

# Supplying Demand for Knowledge Societies: Perspectives on National, Regional and Global Experiments

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Paul Dufour\*  
Office of the National Science Advisor  
Government of Canada

## Abstract:

This paper outlines some global developments that are impacting on and affecting the STEM arena. It presents a snapshot of selected initiatives around the world with a focus on Canada and its recent efforts to enhance talent and skills in the knowledge economy. The paper makes some observations about trends that are critical in pursuing a knowledge- thirsty society with science and entrepreneurial cultures as lynchpin; and offers some policy guidelines to consider in ensuring that STEM research is actively pursued and developed.

\* Views expressed herein are the author’s own and do not necessarily represent those of the government of Canada. The author wishes to express his appreciation and thanks for assistance provided by Andrew Evans and Hollis Whitehead in the preparation of this paper.

[slide 1: de Solla Price quote]

## Introduction:

“To go beyond the bounds of absurdity, another couple of centuries of ‘normal’ growth of science would give us dozens of scientists per man, woman, child and dog of the world population” (Derek de Solla Price, Science Since Babylon, 1975, p.182)

When the Yale historian of science De Solla Price wrote this more than 30 years ago, he was concerned about what he called the saturated state of science, and the explosion of scientific knowledge as measured by the exponential production of knowledge via papers and journals. To be sure, he was not claiming the end of science, rather he was merely flagging something that we all have come to acknowledge.. that we live in an era pre-occupied by getting the conditions right to achieve fully-functioning knowledge-based economies for our citizens but equally an

age where new skills sets will be required to meet what Chris Hill has recently called a “post-scientific society” (see Issues in Science and Technology, Fall 2007).

De Solla Price was also prescient in his remarks on China as well in arguing that their production of scientists would double every five years (this was in 1975). As he argued, “The whole thing is like a gigantic handicap race in which the country that starts last must necessarily have the highest initial speed, and it seems fairly conclusive that this speed can readily be maintained—it certainly has been by America- so that the state of science must eventually reach the concentration that we see in the most highly developed countries.”

Indeed, if one looks closely at the current hand-wringing by the traditional western powers over the rise of the emerging knowledge powers such as China, India and Brazil, the prophecies of the respected historian have some resonance.

### **Context:**

I would like to use my brief remarks here to offer a few observations on this issue of the growing production of knowledge and mobility of knowledge workers and skilled assets around the globe and offer some general thoughts on what we (by this I mean the science and technology policy communities in our respective arenas) might be more attentive to in terms of policy considerations in the coming decade or so.

[slide 2: Tertiary Education]

A quick look at some world maps that scale R&D employment or tertiary education spending rates will tell us that there are still huge inequities in the global system. This is not surprising of course because knowledge is unevenly distributed across this planet and by most normal metrics that the OECD, NSF, UNESCO, EuroStat or other bodies would offer us, it is highly concentrated. But we also know that the planet, or at least large parts of its territory as de Solla Price foresaw, are in “catch

up” mode when it comes to this matter of developing sound frameworks and policies for enhanced knowledge capacity accompanied by the most critical elements -- strengthening primary and tertiary education systems.

I would also like to underscore that the elements of getting this right are complex and interconnected, much like a plane which is often described as a million parts flying in exceedingly close formation. **Slide 3** illustrates through a selected series of proxy indicators how one can map a so-called national innovation system to illustrate how these various planes can fly properly and to illustrate quite well that the system is all connected: if you make one policy adjustment on one part of the plane it will affect other parts. This is especially the case in the various measures that make up the component that centres on skills and talent in the workforce.

Many countries and regions are experimenting with new ways to focus on STEM and related knowledge skills issues as a critical response to the global challenges they are now all faced with.

[slide 4: Global Landscape Headlines)

This manifests itself in several ways through various policy statements, strategies and objectives from national governments as well as through multilateral fora interested in addressing this issue, such as the UN, World Bank, OAS or APEC. [slide 5: African Development Bank Higher Education Strategy] For example, the African Development Bank in its recent Strategy for Higher Education , Science and Technology, argues for the need to support national and regional centres of excellence, build infrastructure for higher education, S&T and link the HEST to the productive sector. It also underscores the need to help reform education systems with a view to promoting more maths, science and technology learning in schools.

[slide 6 : Various International Initiatives and Strategies]

Within Africa, South Africa has recently launched its research chairs programme (modelled in part after the Canadian experiment) designed to

accelerate research and human capital development in that country. The programme will produce 210 research chairs by 2010 and it is hoped that it will also serve to attract world-class researchers to South Africa. And if you have not seen it, the World Bank has just launched a competitive initiative on the Development Marketplace for African Diaspora that will reward innovative African diaspora based in Europe for projects and exchange fora implemented in Sub-Saharan Africa.

Some of you may also know that South Africa has partnered with India and Brazil under a new forum called IBSA (India-Brazil-South Africa) to develop cooperation in various fields including exchange programmes on higher education. A similar objective is targeted with the Japan-Korea-China trilateral alliance in S&T cooperation announced earlier this year. In other parts of the developed world, the Aussies are calling for urgent attention to nurturing rewarding and secure career paths for talented early-career researchers ([www.science.org.au](http://www.science.org.au)) and in the UK, the Government there has just launched a prospectus urging universities to become engaged directly in schools and academies ([www.dius.gov.uk](http://www.dius.gov.uk)) along with a key report called The Race to the Top which places skills and science education at the core of the innovation agenda.

Multilateral organizations such as UNESCO are now fully engaged---see their recent global education report--- and the OECD for example is exploring a large project around international mobility of researchers ([www.oecd.org](http://www.oecd.org)). And just last week, the EU unveiled a plan –with some controversy---to admit an additional 20 million skilled African, Asian and Latin American workers over the next two decades through a blue card scheme (patterned after your green card here)

## **A Canadian Story**

[slide 7: Canadian Expenditures in the Higher Education Sector]

Let me take Canada as another example since I should know this

relatively well. The federal government over the past decade has invested over \$15B in R&D, most of it in our university research system. In part, this large-scale, long-term investment cycle has been possible because we have been blessed with a continuous budget surplus situation over the past eight years. As a result, Canada is leading the G8 in university R&D expenditures per capita and we are second only to Sweden among the OECD in this same category. [slide 8: Canada Research Chairs: Canadian Expatriates Recruited from Abroad] With new experiments such as the 2000 Canada Research Chairs, the Networks of Centre of Excellence, Research Internships programme, Canada Graduate Scholarships and the funding increases to our university, hospitals and colleges, granting councils and foundations, we have succeeded in pump-priming a major component of our innovation system. Of course it begs the question of whether all of this is sustainable ---- a question that many of us are now facing when national or institutional budgets are being scrutinized.

[slide 9: Canada's S&T Strategy, Skills Initiatives]

And harder policy questions are emerging as our new S&T Strategy launched in May of this year will attest. For example, how can we now reap more from our investment in knowledge to take advantage of emerging opportunities in trade, technology and investment? What priority areas should be the nexus of our focus. If we want to compete, we are to compete for what? And if we want to collaborate, we partner for what, with whom and why? What role do skills, talent and ingenuity play in all of this?

It turns out that the answer is—quite a bit. Our new Industry Minister—responsible for the S&T Strategy-- has stated it clearly,

[slide 10: Prentice quote]

*The key to our future lies in our brain power, our capacity to innovate, our ability to produce engineers, researchers and scientists and to commercialize their work.. That is what our science policy is about, and I know that as Canadians we are innovators and that we can compete with and beat anyone in the world if we harness the ingenuity of our*

## young minds

Any policy or programme designed to stimulate the talent and skills pool of a country needs to be joined- up (as the Brits would say) by ensuring there is some coherence among immigration policy, education and technical and vocational incentives, S&T strategy and framework conditions for innovation and invention.

We also have a large, foreign-born and educated population and they are active in working closely as ambassadors with their home countries in promoting S&T partnerships with Canada. In fact, Canada has the highest ratio of foreign-born PhDs to native PhDs and we are second only to the US in terms of high-skilled foreign-born workers. **(Slide 11)**

As you all probably know, 80% of all foreign students in higher education study in only 5 countries. Canada seems to be doing poorly in this regard with only 28 foreign students per 1000 students enrolled compared to Australia with 126 or the UK at 108.

Indeed, taking full advantage of our immigrant population for enhanced economic and social development is a major challenge, along with demographic issues in working more effectively with our mature workers and aboriginal Canadians. Recently, one of our leading scholarly organizations proposed the need for a National Science Corps (not unlike the Global Science Corps suggested here in the US) encouraging exchanges between Canadian experts and those in their home -based countries.

A major consideration centres as well on what you are doing at all levels to stimulate a science and entrepreneurial culture.

In Canada, this is one of the key elements of the May 2007 S&T Strategy ([www.ic.gc.ca](http://www.ic.gc.ca)). We are working towards an action plan that will:

inspire more young people to pursue education and careers in science and technology;  
excite widespread interest, awareness and literacy in science and entrepreneurship;  
inform and engage the public and decision-makers in a dialogue on science and entrepreneurship in everyday life;  
and  
develop partnerships with the private sector, academic and civic societies to ensure this is accelerated.

We know that this is a major issue with many countries including your own. I am quite conscious that the AAAS here for example is a major player in this arena having just signed an agreement with China focussing in part on science culture promotion (incidentally, to illustrate the synergy of our efforts, Canada will play host for the 2012 AAAS annual meeting in Vancouver).

In our new challenges, we are working closely with private sector and outreach partners including provincial governments and science centres and associations who are quite active in science awareness and culture. It is they who are first responders at the front lines of ensuring future supply and demand not just of scientists and engineers but of informed citizens in our K-12 and higher education systems. So too is the Canadian diaspora estimated at about 2.7 million throughout the globe or about 8.3% of our population, a good deal of whom are dual citizens.

The gender gap is also posing some policy issues in certain areas of the S&T workforce. A recent workshop in Canada sponsored by the OECD on gender and S&T research pointed to some challenges that we all face. Among the key recommendations identified in that workshop were the need for more sex-disaggregated data; the evaluation of performance needs, and more rigorous research required to assess the relationship between gender and firm and-or research performance. [slide12: Population,

[Labour Force and Employment by Gender, Canada, 2001](#)] In Canada, for example, our latest survey on doctorates in science and engineering shows that nearly 80% of doctorates are men, yet, in contrast, women account for 47% of employed Canadians and 57% of university graduates. One of your CPST reports focusses well on this issue.

But let me focus on the foundation---science, technology, engineering and math education. In Canada, we rank quite highly in this regard along of course with our top five high rankings in PISA results.

[slide 13: [Perimeter Institute International Summer School](#)]

But we can do more in encouraging our youth. One example in scientific outreach is the Perimeter Institute for Theoretical Physics based in Waterloo. This world-class institute created with a philanthropic donation of \$100M from Mike Lazaridis, the co-founder of RIM, offers a wide range of initiatives such as summer schools workshops, public lectures, mentoring and teacher development. The attached chart shows the over 100 students from around the globe that participated in the 2006 summer school. Note that there were several US students. Another case in point centres on the largest land-based science experiment underway today-the International Polar Year. Canada has invested \$150M into this international venture and a significant part of this will be devoted to the human dimensions of polar research including outreach and science communication with native populations . Exciting experiments such as Students On Ice and Students on Board are bringing young people together from Canada and many other countries to experience being an ambassador for polar science as they work and live on research ships in the two poles.

We also have other examples such as the NSTW, Promo-Science, CRYSTAL, and the Gee! in Genomics. In Canada, the Science and Technology Awareness Network is making great strides to strengthen science promotion in our schools as is ACTUA and the Quebec-based Science Pour Tous. A Nobel Prize winner from Colorado has just joined our University of British Columbia and is working to improve

undergraduate science education through a \$12M project. Some of you may know him: Carl Wieman. As he sees it:

[slide 14: Wieman quote]

*the number of Canadian students going into science will increase if teachers at every level help students see science more like a scientist does: that science allows us to better understand the world around us and is filled with collaborative and intellectual insights about nature and important advances that benefit mankind.*

But there is more to it than that. As Chris Hill reminds us, the issue is science and math education for what? He makes a good case in suggesting that we must find new ways to make scientific and technological literacy a part of the education of all students who wish to play significant roles in the post scientific society –one that is increasingly networked and global in scope. Hence the need to pay attention to such things as hybrid educational programmes that add business skills, public policy, culture and diplomacy to the science and math foundations.

In 1984, Canada's Science Council produced a landmark study on science education for the country. The final report issued a set of critical arguments for why one should study science. They are to:

develop citizens able to participate fully in the political and social choices facing a technological society.

train those with a special interest in science and technology fields for further study

provide an appropriate preparation for the modern work world

stimulate intellectual and moral growth to help students develop into rational autonomous individuals.

These remain with us today as key benchmarks and new measures for assessing impact will be required as the shape and nature of knowledge becomes affected by global issues.

I began my talk with references to the developing and emerging world. There is no question that as capacity for knowledge and skills production has improved across the globe, a strain has been placed on national systems to keep up with training and education in order to meet the demands of the new societies based on knowledge. And some key players have adopted what Richard Freeman in his new book *America Works*, calls human resource leapfrogging; similar to what of these economies have done in technology leapfrogging.

Canada and the US are among those that have generously contributed to the capacity building efforts in many of these arenas with respect to the talent and skills pool and it is a responsibility that we need to maintain (not to mention being in our best interests). In our recent work and partnerships with Africa through its Consolidated S&T Action Plan, we are assisting in shaping the development of a new science culture in these countries and region—from centres of excellence (as in the facilities for infectious diseases) to training on biosafety issues to consideration of joint research chairs programmes. These, and other initiatives, will be the new experiments of supplying the demand for knowledge both at home and around the world.

Ladies and Gentlemen

Canada and the US enjoy arguably the world's largest bilateral partnerships in S&T. We freely exchange students, teachers, researchers and scholars across our respective borders. We have skilled workforces that are culturally diverse. We have worked together to harness our respective science and entrepreneurial cultures and have borrowed new models for learning and skills development . We undertake joint research in every possible area of interdisciplinary research from polar

research to climate change to nanotechnology. With the current global challenge we both face, we have a tremendous opportunity to develop enhanced linkages and leverage partnerships as we move ahead respectively to strengthen our human capital and the knowledge generation that is to come.

Thank you to the CPST for this kind opportunity to speak with you

Paul Dufour

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