECD countries around the use of procurement as a tool to create demand for business innovation.[14]

Talented, educated and entrepreneurial people

A fundamental role of Canadian universities, polytechnics, and community colleges is to educate the individuals whose skills and talents are required to support business innovation, which depends on workers with a wide range of creative, entrepreneurial, commercial, managerial, technical, and scientific skills.[15] As such, Canadian businesses need people with knowledge and expertise in disciplines ranging from science, technology, engineering and math ("STEM" disciplines), through to commerce, management, the social sciences, humanities, professions, and the arts.

Canada's record in this regard is mixed. Canada ranks first in the OECD in graduation rates at the college level and places around the OECD average in graduation rates at the bachelor's level. However, it is below the OECD average in graduation rates for master's and PhD degrees.[16] This seems to be related, in part, to a weak demand for individuals with these degrees. In comparison to the US, a lower proportion of the Canadian labour force has advanced degrees in most industry sectors.[17] Moreover, relative to high school graduates, the earnings advantage of individuals with advanced degrees is less pronounced in Canada than in the US.[18] This would be consistent with other evidence that Canadian firms, on average, may not be as committed to investing in – and retaining – the high-quality talent of Canadian graduates for the advancement of their own innovation strategies.

A strong foundation of entrepreneurial and commercial skills is another vital aspect of business innovation. There is evidence that Canada faces some challenges in this respect. For instance, as noted in STIC's *State of the Nation* report, "Canada has far fewer degrees in business both at the undergraduate and graduate level than the US. Overall, managers in Canada generally have lower educational attainment than those in the US, and CEOs of our largest companies tend to have less formal business education at the graduate level."[19]

Networks, collaborations, and linkages

The successful introduction of new products and processes can benefit from collaboration among firms, governments, and the higher education sector. Businesses develop strategic partnerships to connect to global knowledge flows, share research results and R&D risks, pool skilled staff, commercialize inventions, and help access new markets. As a result, social and physical infrastructure linking collaborators and networks – and, on a larger scale, clusters – are important for innovation and commercialization.

In the case of effective collaborations between the business and higher education sectors, they depend on linking the "supply-push" of research and discoveries with the "market-pull" of firms seeking to exploit their commercial potential. In its overview of public-private collaborations, the STIC 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 groundbreaking scientific research in isolation. A growing body of research suggests that 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.[20]

One of the positive indicators of the state of public-private partnerships in Canada is that the country ranks above the OECD average in respect of the percentage of higher education expenditures financed by industry.[21] This suggests that universities and colleges are playing an important role as a resource for business innovation for certain activities and sectors. On the other hand, STIC underlines that "the OECD placed Canada near the bottom of OECD countries in terms of the proportion of businesses collaborating with universities for R&D."[22]

Although commercialization is a key aspect of public-private collaborations, networks, and linkages, it is important to note that there are many other benefits stemming from such partnerships. These include: open scientific communication and consultation; industry access to specialized equipment, facilities, and personnel (including, in particular, potential future employees); and stimulation of new research questions and directions arising from problems faced by innovative firms.

Capital and financing

Innovative start-up firms can only become sustainable businesses if they have access to risk capital enabling them to build a bridge between their innovative ideas and commercial viability. Risk capital can originate from internal earnings or from external sources of capital. With respect to the latter, risk capital can take the following forms:

- **Seed capital.** In the early or seed stages of firms' development, entrepreneurs must finance activities such as proof-of-concept, product development, and initial marketing. To do so, they often depend on informal investments provided by family, friends or "angels." The latter, who are external to the firms themselves, are typically wealthy individuals with knowledge of the business sector and relevant technologies.

- **Venture capital (VC).** In the post-seed stage of commercial validation, entrepreneurs depend on VC, which is generally provided through professionally managed funds combining the resources of a group of investors. Together with seed capital, VC is vital to the survival and growth of innovative start-up firms, which typically do not have access to traditional institutional funding, given that their projects are difficult to assess by non-specialists, that they entail greater risk than other investment classes, and that they require long lead times to commercialization.

- **Support from traditional institutions.** When firms move beyond the first stages of commercialization and seek to rapidly expand their small businesses into medium-sized or larger enterprises, there is a need to employ greater amounts of capital. In most economies, this is the role of the public markets. However, there can also be institutions – i.e., private equity, pension funds, and banks – that target this gap and provide risk capital at the expansion stage.

Without an active presence in Canada of adequate sources of capital – including the associated and critically important knowledge, experience, and mentorship of investors – there is a chance that the commercial benefits of innovations originating in Canada are exploited by firms in other countries with greater capital capacity.

In its analysis of the state of risk capital in Canada, the CCA concludes that "the limited data available on 'informal' investment sources in Canada suggest that they are much less extensive, in relative terms, than comparable sources in the United States."[23] It underlines that this has repercussions extending beyond the availability of financing, since investors, as noted, are an invaluable source of advice, mentorship, and expertise.

As for VC firms, the CCA analysis also points to a number of challenges facing Canada. For instance, it underlines the lower rates of return of Canadian VC funds relative to the US. It concludes that "the generally weak performance of Canada's VC industry is due to the fact that the industry is still relatively young, and thus has not yet developed sufficient depth of experience to select and mentor the best potential investment candidates."[24]

Capital investments in physical machinery and equipment may also spur innovation within firms, as they embody the latest ideas, technologies, and innovations developed by others. In its most recent *Report on Canada*, the Institute for Competitiveness & Prosperity shows that the Canadian business sector has persistently lagged behind its US counterpart in ICT machinery, ICT equipment, and software investments per worker. In 2009, the Canada-US gap in ICT investment per worker stood at roughly $1,500 – or almost 40 percent. The Institute underlines two main challenges that have, in the past, inhibited businesses' willingness to ramp up investments in technology: relatively high tax rates on capital investment and a lack of competitive intensity. It notes, however, that significant progress has been made on the tax front.[25] With respect to competitive intensity in Canada, it may be weakened by relatively small Canadian markets and differences across sectors in the extent of openness to international competition.[26]

For further information about the topics covered in Section 2, please refer to the Reference Documents that will posted on the Panel's website from time to time, starting in January 2011 (www.rdreview-examenrd.ca).[27]

Consultation questions

1. In addition to the R&D activity defined by the OECD, should government be funding other business activities related to the commercialization of R&D? If so, what and why?

2. Does Figure 2, the model of business innovation presented above, capture the key structural factors and inputs to innovation? If not, what is missing?

3. Regarding capital, is there an adequate supply of risk capital for Canadian firms at each stage of their growth (start-up, small, medium, large)? If not, why not? Where returns on investments are low, what are the reasons and potential solutions?

4. Regarding ideas and knowledge, do you believe it is important for Canadian firms to perform their own R&D and, if so, what do you believe are the key factors that have been limiting business R&D activity in Canada?

5. Regarding networks, collaborations and linkages, what are the main impediments to successful business-university or business-college partnerships? Does the postsecondary education system have the right capacity, approaches, and policies for effective partnerships with business?

6. Regarding the creation of demand for business innovation, what role, if any, do you believe that government should play in being a "first customer" for R&D investments in Canada?

7. Regarding talent, is Canada producing sufficient numbers of graduates with the right skills to drive business innovation and productivity growth? If not, what changes are needed? Where demand for advanced skills is low, what are the reasons and what changes, if any, are needed?

8. Can you describe whether and how your firm employs students currently enrolled in community colleges, polytechnics and universities, and what government measures could make it easier to work with students during their academic programs and to recruit them after their graduation?

Section 3

FEDERAL ROLE AND PROGRAMS

The role of government

As noted above, a primary role of government in fostering innovation is the provision of marketplace policy and regulatory frameworks that structure the climate for private-sector competition and investment. Another key role – and the focus of this Review – is providing appropriate support for business and commercially oriented R&D, whether it be through indirect tax measures, direct assistance to businesses, or funding for public sector or non-profit bodies conducting research of relevance to the private sector. Such support can be targeted to industries, activities, inputs or actors that may be considered areas of strength and opportunity, or on "weak links" of the innovation system that need to be shored up.

Governments have to be mindful that, through trade agreements, they accept obligations that discipline the provision of assistance to businesses. At the same time, they can still support areas such as R&D, regional economic development, assistance to small- and medium-sized enterprises (SMEs), and defence and security.

What we are reviewing

This Review examines the effectiveness of federal initiatives, hereafter referred to as "programs," that support business and commercially oriented R&D. This includes a wide variety of programs, of which an illustrative list is attached in Appendix 2. The programs include such diverse examples as:

- The SR&ED Tax Incentive Program, which seeks to encourage Canadian businesses of all sizes and in all sectors to conduct R&D in Canada. The largest program in the scope of this Review by a considerable margin, it provides two types of incentives for firms undertaking R&D: (1) an income tax deduction; and (2) an investment tax credit, which is partially or fully refundable for small Canadian-controlled private corporations.

- The Industrial Research Assistance Program, delivered through a network of industrial technology advisors, which provides, in addition to technical advice, non-repayable contributions to small- and medium-sized enterprises for eligible R&D costs.

- The Atlantic Innovation Fund, a regional development program for Atlantic Canada, which provides non-repayable contributions to university-led innovation projects and repayable support for business-led projects, reviewed by an arms-length advisory board.

- The Centres of Excellence for Commercialization and Research program, which supports the operating and commercialization expenses of non-profit centres of commercialization and research expertise.

- The Industrial Postgraduate Scholarships Program, which provides financial support for highly qualified science and engineering graduates, allowing them to gain research experience in industry while undertaking advanced studies in Canada.

- The Space Technologies Development Program, which formulates, implements, and manages contracted out R&D projects in response to identified needs and opportunities.

As the examples above show, federal support for business R&D is provided through a diverse array of programs. Their design features can vary considerably in relation to factors such as the following:

- **size** (program budget, number of projects supported, amount of administrative staff, and maximum assistance provided);
- **scope** (general support open to all businesses versus support targeted to industrial sectors, research areas, or regions);
- **recipient** (support provided directly to a business versus support to other organizations conducting commercially relevant R&D activities);
- **input supported** (ideas and knowledge; talented, educated, and entrepreneurial people; networks, collaborations, and linkages; and capital and financing);
- **activity supported** (basic research, applied research, experimental development, or commercialization); and
- **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).

Defining program effectiveness

For the purposes of program evaluation, the Treasury Board of Canada defines effectiveness as "the extent to which a program is achieving expected outcomes."[28]

The Review will therefore seek to examine the effectiveness of programs in increasing business R&D and facilitating commercially relevant R&D partnerships in order to bolster business innovation and productivity in Canadian firms. Since the government's ultimate objective is to increase living standards, a natural extension could be to consider the net economic benefit of individual programs.

Balance among programs

In its forthcoming report on business innovation policies, the OECD notes that the "combination of demand-side and supply-side policies is an important consideration for the policy mix. Neither supply-side nor demand-side policies are likely to be effective in isolation. Fostering innovation requires addressing the entire innovation chain."[29] The report also notes balance-related considerations pertaining to the number of policy instruments deployed. It states that the "trade-off involved here is on the one hand to have a set of instruments that is sufficiently differentiated to meet the needs of complex innovations systems. On the other hand, the policy mix needs to avoid inefficiencies arising from operating too many schemes at too small a scale."[30] As regards this Review, it is therefore important to come to an understanding of the right mix and balance among programs.

The mix between direct and indirect support measures is another important consideration. In *State of the Nation 2008*, the STIC observes that, as a percentage of GDP, government support for business R&D in Canada is among the most generous in the world. STIC further underscores that, relative to comparator countries, that support is heavily weighted toward tax incentives as opposed to direct support measures.[31] Of particular note, the US spends significantly more on direct support measures in comparison to support through tax incentives. Furthermore, Sweden, Finland, and Germany offer no R&D tax credits as incentives to companies conducting R&D, preferring direct support measures exclusively.[32]

Program delivery

Delivering programs requires human and financial resources. Resource requirements can vary depending on the form of support, the program's scope, the scale of its objectives, and other factors. That said, all programs require some measure of support for administrative activities such as the following:

- undertaking outreach activities aimed at the target community;
- providing information and assistance to program applicants;
- reviewing project proposals to ensure adherence to program criteria;
- conducting merit review and selection processes;
- performing audit, evaluation, and risk management activities; and
- reporting on progress and results.

Beyond program staff, businesses applying for support must also devote time and resources to complete application forms and proposals, meet with officials, prepare reports, and undergo audits and evaluations. Reporting, audit, and evaluation activities have been areas of enhanced emphasis in recent years due to the growing importance that Canadians place on ensuring transparency and accountability in the use of public funds.

Another consideration related to program administration is whether the program is delivered directly by a federal department or agency (e.g., the Industrial Research Assistance Program and the Strategic Aerospace and Defence Initiative) or by a third-party organization (e.g., Sustainable Development Technology Canada and FPInnovations).

For further information about the topics covered in Section 3, please refer to the Reference Documents that will posted on the Panel's website from time to time, starting in January 2011 (www.rdreview-examenrd.ca).

Consultation questions

9. With which federal programs supporting business or commercially oriented R&D in Canada do you have direct experience and knowledge? In your view:

    a. Which of these programs are working, and why?
    b. Which programs are not working, and why not?

10. If you have direct experience and knowledge of the SR&ED tax credit, what are your views in relation to the following:

    a. Does the current structure of the SR&ED tax credit encourage incremental investment in R&D? Does it free up capital to invest in other aspects of innovation activities in the firm? Does this vary by size, ownership, sector or nationality of firm?
    b. What are the strengths and weaknesses of the refundable portion of the SR&ED tax credit for Canadian-controlled private corporations and to what extent does it encourage the growth and commercial success of SMEs?
    c. Bearing in mind the improvements being made by the Canada Revenue Agency, are there additional opportunities for change to simplify the administration of the SR&ED tax credit and facilitate the applications process?

11. How could the Government of Canada lighten the administration requirements of its programs on recipients and improve outreach to business?

12. How could the Government of Canada be more innovative and responsive to meet new needs or opportunities, and try alternative service delivery-approaches in its programs?

13. Are there any gaps in the Government of Canada's support to business and commercially-oriented R&D? Do firms performing R&D in other countries have an advantage over Canadian firms because of access to programs that are not available in Canada? What would be the principal features of new programming to fill these gaps?

14. What lessons and best practices can be taken from provincial business and commercially oriented R&D programs, and how should the two orders of government align their programming?

15. Is there a difference between R&D and innovation? If yes, how are they different? Should government focus on R&D or Innovation? What should the balance be?

Section 4

CONCLUSION

The Panel is pleased to have the opportunity to undertake the Review of Federal Support to R&D. This important exercise is taking place at a critical time – a nexus of global economic instability and rapid emergence of new powers. In this context, filled with opportunity and challenge, the countries most likely to succeed are those who understand that business innovation holds the key to raising living standards. The Panel hopes that this Review, with its specific focus on the role of R&D in support of business innovation, will culminate in a set of practical recommendations for the government – recommendations that will help Canada's private sector unleash its potential and rank among the world's innovation leaders.

Providing your views

The Panel appreciates your views and advice. Please visit www.rdreview-examenrd.ca for information on how to make a submission to the Panel.

Appendix 1

LIST OF ACRONYMS

BERD	Business expenditures on research and development
CCA	Council of Canadian Academies
GDP	Gross Domestic Product
ICT	Information and communications technologies
OECD	Organisation for Economic Cooperation and Development
PPP	Purchasing power parity
R&D	Research and development
SME	Small- and medium-sized enterprise
SR&ED	Scientific research and experimental development
S&T	Science and technology
STEM	Science, technology, engineering and math
STIC	Science, Technology and Innovation Council
US	United States
VC	Venture capital

Definitions

The OECD 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, R&D allowances, reductions in R&D workers' wage taxes and social security contributions, and accelerated depreciation of R&D capital."[33]

Appendix

2

ILLUSTRATIVE LIST OF FEDERAL R&D PROGRAMS

This list is illustrative in nature and intended for discussion purposes only. Consistent with its mandate, the Panel's activities may focus on any and all federal programs that have an impact on business or commercially oriented R&D. As such, during the course of its work, the Panel may choose to examine programs that are not listed. It may also choose to exclude from examination some of the programs that are listed.

Ideas and knowledge (including programs relating to more than one input to innovation)

1. Atlantic Innovation Fund – ACOA
2. Automotive Innovation Fund – IC
3. Business and Regional Growth Program – CEDQ
4. Business Development Program – ACOA
5. Collaborative Health Research Projects – NSERC
6. Idea to Innovation Program – NSERC
7. Industrial Research Assistance Program – NRC
8. NRC Institutes and Laboratories:
   - 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 Nanotechnology
   - Institute for Ocean Technology
   - Institute for Research in Construction
   - Plant Biotechnology Institute
   - Steacie Institute for Molecular Sciences
9. Next Gen Biofuels Fund – SDTC
10. Northern Ontario Development Program – IC/FedNor

11. Proof of Principle Program – CIHR
12. Scientific Research and Experimental Development Tax Incentive Program – FIN/CRA
13. Space Technologies Development Program – CSA
14. Southern Ontario Development Program – FedDev ON
15. Strategic Aerospace and Defence Initiative – IC
16. Technology Development Program – DND
17. Western Diversification Program – WD

Talented, educated and entrepreneurial people

18. Industrial Postgraduate Scholarships – NSERC
19. Industrial R&D Fellowships – NSERC
20. Industrial R&D Internship Program – Tri-Council
21. Industrial Undergraduate Student Research Awards – NSERC

Capital and financing

22. BDC Venture Capital – BDC

Networks, collaboration and linkages

23. Agricultural Bioproducts Innovation Program – AAFC
24. Applied Research and Commercialization Initiative – FedDev ON
25. Automotive Partnership Canada – IC portfolio
26. Business-Led Networks of Centres of Excellence – Tri-Council
27. Centres of Excellence for Commercialization and Research – Tri-Council
28. Collaborative Research and Development Grants – NSERC
29. College and Community Innovation Program – NSERC
30. Contributions to FPInnovations – NRCan
31. Engage Grants – NSERC
32. Growing Forward – Canadian Agri-Science Clusters – AAFC
33. Growing Forward – Science to Support Commercialization of New Agri-Based Products – AAFC
34. Growing Forward – Supporting the Innovative Capacity of Farmers – AAFC
35. Industrial Research Chairs – NSERC
36. Industry-Partnered Collaborative Research Program – CIHR
37. Interaction Grants – NSERC
38. Networks of Centres of Excellence – Tri-Council
39. SD Tech Fund – SDTC
40. Strategic Network Grants – NSERC
41. Strategic Project Grants – NSERC
42. Strategic Workshops – NSERC
43. Technology Clusters Program – NRC
44. Technology Development Program – FedDev ON

List of departmental and agency acronyms

AAFC	Agriculture and Agri-Food Canada
ACOA	Atlantic Canada Opportunities Agency
BDC	Business Development Bank of Canada
CEDQ	Economic Development Agency of Canada for the Regions of Quebec
CIHR	Canadian Institutes of Health Research
CRA	Canada Revenue Agency
CSA	Canadian Space Agency
DND	Department of National Defence
FedDev ON	Federal Economic Development Agency for Southern Ontario
FedNor	Federal Economic Development Agency for Northern Ontario
FIN	Finance Canada
IC	Industry Canada
NRC	National Research Council Canada
NRCan	Natural Resources Canada
NSERC	Natural Sciences and Engineering Research Council
SDTC	Sustainable Development Technology Canada
SSHRC	Social Sciences and Humanities Research Council
Tri-Council	Comprises three granting councils: NSERC, SSHRC and CIHR
WD	Western Economic Diversification Canada

Appendix 3

ENDNOTES

1. OECD (2010), *Main Science and Technology Indicators* (Vol. 2010/1). Canada's business expenditures on R&D are projected to be $14.8 billion in 2010. The figures in the table have been rounded and converted to a common currency ($US) at purchasing power parity (PPP).

2. This condensed definition of innovation is borrowed from the Council of Canadian Academies (CCA). See CCA (2009), *Innovation and Business Strategy: Why Canada Falls Short,* pp. 13 and 21.

3. These analyses include the CCA report referenced above and *State of the Nation 2008,* by the Science, Technology and Innovation Council (STIC, 2009). BERD intensity is defined as business expenditures on R&D (BERD) as a percentage of Gross Domestic Product (GDP).

4. OECD productivity database (accessed December 2010).

5. Centre for the Study of Living Standards (2010), *Aggregate Income and Productivity Trends: Canada vs. the US.*

6. Finance Canada, *Budget 2010: Leading the Way on Jobs and Growth,* p. 86.

7. CCA (2009), *op. cit.*, p. 85.

8. Statistics Canada (2010), *Industrial Research and Development: Intentions 2009* (Catalogue no. 88-202-X).

9. Statistics Canada (2009), *Gross Domestic Expenditures on Research and Development in Canada (GERD), and the Provinces* (Catalogue no. 88-221-X).

10. Statistics Canada (2010), *Industrial Research and Development: Intentions 2009* (Catalogue no. 88-202-X), and Statistics Canada (2010), *Gross Domestic Product by Industry* (Catalogue no. 15-001-X).

11. CCA (2009), *op. cit.*, p. 4.

12. *Ibid.*, p. 6.

13. This is an updated version of the table presented in CCA (2009), *op. cit.*, pp. 90-91. Data was obtained from the OECD's Structural Analysis Database (STAN), 2009. For post-2003 data, comparative Canada-US coverage is incomplete.

14. OECD, *Business Innovation Policies: Selected Country Comparisons*, pp. 71-73 (report forthcoming).

15. Polytechnics are bachelor-degree granting colleges in Alberta and British Columbia (NAIT Polytechnic, SAIT Polytechnic and BCIT) that have been formally recognized by these provinces as polytechnic institutes.

16. OECD (2010), *Education at a Glance 2010*. Graduation rates "correspond to the estimated percentage of an age cohort that will complete tertiary education, based on current patterns of graduation. . .Graduation rates provide an indication of the current production of higher-level knowledge by each country's education system" (p. 78).

17. CCA (2009), *op. cit.*, p. 60.

18. Institute for Competitiveness & Prosperity (2010), *Beyond the Recovery: Report Card on Canada 2010*, p. 35.

19. STIC (2009), *op. cit.*, p. 44 (drawing on work of the Institute for Competitiveness & Prosperity).

20. *Ibid.,* p. 34.

21. OECD (2010), *Main Science and Technology Indicators* (Vol. 2010/1).

22. STIC (2009), *op. cit.*, p. 36.

23. CCA (2009), *op. cit.*, p. 8.

24. *Ibid.*, p. 8.

25. Institute for Competitiveness & Prosperity (2010), *op. cit.,* pp. 39-40.

26. For more information on issues related to international competition, see Competition Policy Review Panel (2008), *Compete to Win.*

27. The Government of Canada recently held a public consultation process aimed at informing the development of a digital economy strategy for Canada. The process covered a range of issues related to ICT. For more information, readers can refer to the following website: www.de-en.gc.ca.

28. Treasury Board of Canada Secretariat (2009), *Policy on Evaluation.*

29. OECD, *Business Innovation Policies: Selected Country Comparisons*, p. 7 (report forthcoming).

30. *Ibid.,* p. 8.

31. STIC (2009), *op. cit.*, p. 21.

32. OECD (2010), *Measuring Innovation: A New Perspective.* The OECD defines government direct R&D funding as including grants, loans, and procurement. It defines government indirect R&D funding as including tax incentives such as R&D tax credits, R&D allowances, reductions in R&D workers' wage taxes and social security contributions, and accelerated depreciation of R&D capital.

33. *Ibid.*, p. 76.