Knowledge, Innovation and Development: Enhancing Canada’s Standard of Living Through Emerging Global Partnerships

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Executive Summary

If Canada is to raise its standard of living by improving its knowledge and innovation performance, and meet increased global competition, it must strengthen its approach to global partnerships. Domestically, Canada has done much to stimulate the foundations for research and knowledge transfer over the past several decades. The establishment of various policy experiments such as the Canada Foundation for Innovation, the Canada Research Chairs, Genome Canada and the Canadian Institutes of Health Research, not to mention increased funding for university research and the National Research Council, have succeeded in creating a knowledge renaissance both within the research community and through concomitant partnerships with the private sector, governments, and the higher education sectors.

But knowledge is a universal currency; and innovation a global enterprise. Attention needs to be paid to building on Canada’s legacy as a knowledge broker and its future as a global leader in innovation in order to maintain and improve its cachet as a leading economy for trade, investment, development and R&D. Networking and ongoing partnerships at home and abroad are necessary to take advantage of new opportunities for the enhanced economic and social well-being of Canadians.

Discovery, skills and innovation know no boundaries in today’s wired and inter-connected world. They can take place anywhere, anytime. China is the world’s 5th leading producer of science and engineering doctorates. Korea and Taiwan now outrank Canada as the 5th and 6th most active foreign inventors in the US. Germany and the UK are now the top two leading scientific partners to the US, having outstripped Canada’s number one spot. India is a global leader of software development. Mexico may soon supplant Canada as the US’ leading trade partner. Brazil is challenging the Canadian global market share in aerospace products. In short, Canada is facing challenges from new and emerging knowledge producers.

Unfortunately, Canada has no strategic focus in place to meet these challenges or to tackle new opportunities in the global knowledge market. Our private sector views the world as a unipolar market: the USA; and our trade and industry associations are sorely under-resourced to address the wide array of competitive intelligence needs of their members. Our government research agencies have adopted piecemeal approaches to international S&T alliances and arrangements; this despite numerous reports suggesting solutions to the need for coordination and more targeted resources. Our higher education sector offers little incentive to scholars, and students to partner more effectively with international research institutes and train or learn abroad. Canada is not taking full advantage of the enormous international research agenda on security and counter-terrorism that can enhance global knowledge partnerships. Foreign policy, trade policy, development assistance and the innovation and skills agenda are not operating as seamless activities. Opportunities to link the significant strategic intelligence of our aid agencies, IDRC and CIDA, with foreign policy, investment and trade policies have been overlooked.
And yet, our global partners continue to invest in programmes and new policy design. Canada cannot afford a two-track approach to domestic and international innovation and S&T investments. Canada needs to continue the institutional experimentation that has begun in domestic R&D programmes with one designed to tackle the gaps at the international partnerships level. Linkages with emerging partners, including those in the developing world, have to be seen as bringing major benefits to Canada; a major effort needs to take place to assess and explain the benefits to Canadians of Canada’s linkages to multilateral and global research organizations; leadership is required by all sectors to better coordinate policies that affect international S&T linkages with new partners abroad; the Team Canada model should be modified to address new opportunities in technology, commercialization or innovation; consideration should be given to creating an international technology facility or institute to assist SMEs in taking advantage of new technology opportunities with emerging markets; Canadian universities and colleges need to address more effective strategies for linking with international knowledge partners and providing incentives for scholars and students alike and approach their learning and research from a truly global perspective.

In short, Canadian decision-makers and knowledge leaders have to think “intermestically”. Domestic and international decisions are two sides of the same coin.

The TD Forum on Canada’s Standard of Living offers a rare opportunity for Canadians to show leadership in constructing their new innovation and skills and foreign policy reviews so that they can take full advantage of Canada’s unique place in the global knowledge and innovation arena. Let’s not miss this opportunity!
The Context and the Challenge:

‘Canada in the years ahead will be challenged to maintain its place among the world’s 15 leading economies, let alone the G7; our role in the world will depend upon more than our accumulated international reputation; knowledge-based economies will dominate the 21st century: and Canada will be obliged to earn its way in that new century in large part through its intellectual capacity and global leadership.’

Prescient words indeed! When this report was written in the mid-1990s, the authors could not have anticipated the current major focus on Canada’s innovation and S&T policy. Today, as a result of the Innovation and Skills strategy laid out by the Government of Canada, the goal is to move Canada to be among the top five (from 14) economies in the world in R&D and innovation. The authors had early notions of the attempts to align Canada’s growing role in international S&T partnerships through trade, investment and research linkages. And they were witnessing the emergence of powerhouses in innovation and technology beyond the then OECD membership (such as China, Korea, Chile, Brazil, India, Singapore).

It wasn’t that long ago that Canada was itself in the same position as many of these emerging technology partners. Indeed, a paper two decades ago on why Canada resembles a developing country, outlined some of the elements of Canadian industrial R&D and innovation efforts that hampered Canada’s rise as a major innovation player (e.g. a rural economy based on agriculture and natural resources driven by exports of raw primary products; local industry characterized by manufacture or assembly of products developed elsewhere; little industrial demand for R&D and poor contact between R&D institutions leading to little transfer of research to development in industry) (See Annex A for a typical example of a S&T strategy in developing countries)

Obviously, things have changed. While one can argue that there is always room for improvement, the Canadian economic and social policy experiment has succeeded in bringing Canada’s standard of living up to world levels in part as a result of reforms and changes to its innovation, skills and R&D regimes. These have taken time, but they have led to some significant change. Canada has accomplished this renaissance through attention to policy integration initiatives, economic and fiscal reforms, global partnerships in trade and science, and a great deal of learning-by-doing or experimentation.

Despite reforms, change remains the challenge, and knowledge is the global currency. Constant networking and ongoing partnerships at home and abroad are necessary to take advantage of new opportunities for enhanced economic and social well-being of Canadians. In this global age of networking, partnerships, knowledge breakthroughs and the rapid spread of information technologies, it is critical for a mid-sized power like Canada to ensure it maintains its cachet as an international broker in peacekeeping, development assistance, reconstruction and health. Canada’s first-place position in the Human Development report produced by the United Nations over the past several years is recognition that Canadians quality of life depends on global human security, prosperity and development. This can only be maintained by harnessing and utilising
responsibly the power of Canadian innovation and knowledge in the broadest possible international context.³

In research and science, Canada has a role to play as well since the nation is only responsible for about 4.8 percent of the world’s pool of science and 2 percent of its technology. In this arena, Canada cannot assume that the only knowledge that counts for the welfare of its citizens is that to be found in the industrialized world. Our relationships, indeed our interdependence, with developing countries, have demonstrated that Canada benefits as much from S&T cooperation and knowledge transfer as do developing nations.⁴ As one example, Canada has been supporting the Consultative Group for International Agricultural Research (CGIAR) through CIDA and IDRC. This network of 16 research centres works closely with the agricultural research systems of developing countries, and has been responsible for developing improved crop varieties and farming systems. Benefits have also flowed back to Canada; the average yield and genetic diversity in the most important wheat varieties in Canada have both increased through the incorporation of material from the CGIAR centres; and chickpea production in Saskatchewan has grown from 12 farmers on 200 acres in 1995 to over 3,000 farmers on 250,000 acres today, thanks to the research work in CGIAR.⁵ Similarly, Canada’s financing of research that helped eliminate spruce budworm infestations in the 1970s and 1980s via the International Institute for Applied Systems Analysis, an Austrian-based international research consortium of 16 countries, has led to savings of millions of dollars for our forestry community.⁶ In short, participation in international research ventures leads to significant leverage effects that no one country can achieve on its own.

These and other examples signal the excellence of research in Canada, with many countries assessing Canadian expertise in these and related areas⁷. Canada’s membership in global clubs is second to none. Its ability to leverage its strengths in such areas as telecommunications and health research will be an important asset to its global leadership, and in improving the standard of living for Canadians. Indeed, the leadership of Canada in the G8 Digital Opportunities Task (DOT) Force is a good example of bringing business and civil society together to advance development and reduce poverty through the use of information communications technologies. The DOT Force has designed a network that links together national governments, private sector bodies and international organizations to provide developing countries with access to expertise on the laws, policies and regulatory frameworks necessary for development.

Many of Canada’s trade partners (an important source of income for Canadians) were aid recipients such as Singapore, Korea, China and Chile. These countries and others have been highly successful in expanding their high tech trade exports (see Annex B of trade, GDP, and export growth by technology category among selected emerging economies)⁸ Investments in research and innovation have changed the dynamics of the standard of living in these countries as well, and Canada has benefited from these emerging trade relationships. One has only to look at the several Team Canada visits organized by the Prime Minister and Premiers of Canada with the business and education communities to Latin America and Asia to have a sense of the impact on opening markets for technology and investment. Canada’s strength in consulting engineering
has led to significant partnerships in the developing world to address needs in such areas as water supply and water quality; environment, health systems; and energy transmission. Private sector recognized leadership in information technologies has led to productive arrangements in China, South Africa, Jordan and Costa Rica for example. The work of the International Development Research Centre in reviewing and recommending S&T strategies of South Africa, Vietnam and Chile, for example, has led to significant changes (and ultimately benefits) in those countries’ approaches to trade, investment and innovation.9

Science and technology investments, along with education reforms are often seen as the first forays into stronger, more stable, trade relationships with emerging economies. (see Annex C on policy characteristics and differences between S&T and innovation among scientifically-advanced and scientifically-weak countries). It is no coincidence that S&T arrangements are often used to bridge political differences. IDRC’s early efforts with the South African ANC party served as a platform for larger and more expanded role in economic development, social reform and technology investment when the Mandela administration came into power. Witness for another example, Secretary of State Powell’s endorsement of work by the US National Academies of Science research projects with selected Arab states,10 or the role of scientists in normalizing U.S.-China relations in the 60s and 70s11. A recent example of enhancing peacebuilding through research cooperation is the support by UNESCO of the international synchrotron radiation centre proposal in Jordan (baptised SESAME). To launch this facility, 13 countries, including Iran, Israel, the Palestinian Authority and Pakistan have established an Interim Council with pledges of $50K per year for three years. Diffusion and dissemination of S&T are often used for aid relief (e.g.; the use of satellite imagery and agricultural technology to address relief efforts in Afghanistan) or in addressing health problems (e.g.; water quality and supply, monitoring of emerging infectious diseases); or in tackling international security issues (e.g.; the bioterrorism cooperation research efforts; the trade issues surrounding genetically modified foods, technical standards or intellectual property rights).12

In short, the pervasiveness of knowledge, the mobility of skills, and its boundary-less nature make it a highly productive tool for improving the economic and social conditions of citizens around the globe. In the Canadian case, how can this be turned to our advantage, and in particular, how can we use the emerging networks of knowledge systems around the globe to strengthen Canada’s long-standing brokerage role with the developing world?
Some Strategies to Consider: A Roadmap through Knowledge Partnerships

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the opportunities and need for international scientific cooperation will grow, especially as 
nations become more tightly integrated through the expansion of large technological systems, 
and as interdependence unavoidably advances. The need for cooperation will also be 
increasingly manifested as global-scale threats become more widely evident.``

While Canada has a fairly well-articulated federal strategy for S&T and innovation, its no secret 
that Canada has no formal policy on international S&T or research partnerships. In fact, lack of 
such a strategy is hampering our image as a serious and reliable partner.14 Despite the well-
focussed domestic strategy, the Canadian approach to using international S&T networks is to 
muddle through in an ad hoc fashion, often with little regard to focus, strategy or benefit. The 
1994 review of Canada’s foreign policy argued that domestic policy is foreign policy and foreign 
policy is domestic policy—today, little attention is paid to this sage adage. Domestic and foreign 
policy remain two solitudes. Unlike in other countries where an “intermestic”15 approach can be 
discerned, Canada’s resources devoted to international S&T reporting and intelligence are thin 
with only 6 full-time S&T attachés posted abroad. Less than $70M annually goes to international 
S&T activities through bilateral or multilateral agreements (in contrast, the US alone spends over 
US$100M on its scientific partnerships with Canada and Mexico; Korea has 8 S&T attachés, 
13 overseas local labs of Korean universities in 5 countries, and 14 international R&D 
cooperation centres in 6 countries). And of course, since Canada is a G-8 nation, its membership 
in various multilateral clubs strains resource commitments (e.g. security for the G-8 meeting in 
Kananaskis amounted to $300M, almost one-third of the Government’s commitment to 
assistance for Africa).

The result of this inattention to international strategy and knowledge opportunity has been, as 
one observer has noted, “A crazy quilt of poorly-defined responsibilities, inconsistent strategies, 
and inadequate resources, frequently knotted up and occasionally knitted together by ad hoc 
mechanisms of coordination.” The same can be said for many countries and international 
orizations. There is no monopoly on wisdom when it comes to fast-paced technological 
change outflanking policy reform. The World Bank, the WTO, and the regional development 
banks around the globe are examples of organizations struggling with how to incorporate the 
changing nature of knowledge into their respective research strategies16. So too with the private 
sector and its trade associations. In the US, the Council on Competitiveness has recently 
Established a senior position for global and international affairs. In the Western Hemisphere, a 
grouping called the Council of Industrial Research Associations of the Americas has been 
established to strengthen ties and exchange good R&D practice among industries in the region.

The ACST report noted above from the Canadian government explicitly excluded the key 
development agencies from their remit arguing that they could not do justice to the scale of 
operations in these organizations. IDRC and CIDA are major funders of international S&T 
activities. And yet, the UK Prime Minister Tony Blair has argued that he is concerned about the 
technological competition emerging from Bangalore, India; this despite introducing a fresh
investment spurt into the UK trade, technology and investment strategy, including doubling the UK S&T network abroad.

The spread of knowledge is indeed growing. Distributed research efforts are becoming more commonplace, with regional and sub-regional cooperation on the rise. A growing share of the world’s scientific and technical publications have coauthors located in different countries. Foreign sources of R&D funding and international strategic alliances are the norm. For some countries, such as Canada, these constitute significant sources of industrial R&D (20% of total industrial R&D). Patents filed in multiple countries for the same invention have grown almost exponentially, signalling the increased globalization of markets and intellectual property.

Among the developing world, from 1986-1999, output of scientific publications was largest in Latin America. While this increase was admittedly from a low base, it does reflect a trend of growing effects of building S&T and innovation capacity in this region. North Africa (including Algeria, Morocco, Tunisia) and the Middle East region (including Iran, Jordan and Syria) increased scientific output by 20 percent. In Asia, output nearly doubled over the same period with China, South Korea, Taiwan, Singapore and Hong Kong leading the way. China is now the world’s fifth leading producer of science and engineering doctorates.

Interestingly, during the same period, Canada has been displaced as the leading scientific partner for the US, with Germany and the UK now the top two. In part, this is a reflection of the changing nature of economic and political interests among the two countries; but it is also a signal that Canada is perhaps diversifying its portfolio of cooperation among other countries, including those of the South. Indeed, of the five countries that show an increase in collaboration with Canadian researchers of more than 200% between 1990-1999, four are in the developing world (Brazil, South Korea, Hong Kong and Singapore).

Another indicator of the spread of knowledge is in the area of patents. These data can provide useful markers of technical change and can serve to measure inventive activity. On a comparative basis, they can also serve to provide information on the technological competitiveness of certain countries. While the US is far and away the world’s leading player, here too the spread of invention is marked. Patenting by foreign inventors is on the rise, representing 45% of all patents issued in the USA in 1999. While Germany and Japan dominate in this category, other players are arriving, including Taiwan and Korea. Indeed, since 1998, these latter two countries have surpassed Canada to become the 5th and 6th most active foreign inventors in the USA. In short, the research and innovation landscape is changing and opportunities exist for enhanced collaboration beyond the traditional industrialized S&T partners.
Benefits: Why Partnerships Matter

“The network age alters the capacity-building challenges for developing countries. Capacity---meaning well functioning institutions and policies, skilled people and leadership with vision---matters more as the shift to the network age has increased the rewards and penalties for both individuals and organizations in terms of their knowledge and competence.”

As a result of these and other signals, a new knowledge paradigm is emerging that requires special attention if Canada is going to turn this to its advantage both at home and in terms of its critical role as a knowledge broker with the developing world. A conscious strategy will need to be developed to work more closely with integrating foreign policy, development and domestic S&T approaches. While one could argue that the new CFI (one-time) funds for international research infrastructure support address one of the recommendations, the ACST report on Canada’s international S&T role remains essentially on the shelf. Meanwhile, various departments and agencies have taken it upon themselves to fill a vacuum.

The Canada Foundation for Innovation has established two $100M funds to strengthen international research cooperation and joint ventures with leading scientists, including support for a Canada-Kenya research laboratory to provide researchers in Canada and collaborators in Nairobi, Washington and Oxford with a state-of-the-art facility for research on highly infectious diseases such as AIDS and hemorrhagic fever.

Genome Canada, a $300M initiative launched in 2000 to promote genomics research in five strategic growth areas, has encouraged linkages with partners in Spain, Sweden and Germany, and has supported an initiative based at the University of Toronto to address issues surrounding a growing genomics divide in the developing world.

The Social Sciences and Humanities Research Council of Canada has opened the door for the participation of foreign scholars in its research programmes. Its support for multidisciplinary research covers a variety of topics addressing issues on globalization, immigration and citizenship.

ACST Recommendations on Canada’s Role in International S&T (2000)

1. Create a new fund to enable access to international S&T programs open to academic, private sector and government

2. Expand the Industrial Research Assistance Programme of the NRC to support international endeavours of SMEs

3. Create an Executive Committee responsible in providing focus for Canada’s international S&T activities and to coordinate international activities
The Canadian Institutes of Health Research, along with Health Canada, the Canadian International Development Agency and the International Development Research Centre have launched a Global Health Research Initiative designed to develop strategies for responding to the health priorities and agendas of poorer nations.

The National Research Council of Canada has fostered research cooperation with agencies in Taiwan, Singapore and Thailand and is championing the efforts of the APEC R&D Leaders Forum for enhanced cooperation in technology foresight, research and technical standards.

The list is longer. Suffice it to say that in the absence of an overriding strategy, efforts are being developed to take advantage of opportunities for collaboration and cooperation. At the heart of this approach is the recognition of a new paradigm for partnerships around the globe.

What are this new paradigm’s characteristics?

1. **An understanding of the value of global partnerships and networks.** Knowledge is an intangible asset requiring investment in skills, institutions and governance. Capitalizing on all elements of these is a hallmark of an effective knowledge system. Since a good deal of Canada’s public research strength resides in the higher education system, the extent to which Canadian universities are strategically linking their research capabilities to those of both the developed and the developing world will determine how effectively research results can lead to social or economic benefits. For example, the work of the new collaborative research initiative on globalization and autonomy based at McMaster University will be examining diasporas or transnational communities, and cultural minorities with special attention paid to indigenous peoples. At the crux of this research is an ability to provide individuals with the tools to control and harness new forces of globalization in order to secure their autonomy (i.e.; the capacity to shape the conditions under which they live). Another innovative approach can be found in the establishment of the $125M fund to encourage promising young students to undertake advanced research in the humanities and human sciences. Through the Pierre Elliott Trudeau Foundation, students will be exposed to such global issues as human rights and social justice, responsible citizenship, and humans and their natural environment.

2. **A re-visiting of research excellence and ‘‘good’’ practice.** Much effort has gone into applying Western scientific standards to research performance. In certain cases, it is not clear that countries, institutes, or firms can always meet these standards. Flexibility is required if partnerships are to be developed that respect and appreciate cultural and institutional specificities. A change in attitude from ‘‘best’’ to ‘‘good’’ practice is perhaps required, since perfection is a relative state. For example, the focus on the value and relevance of indigenous knowledge in certain contexts needs to be taken into account. In this light, the National Science Foundation has adopted two standards for review in assessing joint proposals with the South: merit, AND broader impact of the research. As
Maureen O’Neil, President of the IDRC has put it, ‘hedging and risk-averse approaches must not trap Canadian researchers within one definition of research excellence, blinding them to other less familiar approaches to knowledge creation and capacity building while blunting the potential to create exciting new knowledge.’

3. The growing role of multidisciplinary research and distributed knowledge networks has forced a re-think of how to conduct research. Centres of excellence, joint research chairs, technology clusters, and regional cooperation mechanisms are now the norm. As well, the new international security agenda will almost certainly have an impact on how countries approach S&T collaboration in the future. Frameworks of knowledge production including indigenous knowledge, social sciences and humanities, natural and physical sciences, engineering, environmental and health sciences are increasingly required in addressing economic and social equity issues. The explosive development of indicators and report cards addressing trade and development, human development, ICT, international S&T and innovation activity, are testimony to the need for better integration of knowledge and policies.

4. A need to re-assess strategies of funding and governance mechanisms for S&T partnerships with the developing world. As the world has become more interdependent and linked through trade, investment, ICT and knowledge transfer, it is increasingly clear that organizational structures designed for a certain era may need to be re-thought, at least in terms of how programmes are delivered and policies shaped. In Canada, for example, the experimentation that has led to the Canada Foundation for Innovation, the Canada Research Chairs, the Networks of Centres and Excellence, the Canadian Foundation for Climate and Atmospheric Sciences, the Canadian Institute for Advanced Research, Genome Canada, and the Canadian Institutes of Health Research came as a result of perceived and glaring gaps and the need, in part, to create something new and flexible rather than build on existing structures. Similarly, at the international level, efforts are underway to re-assess how knowledge can play a larger role in S&T institutions. The World Bank is re-assessing its S&T strategy as part of its wider objective to strengthen S&T partnerships for development. USAID, some of the regional development banks, UNESCO, IIASA, and WHO are but some of the organizations now re-visiting their approaches in support of S&T. In some instances this is being done through a more focussed approach involving selective bilateral assistance based on specific criteria; in other cases, it is being driven by broader changes to the research environment. The issue here is: does one require new institutional approaches or experiments to address the changing research landscape for S&T and development?

5. New rules of the game are affecting the movement of people, knowledge and technology; ultimately this will affect the scale and scope of global partnerships. As Ben Ngubane, South Africa’s science minister has argued: ‘societies that are not involved in the production of new knowledge and technologies are poorly equipped to make choices about the technologies they transfer and adopt from the developed world.’ More than
this, in order for true partnerships to develop, countries need to be fully implicated in the changing nature of trade through the WTO and negotiations over such issues as intellectual property rights, biodiversity, food and health safety and technology transfer and technical standards. Equally, on the finance side, as a small open economy, Canada benefits from a more stable international financial system--efforts to build a so-called new financial architecture are in its interests. These are driving the world economy, and developed and developing countries alike must be active here.29

6. The emergence of enabling technologies such as ICTs, genomics and life sciences, and new materials or nanotechnology, has had a considerable impact globally. Many OECD countries have introduced significant funding and strategic approaches in these areas; the developing world is quickly being left behind. The digital divide, the genomics chasm, the knowledge gap are all the new buzz-words designed to instill an urgency to address these gaps. While there remains a considerable, and legitimate debate over the value of investments in these technologies by the developing world, 30 it is clear that in order for developing countries to equip themselves properly to negotiate technical cooperation agreements and global partnerships, a basic capacity in skills, institutions, and emerging technologies is required. While there are growing examples of niche capabilities in certain countries, how and to what extent the South can equip itself with the 21st century tools of knowledge production and requisite social, political and institutional capacities to address these remains in some question.

7. The growing importance of the science-society interface is being registered globally. Much has been said about the need for a new social contract between science and society, given the dynamic changes to knowledge. Increasingly, the ability of decision-makers to use sound science advice for change is being challenged by the sheer explosion of knowledge. Knowledge is overtaking policy change. Many governance and advisory structures are simply not up to the task. More needs to be done to address the effective communication of science with the public and the understanding of the public for the research community. The trade environment is also being shaped by the increasing use of sound science, as negotiators invoke scientific rationales for movement or non-movement of goods and services (i.e; witness the use of the precautionary principle on food safety; or the use of technical standards as non-tariff trade barriers to selected goods). Even a new field of “sustainability science” has emerged to address questions of impacts of research on the environment. At the heart of this debate comes a warning for all societies--best put by: “Neither technology nor economics can answer questions of values. Is our path into the future to be defined by the literally mindless process of technological evolution and economic expansion, or by a conscious adoption of guiding moral precepts? Progress is meaningless if we don’t know where we’re going.”31
Solutions to the Global Knowledge Challenge for Canada: Leadership will be the Key

`Canada will need scientists, doctors, technicians, teachers, business people, and others who will be welcomed in the South” They will have to be functional in the South. And their knowledge will have to be as good as or better than, whatever else is on offer. This can evolve only through investing in Canadian knowledge and Canadian capacity and through the encouragement of direct working relationships over time. ‘’

As we have argued, Canada will witness a major challenge in the coming decade to its innovation and skills challenge. It will be more than a domestic issue. It will be affected by massive structural, labour and trade adjustments taking place elsewhere, both in the developed and developing world.(i.e. the rise of Mexico as the US’ leading trade partner in the coming decade). It will be transformed by the advances to knowledge that are cropping up from all regions of the globe. It will be affected by the ability to integrate research for policy change through effective leadership from our decision-makers It will be challenged by maintaining a balance between social, environmental, ethical and economic choices. An emerging paradigm of global partnerships, networks and knowledge production will impact Canada. Can it be managed? Can we construct a new approach to this better integrating our foreign, trade, development, innovation and skills strategies?

Fortunately, Canada has several strategic assets: a) a redefined and progressive innovation approach; b) a multilingual, multicultural opening to the world; c) a sound fiscal and stable regulatory environment; d) key research and technology strengths with global outreach; e) a strong record in using its G-8 status to open up new and responsible relationships with emerging and developing economies in health, environment, and S&T. The key will be to strengthen our image to existing and new partners around the globe. Trade options must be improved; investment opportunities must be enhanced; and our S&T strengths and expertise need to be turned to more effective advantage.

Given this optic, what specific recipes can be considered in the context of the Forum on Canada’s Standard of Living?

I. Clearly, more attention has to be paid to the ACST report on Canada’s role in international S&T and its arguments. The innovation and skills strategy papers of the Government pay scant attention to its recommendations. The research and industry communities has been consulted extensively on what needs to be done in this area (and a similar fate occurred to the 1995 NABST report on how Canada’s international S&T activities can benefit SMEs). Effort needs to be taken to build on the work of the development agencies in promoting Canada’s expertise and leadership in international cooperation. The current review of Canadian foreign policy offers a rare opportunity to better integrate international knowledge partnerships as key elements of our diplomacy and trade activities abroad. More resources to posts and missions abroad to address opportunities in technology and research partnerships need to be considered, including
activities of IDRC and CIDA. Training of new personnel and heads of missions on key aspects of Canada’s international and domestic innovation efforts must take place to ensure an enhanced appreciation of the benefits of such collaboration.

II. Canada’s scientific and technical involvement in various multilateral agencies should be re-examined to determine the impact and benefits of these arrangements. Most Canadians have little idea of what Canada is gaining from its participation in such organizations as APEC, OAS, OECD, NATO, the G-8, the Commonwealth and la Francophonie to name a few. These are important alliances for Canada for many reasons; but the rationale is rarely clearly laid out, especially from a knowledge partnerships point of view. A major review and assessment of these memberships is in order to stress the social and economic benefits for Canadians.

III. On the bilateral front, Canada has periodically reviewed the value of certain S&T agreements; but the nature of these arrangements is shifting. As we have seen, Canada is looking more carefully at new, emerging economies such as Brazil, Mexico, China, India and Korea. Canadian aid to these countries has helped shape their rise as strong global players. It may be time to consider a new mechanism to help shape our strategic interests with these, and other economies. An international technology and R&D partnership programme or institute should be considered along the lines of the Canada-Israel Industrial R&D Foundation which has functioned well over the past several years. The idea here would be to establish a modest program facility to foster and facilitate bilateral technology partnerships among Canadian firms or research organizations and selected foreign firms or research institutes. Each participating country would contribute half of the costs of the bilateral entity over a selected period of time that would operate at arm’s length from government. Because international R&D partnerships are important sources of new knowledge and are key avenues of access to global markets, such an initiative could provide Canadian SMEs in particular with much needed assistance in new markets that have strong technological opportunities.

IV. The model of the Team Canada visits connecting trade, investment, innovation and development needs to be re-assessed given the growing interest in new foreign partners. With the announcement for example of the new Canada-Africa Fund following the G-8 Summit in Kananaskis, it might be worthwhile to consider a targeted visit by our higher education, research, and technology organizations to build on the momentum of the NEPAD initiative with Africa. Similar visits to selected countries in the Middle East might also be considered in the near future, all with the objective of using knowledge to strengthen partnerships.33

V. Finally, it may be worthwhile to reconnect the Canadian higher education system to the world. Canadian universities are key players in Canada’s innovation system and they are our frontline of intelligence and skills for linkages around the globe. The Association of Universities and Colleges of Canada (AUCC) is actively pursuing, with the IDRC, a
re-examination of the scale and scope of partnerships in the developing world; but more can be done. Our public education research institutions have a strong role to play in this. After all, research is a global endeavour requiring engagement, and efforts need to be encouraged to have a truly global outreach. Fortunately, there are signs that this is happening with prodding from the granting councils and the CFI, but these and other efforts need to be connected to the full set of trade, investment and technology initiatives being put in place through the innovation and foreign policy reviews. Leadership from the public and private sectors will be a sine qua non for a successful campaign.

Endnotes:


3. For an economic argument on the importance of returns to the society from investing in R&D, see “Why and How Governments Support Research and Development, “background paper to the Department of Finance and Revenue Canada, December 1997

4. Recent evidence of this shift is the Canadian Government’s new attention to S&T arrangements and forthcoming roundtables with Korea, Brazil and Mexico, expanding the traditional role of bilateral agreements. Canada’s participation in astronomy projects such as the Gemini telescopes involve cooperation with Argentina, Brazil and Chile in addition to G-7 countries, and has been a boon to Canadian construction and engineering companies who have over 80% of the global market for telescope domes.

5. As a response to the Kananaskis G-8 Africa Plan, Canada has recently added $40M over three years for Africa-related programming through the CGIAR

6. For more, see “Canada’s Interests in IIASA,“ a report prepared by Mullin Consulting Ltd, to Industry Canada, September 1994. A founding member of IIASA in 1972, Canada has since terminated its membership.

7. Foreign trade and technology delegations from the developing world have found considerable interest in replicating such programmes as the National Research Council’s Industrial Research Assistance Programme which assists SMEs with technical support; and Canada’s SchoolNet programme that has expanded to other countries keen to strengthen the on-line content of school curricula.
8. It is easy to forget that Korea’s GDP in 1960 for instance was that of a developing nation; today, its GDP per capita is 20 times that of India’s and its determined efforts on the R&D front have placed it 6th (just after the USA) in terms of R&D expenditures as a share of GDP. See Carl Dahlman, *Korea and the Knowledge-Based Economy: Making the Transition*, World Bank Institute, November 20, 2000


10. See remarks by Secretary of State Colin L. Powell at the National Academy of Sciences Annual Meeting, Washington, D.C., April 30 2002


12. For an overview of the effects of S&T issues on foreign policy, see National Research Council, *The Pervasive Role of Science, Technology and Health in Foreign Policy: Imperatives for the Department of State*, National Academy Press, 1999


14. This point was made at several times during the consultations for the report of the Expert Panel on Canada’s role in international science and technology. See *Reaching Out: Canada, International Science, and Technology, and the Knowledge-Based Economy*, Advisory Council on Science and Technology, 2000

15. The word ``intermestic`` a combination of ``international`` and ``domestic``, was coined by Robert W. Rycroft in , ``The Internationalization of U.S. Intergovernmental Relations in Science and Technology Policy, `` *Technology in Society*, 12, pp.217-233

16. For an early attempt by Inter-American Development Bank to assess and develop a new strategy for funding S&T, see Roman Mayorga, *Closing the Gap*, IDB 1997. Estimates by the World Bank of total spending in 2001 by aid agencies on bilateral and multilateral S&T projects and activities amount to approx $1.57 B or 0.00540% of world GNP

17. Tony Blair,``Science Matters``, remarks to the Royal Society of London, 23 May 2002


19. Analysis provided by the Association of Universities and Colleges of Canada

21. Actually, this is the third time the government has tried to address coordination and integration issues with Canada’s role in international S&T. Two previous reports in 1995 (National Advisory Board on Science and Technology, and in 1982 put forward suggestions in these areas. See Paul Dufour, Taking the (Right?) Fork in the Road: Canada’s Two-Track Approach to Domestic and International S&T, Science and Public Policy, (forthcoming)

22. For a more complete listing, see National Research Council of Canada, Funding Source Guide to support international S&T collaboration by Canadian Government scientists, April 2002

23. See J. Knight, Progress and Promise: The AUCC Report on Internationalization of Canadian universities, Ottawa, 2000

24. Even Canada goes through these considerations. See, for example, the latest report from the House of Commons Committee on Industry, Science, and Technology, Canada’s Innovation Strategy: Peer Review and the Allocation of Federal Research Funds, May 2002

25. Maureen O’Neil, “We may need a new definition of ‘research excellence’,” University Affairs, May 2002. In a related commentary by Rod Nichols (former President of the New York Academy of Sciences), he argues that “The point is that Western or Northern criteria for originality simply are not the values in, say, international S&T cooperation for coping with natural disasters, or for building up fisheries,” see “The U.S. and International Structures for Cooperation in Science and Technology: Renewal or Not?, AAAS Annual Meeting, Boston, 18 February, 2002

26. See for example, RAND, Science and Technology Policy Institute, ”Linking Effectively: Learning Lessons from Successful Collaboration in Science and Technology,” documented briefing, by Caroline Wagner et al.; April 2002

27. While Canadian research agencies have initiated several joint projects in a number of areas, the US will clearly dominate this agenda: see National Academy of Sciences, Making the Nation Safer: The Role of Science and Technology in Countering Terrorism, 2002

28. See for example the World Health Organization’s attempt to address the growing genomics divide in its recent report on Genomics and World Health; or the NEPAD’s launch of an S&T Commission; Science and Technology for Human Development in Africa, a proposal to develop an action plan and strategy for the New Partnership for Africa’s Development, (draft, February 2002)
29. As an example, see the efforts of the Crucible Group to bring together various stakeholders from many countries to address policy issues that could imperil the availability of plant genetic resources for world food security and for agricultural development. See Seeding Solutions: Vols1-2; International Development Research Centre, International Plant Genetic Resources Institute, and the Dag Hammarskjöld Foundation, 2000-2001


32. Connecting with the World, ibid

33. See for example the review sponsored by the IDRC and Jordan’s Higher Council for Science and Technology of Jordan’s S&T and innovation system; (forthcoming)
### Annex A: Summary of Basis for a S&T Strategy

#### SUMMARY OF BASIS FOR A SCIENCE AND TECHNOLOGY STRATEGY

<table>
<thead>
<tr>
<th>S&amp;T PROBLEMS IN COUNTRIES OF LAC</th>
<th>SUGGESTED OBJECTIVES FOR THE STRATEGY</th>
<th>TYPICAL TOOLS THAT COULD BE USED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source research and development (R&amp;D) capacity</td>
<td></td>
<td>Funds for peer review based competitions of R&amp;D projects</td>
</tr>
<tr>
<td>Little linkage between R&amp;D and development needs</td>
<td></td>
<td>Funds for high level training of human resources</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strengthening and institutional infrastructure</td>
</tr>
<tr>
<td>Unbalances between S&amp;T supply and demand</td>
<td>Ensure a closer matching of S&amp;T supply and demand</td>
<td>Technology development funds for enterprises</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Support for joint R&amp;D projects and exchange of personnel between universities and users</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Linkage requirements in funds that support supply</td>
</tr>
<tr>
<td>Low productivity due to lack of technological diffusion</td>
<td>Promote the dissemination of existing technologies which are appropriate for the conditions of each country</td>
<td>Support for S&amp;T services, especially those of information and extension</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adaptation of foreign technologies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Development of several technological centers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Middle level technical training and professional up-dating</td>
</tr>
<tr>
<td>Little competitiveness due to insufficient technological innovation</td>
<td>Encourage firms to engage in R&amp;D</td>
<td>Technology development funds for enterprises</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Risk capital funds</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fiscal and legal incentives (intellectual property rights)</td>
</tr>
<tr>
<td>Weak base of qualified human resources</td>
<td>Remedy shortages of qualified human resources</td>
<td>Funds for high level training of human resources</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strengthening of research and post-graduate programs in universities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Middle level technical training and professional up-dating</td>
</tr>
<tr>
<td>Absence or weakness of national innovations systems (NIS)</td>
<td>Coordinate public policy and create incentives for system-wide collaboration among NIS stakeholders</td>
<td>Stakeholders dialogues</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Policy studies and identification of key linkages</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loan conditionalities and requirements</td>
</tr>
<tr>
<td>Little collaboration among countries of the region</td>
<td>Support international cooperation in S&amp;T</td>
<td>Regional technical cooperation projects</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Support for cooperation among countries through components of national programs</td>
</tr>
</tbody>
</table>

### Annex B: Trade, GDP, and Export Growth by Technology Category

#### Table 8: Trade, GDP, and Export Growth by Technology Category

<table>
<thead>
<tr>
<th>Country</th>
<th>Trade as % of GDP 80-85</th>
<th>Trade as % of GDP 95-00</th>
<th>GDP Growth Rate 80-85 (%)</th>
<th>GDP Growth Rate 95-00 (%)</th>
<th>Manuf. Exports Growth 1980-1995</th>
<th>High tech as % of manuf. exports 1985</th>
<th>High tech as % of manuf. exports 1995</th>
<th>Med. tech as % of manuf. exports 1985</th>
<th>Med. tech as % of manuf. exports 1995</th>
<th>Low tech as % of manuf. exports 1985</th>
<th>Low tech as % of manuf. exports 1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thailand</td>
<td>49.8</td>
<td>49.6</td>
<td>3.0</td>
<td>15.5</td>
<td>192.0</td>
<td>4.7</td>
<td>34.8</td>
<td>22.0</td>
<td>20.5</td>
<td>25.4</td>
<td>25.3</td>
</tr>
<tr>
<td>China</td>
<td>26.7</td>
<td>34.2</td>
<td>3.9</td>
<td>7.8</td>
<td>131.4*</td>
<td>5.2</td>
<td>17.4</td>
<td>12.2</td>
<td>19.8</td>
<td>43.7</td>
<td>51.8</td>
</tr>
<tr>
<td>México</td>
<td>21.2</td>
<td>49.9</td>
<td>-2.3</td>
<td>4.2</td>
<td>250.0</td>
<td>9.0</td>
<td>27.7</td>
<td>55.4</td>
<td>45.2</td>
<td>13.2</td>
<td>19.8</td>
</tr>
<tr>
<td>Malaysia</td>
<td>106.8</td>
<td>219.8</td>
<td>3.8</td>
<td>5.4</td>
<td>294.7</td>
<td>26.9</td>
<td>31.0</td>
<td>11.4</td>
<td>19.9</td>
<td>8.0</td>
<td>11.2</td>
</tr>
<tr>
<td>Philippines</td>
<td>52.2</td>
<td>106.1</td>
<td>-3.1</td>
<td>3.1</td>
<td>100.0</td>
<td>36.9</td>
<td>68.9</td>
<td>6.4</td>
<td>8.6</td>
<td>17.1</td>
<td>13.1</td>
</tr>
<tr>
<td>India</td>
<td>15.9</td>
<td>22.1</td>
<td>3.3</td>
<td>4.4</td>
<td>25.4</td>
<td>4.1</td>
<td>6.6</td>
<td>10.1</td>
<td>14.6</td>
<td>45.3</td>
<td>48.7</td>
</tr>
<tr>
<td>Brazil</td>
<td>10.3</td>
<td>17.9</td>
<td>-2.9</td>
<td>1.6</td>
<td>45.9</td>
<td>4.9</td>
<td>6.6</td>
<td>29.8</td>
<td>36.8</td>
<td>21.3</td>
<td>16.7</td>
</tr>
</tbody>
</table>


### Annex C: Policy Characteristics for S&T Capacity

#### Table 10: Policy Characteristics for S&T Capacity

<table>
<thead>
<tr>
<th>Scientifically-Advanced Countries</th>
<th>Continuum of Policy Characteristics for S&amp;T Capacity</th>
<th>Scientifically-Weak Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Resources Devoted to S&amp;T/R&amp;D: both absolute and as % of GDP</td>
<td>Low</td>
</tr>
<tr>
<td>High</td>
<td>Public Awareness of and Political Commitment to Science and Technology</td>
<td>Low</td>
</tr>
<tr>
<td>Common</td>
<td>Competitive, Merit-based Systems for Allocation of R&amp;D Resources and Researcher Recognition/Advancement</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Common</td>
<td>Open, Competitive markets that allow for the emergence of innovative firms that demand knowledge;</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Common</td>
<td>Financial Infrastructure to Support Innovative Firms</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Common</td>
<td>Functional Education Systems that Promote Sound Science Education at All Levels</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Strong, Common</td>
<td>Associations and Networks that share information locally, nationally, regionally, and internationally across and within sectors</td>
<td>Weak, Uncommon</td>
</tr>
<tr>
<td>Strong</td>
<td>International Collaboration in Research and Science/Industry Linkages</td>
<td>Weak</td>
</tr>
<tr>
<td>Strong</td>
<td>Evaluation and Accountability Mechanisms for Researcher Output and Effectiveness</td>
<td>Weak</td>
</tr>
<tr>
<td>Common</td>
<td>Existence of Systematically-collected and Accurate Information and Indicators on the Science, Technology and Innovation System</td>
<td>Uncommon</td>
</tr>
<tr>
<td>More so</td>
<td>S&amp;T Policies Coordinated, Based on Evaluation and Indicator Data, and Updated Frequently</td>
<td>Less So</td>
</tr>
</tbody>
</table>