Strengthening management for prosperity

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SUMMARY

Canada is not achieving its full prosperity potential. While we are enjoying unprecedented overall economic success with low unemployment, a strong dollar, an enviable fiscal situation, and a well-performing stock market, we are not as successful as we could be. Relative to the United States, the economy most similar to ours and our largest trading partner, we have a growing prosperity gap. Canada's lag in GDP per capita has grown from $3,300 in 1981 to $9,200 in 2005 (in constant 2005 dollars). This growing gap reflects a failure to reach our full economic potential. It means that our generation has not created as much economic value as possible from the human, natural, and physical resources with which we were endowed for the benefit of our children.

Our work at the Institute for Competitiveness & Prosperity shows how we lag in innovation and productivity – two highly inter-related elements that raise the competitiveness of an economy and improve the living standards of its citizens. In our recent report on Canada's competitiveness and prosperity[1] we set out an agenda across four elements for strengthening innovation and productivity. We called for a shifting of our overall **attitude** from collective complacency to a determination to realize our prosperity potential; we made recommendations that shift Canada's emphasis from consuming today to **investing** for tomorrow's prosperity; we outlined proposals to move our taxation system to **motivate** investments; and we proposed a strengthening of our market and governance **structures** to encourage creativity and growth instead of preserving the status quo.

In this paper we focus on an important part of **structures** – management talent. We discuss the importance of management capabilities to well functioning market structures necessary for innovation. We then review Canada's success in building this management capability. Finally we compare achievements in graduating management talent versus other skills necessary for innovation, namely science and engineering. We conclude that an important part of closing our prosperity gap is for Canada to broaden its approach to innovation including a greater commitment to strengthening management talent.

[1] Institute for Competitiveness & Prosperity, Report on Canada 2006, *Agenda for Canada's prosperity*, March 2007.

Management talent and the innovation system

Any analysis of innovation needs to be based on a systematic view, not a piecemeal approach as is often the case. For example, much of the current discussion on innovation focuses on the "receptor capacity" of industry to commercialize the ideas that "flow" out of research institutions. This approach considers innovation to be a linear series of discrete steps – excellent researchers achieving a breakthrough finding in the lab, followed by work to develop this into a product that can be commercialized, and then creating a new business that will bring the idea to market[2]. But, innovation is more than a series of discrete steps; instead, the "innovation system" is the result of the ongoing interaction of three elements – the supply of innovation, the demand for innovation, and the financing of innovation *(Exhibit 1)*.

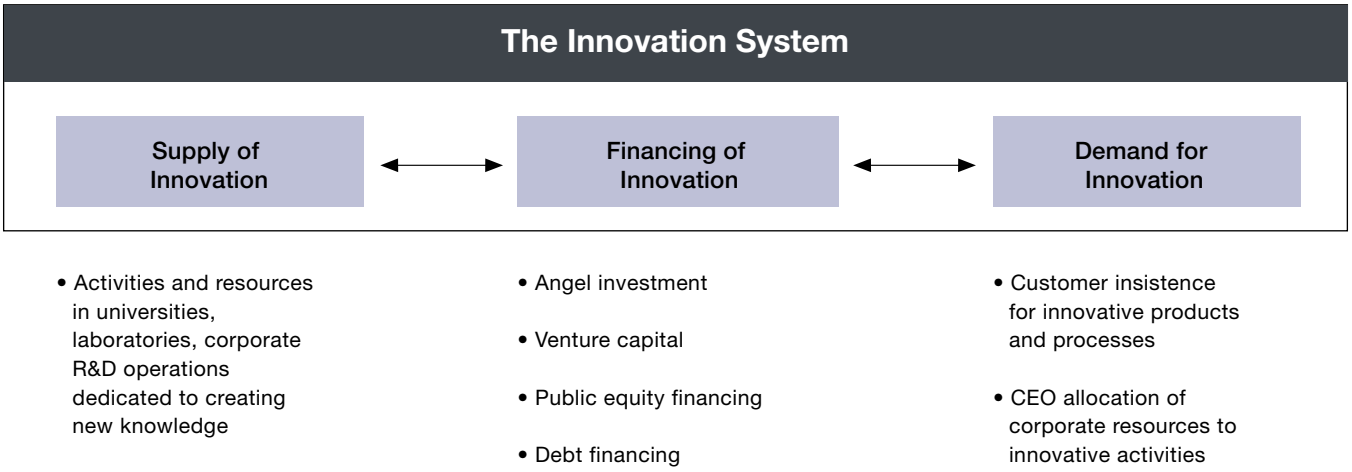
Three components of the Innovation System: Supply, Demand, and Financing

Each of the three components of the Innovation System is critical for its success; but all three need to work together in balance.

The supply of innovation includes the activities and resources dedicated to increasing the stock of innovation. It includes highly qualified personnel and their facilities and resources. They can be found in universities, research labs, and corporate R&D departments. Without these base activities and resources, scientific breakthroughs, and new ideas will not be available for commercialization. However, the fact that they are critical does not imply that this is the entire innovation system.

The demand for innovation is the direct complement to supply. There are two important levels of demand. First is customer insistence for new products and process breakthroughs. Without customer demand for innovation, there will not be successful and sustained innovative activity.

Exhibit 1 **Innovation system has three components**



Source: Institute for Competitiveness & Prosperity.

[2] See Jeffrey Crelinsten, "From Research to Commerce, Changing our Priorities about Commercialization", prepared for the Information Technology Association of Canada, June 2005 for an exposition of how current policies are based on this mistaken notion of the innovation process.

Second is the corporate demand by which the CEO decides to allocate resources to innovative activities as opposed to existing activities or current profit, thereby generating demand for innovation within the firm.

The innovation system includes **financing of innovation**. This is an important bridging device between demand and supply since, even if these two factors are in balance, significant funding is typically required to commercialize new ideas and scientific breakthroughs. In many cases an intermediary firm is required to translate the supply of innovation into products and services that are in demand. Risk capital of a truly speculative nature – angel equity, venture capital, and other private equity – must often be raised *de novo* rather than out of retained earnings or as part of a corporate investment portfolio. Consequently, in examining the innovation system, we need to understand the dynamics of financing as well as the demand and supply.

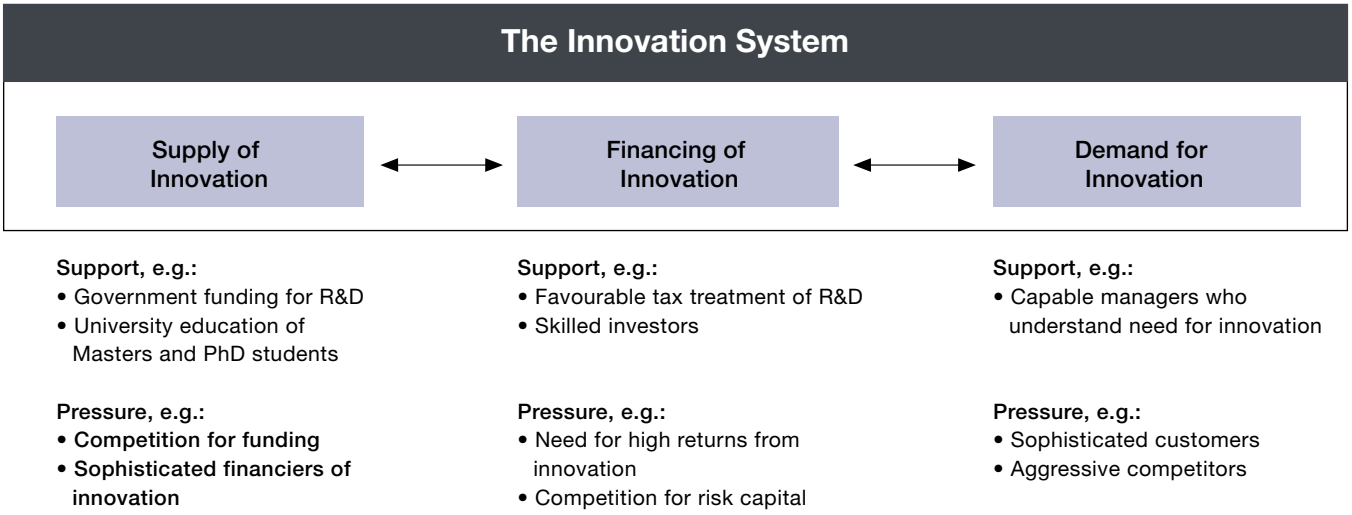
The importance of Support and Pressure in activating the Innovation System

In a strong innovation system, we would expect to find both supply of innovation and demand for innovation interacting with each other and increasing over time, spurred on by financing of innovation that expands to meet the challenge. How are signals sent between the elements of the innovation system so that supply is responsive to demand, demand takes advantage of what can be supplied, and financing is robust? The drivers of continuous upgrading are in the form of **pressure** and **support** that act on each of the three elements of the innovation system *(Exhibit 2)*. That is to say, each element needs to have support to make its task easier but also pressure to provide incentives to move ahead. All support and no pressure creates a cushy and lazy environment inimical to innovation and upgrading. Similarly, all pressure and no support creates a harsh and barren environment, equally inimical to innovation and upgrading. Support and pressure can come from outside the innovation system (e.g., government) or from another of the three elements within the system (e.g., sophisticated financiers pressuring researchers for high quality supply of innovative research).

Support and Pressure for Supply of Innovation. Government funding of R&D is a major source of support for the supply of innovation. University education of Masters and PhD students also provides support for supply of innovation. Beneficial pressure for upgrading innovation supply is generated by the competition for peer-reviewed research funding and by pressure from sophisticated financiers of innovation.

Support and Pressure for Demand for Innovation. Support comes from capable managers who understand the importance of innovation activities and pursue strategies based on innovative products and processes. Beneficial pressure derives from sophisticated customers who demand and reward successful innovations and by competitors who compete on the basis of innovation and upgrading.

Exhibit 2 **Pressure and Support drive all three elements of the Innovation System**



Source: Institute for Competitiveness & Prosperity.

Support and Pressure for Financing of Innovation. Support comes from favourable tax treatment of risk capital and from skilled investors who understand the specialized financing vehicles necessary to support innovation. Pressure comes from providers of capital who insist on high returns from investing in innovation and from competition between providers of risk capital.

In summary, innovation is a system that results in upgrades across the entire economy. If one element lacks the necessary pressure or support, then the whole system will not perform to its potential. Having an imposing strength in one element will not make up for weakness in another. If Canada were to enjoy robust supply of innovation but weak demand, the supply of innovation would flow to the demanding US market. This is a system in which the chain is only as strong as its weakest link. Public policy in innovation must be built on an assessment of pressure and support in each of these areas – and should seek to fill gaps where appropriate.

Current approach is narrowly focused and not balanced

Canada's innovation policy is out of balance in that it is driven by the assumption that we do not have enough innovation because we have an inadequate supply of certain key factors that lead to innovation.[3] More specifically, the model implicitly assumes we lack innovation in Canada because we have an inadequate supply of scientists and engineers, we lack adequate risk investment funds, and our businesses need specific incentives to increase the amount of research and development they conduct.

The logic behind the current model starts with the way innovation and commercialization are defined. Governments tend to focus on scientific or technical innovation versus business innovation. Thus, innovation is thought of as the result of scientific and technical R&D in Canadian universities, hospitals, and research centres. Notably, this R&D accounts for less than half of all R&D spending in the country and yet is tracked extensively.

By contrast, much of the true research and development carried out by business is not even recorded as such. It is difficult to track and analyze, partly because the innovations are often incremental adaptations rather than breakthroughs, and partly because they are innovations in process, marketing, and organization. For example, Research in Motion, one of Canada's global leaders, developed its leading competitive position in wireless communications as much through product design, distribution strategy, and branding as through traditional R&D expenditures as measured by government statistics. Similarly, Cott Corporation increased its share of the carbonated beverage market by focusing its operations on the production of retailer brand, or "private label," carbonated beverages, allowing retailers to target beverages to the preferences of its customers better. Again, this innovation would not appear in the public R&D or commercialization data.

From focusing on the centrality of scientific and technical innovation, government policy attention turns to places where this occurs – scientific and technical departments of universities and other laboratories and research centres. The logic is: "If we had enough people conducting research and enough money to fund them, we should have enough innovation. Since we do not have enough innovation, these factors must be missing or inadequate."

Innovation policy is also driven by a focus on high technology. Yet, in what most would agree is the world's most innovative economy, the United States, a mere 1.9 percent of jobs are in the following combined traded clusters generally considered to represent all of "high tech": IT or information technology (hardware and software); communications equipment; aerospace vehicles and aerospace engines; medical devices; and pharmaceuticals and biotechnology. In Canada, the equivalent percentage is 1.6.[4]

Matching the US in percentage of the economy's jobs in these high tech industries would mean an increase for Canada of 38,000 jobs out of a total of 12 million. This slightly richer mix of industries would increase Canada's productivity by an insignificant 0.1 percent.

Canada does not have an innovation problem because of the lack of university science and technology research and education. We have an innovation problem because businesses in Canada do not spend enough on innovative activities, including – but not restricted to – research and development. An important part of the solution is to strengthen management talent in Canada.

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[3] Martin, Roger and Milway, James, *Commercialization and the Canadian Business Environment: A Systems Perspective*, July 2004. Available at **http://www.competeprosper.ca/images/uploads/InnovationSystem_040705.pdf**

[4] For more information about the concept of traded clusters, see Institute for Competitiveness & Prosperity, Working Paper 5, *Strengthening structures: Upgrading specialized support and competitive pressure*, July 2004, p. 24.

Management capabilities and innovation

In this paper, we focus on the importance of management talent in the innovation system. We are not limiting our discussion of the role of management to the ability to commercialize research outputs, but rather the broader sweep of the function from external assessments of an industry, customers, and competitors to internal analysis of strengths and weaknesses. The management function includes goal setting, organization building, resource allocation, and monitoring of results. It also includes actions in financing the enterprise, sales and promotion, production and delivery, and people development. These management capabilities are crucial to an effective innovation system. This is not to say they are more or less crucial than research, science and engineering skills. But, the evidence strongly suggests that public policy has not focused adequately on the development of these skills.

Management talent and the Demand for Innovation. Good management is a significant driver of demand in an effective innovation system. Capable managers *support* the demand for innovation through a keen understanding of the need for product and process innovation in developing company capabilities. Senior management drives the resource allocation in a company and thus stimulates the demand for innovation. Good management also provides the necessary *pressure* that drives the demand for innovation. As customers, good managers drive the requirement for innovation by suppliers; this, in turn, drives overall demand for innovation. Good managers also pressure industry rivals to be innovative in order to succeed – in fact, to survive. A CEO has a fundamental budget decision with respect to innovation. How much should be spent on developing new products and processes versus running the current business? Innovation activity will be demanded by firms only to the extent that it serves their particular business strategy – which is partly informed by customer pressure and rivals' actions. If corporate boards and CEOs have not demanded business strategies that call for innovation, then innovation will not be sought. This occurs whether or not there is abundant supply of innovation capacity and breakthrough research from universities and elsewhere.

Management talent and the Supply of Innovation. Technical strengths in science and technology are probably the most important contributors to the quantity and quality of the *supply* of innovation. Nevertheless, management skills are important enablers that support the supply of innovation. Management skills are critical to organizing R&D efforts, for setting priorities, developing strategies, and acquiring resources. Good management skills also provide the pressure to ensure high quality resource allocation decisions among competing priorities for research funding.

Management talent and the Financing of Innovation. Financiers of innovation require both excellent scientific knowledge and management skills. Excellent strategic capabilities, particularly in marketing strategy, customer segmentation, and competitive analysis along with leading edge financial expertise provide critical *support* to high quality financing decisions. These skills are also important to provide the *pressure* for developing creative, but realistic, business plans for profitable commercialization of research knowledge. As we found in our survey of successful innovative Canadian firms, expectations are for venture capitalists to provide a full range of management-related skills along with the financing they bring.[5]

Hence, in building an innovative firm or an innovative economy, management talent matters. Senior management in our firms can develop strategies for which innovation is a critical component. Or alternatively, they can develop strategies for which innovation is inconsistent or even completely unimportant. Firms following strategies of innovation aim at creating and selling a unique product or service or creating a uniquely valuable process for delivering an existing product or service or both. Firms such as RIM and Cognos would be in the former camp. Firms such as Masonite, Cott, and Four Seasons would be in the latter camp using unique and superior processes for creating products and services not technically dissimilar to those of competitors.

Firms with strategies of innovation emphasize marketing and branding strategies over pure selling capabilities. They compete across the broad range of the value chain – aiming for advantage in areas such as after-sales service or customer partnerships, not just being low cost or having broad distribution. They aim to secure competitive advantage based on innovation, not access to low cost inputs. They seek to dominate niches of global markets instead of being broadly successful in local markets. If CEOs and managers across the economy, in general, choose strategies requiring innovation – because of their

[5] The Strategic Counsel, "Assessing the Experience of Successful Innovative Firms' in Ontario", September 2004, Research conducted for The Institute of Competitiveness & Prosperity. Available at **http://www.competeprosper.ca/images/uploads/InnovationInterviewStudyRep.pdf**, p.31.

own companies' unique interaction of pressure and support – they in turn will demand high volumes of innovation and the economy will be more innovative.

If, instead, CEOs in a given economy do not see the need nor have the skills to develop strategies requiring innovation, they will demand modest volumes of innovation and the economy will be less innovative. In such an environment there will not be meaningful private market pressure for greater supply of innovative capacity or for high quality financing support. And if there exists a high innovation capacity as a result of public sector spending on innovation, then much of that innovative capacity will be exported – by way of scientific and technically-trained individuals leaving to find jobs outside the country and intellectual property (e.g. patents) being exploited outside rather than inside the country.

Who manages successful scientifically oriented organizations? It is commonly held that technology businesses are fundamentally different than most businesses and that they must be led by people with a solid academic background in technology disciplines. In the US, there are seven computer and networking hardware and software firms that have reached the *Fortune 100* in size. All are well-known, globally competitive firms – IBM, HP, Dell, Microsoft, Intel, Motorola, and Cisco. However, rather than being highly technically trained, most of the CEOs of these high-technology firms are business educated. Only one, Edward Zander of Motorola, has any kind of scientific or technical degree and he later went on to earn an MBA. Four of the seven CEOs hold an MBA and a fifth has an undergraduate business education *(Exhibit 3)*. Two of the firms – Motorola and Intel – recently appointed CEOs with MBA degrees after having CEOs with scientific backgrounds. In addition, at Microsoft, Bill Gates, who is not a university graduate, was replaced as CEO by Steve Ballmer, an MBA.

The balance of science & engineering and other skills in successful high technology firms. US experience in the creation of highly successful high technology firms does indicate the important role played by science and engineering (S&E) graduates in founding firms; but as these firms mature, CEOs are less likely to have been educated in S&E disciplines.

To deepen our understanding of the role of S&E education in creating innovative firms, we first identified 32 firms in high technology sectors that are on the *Fortune 1000* and were formed less than 30 years ago. This includes firms like Dell, Sun Microsystems, SanDisk, and eBay. It excludes older firms like Microsoft and Apple. We reviewed the educational attainment of each company's founders and sorted these into those with university-level S&E degree (e.g., Vinod Khosia and Bill Joy, co-founders of Sun Microsystems), those with a university-level degree outside S&E disciplines (e.g., Scott McNealy, the third co-founder of Sun), and those who did not attain a university degree (e.g., Michael Dell, who dropped out of the University of Texas to focus on his fledgling firm, Dell Computers).

The results point to the importance of science and engineering talent in

Exhibit 3 **Leading US technology firms tend to be led by business graduates, not science and engineering graduates**

Firm (Fortune 100 rank)	CEO	Graduate Degree	Undergraduate Degree
Hewlett-Packard (14)	Mark Hurd	None	**Business Administration**
IBM (15)	Samuel Palmisano	None	History
Dell (34)	Michael Dell	None	None
Microsoft (49)	Steven Ballmer	**MBA**	Mathematics and Economics
Motorola (52)	Edward Zander	**MBA**	Electrical Engineering
Intel (62)	Paul Otellini	**MBA**	Economics
Cisco Systems (77)	John Chambers	**MBA**	**Business Administration** and Law degrees

Source: Institute for Competitiveness & Prosperity; *Fortune 500* (2007).

starting up successful high technology companies. According to company records and public filings of the 32 highly successful firms, there were 60 founders and co-founders. We were able to determine educational attainment for 50 of these. Among these 50, fully 37, or 74 percent, had attained a university degree in an S&E discipline; eight, or 16 percent, had attained a university degree in another discipline; and five had not completed university education. *(Exhibit 4)*

To gain insight into the Canadian experience, we analyzed firms from our global leaders list – public or large private companies who were among the top five globally in their market segments.[6] There are eight global leaders in the high technology industries with 14 founders and co-founders. We found similar results – nine of the 14 founders, or 64 percent, were university graduates from an S&E discipline. Three, or 21 percent, attained a degree in a non-S&E discipline. Two of the co-founders did not attain a university degree.

Clearly, scientists and engineers play an important role in founding successful technology firms both in Canada and the United States. Obviously, at the early stage of a new business in technology fields, solid technical capabilities are required to discern market opportunities and develop winning solutions.

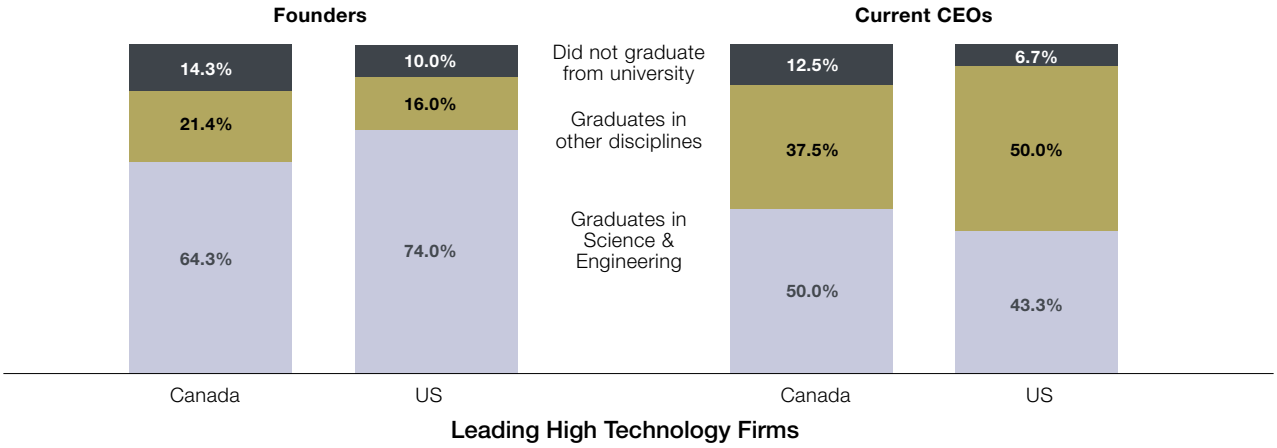
As these firms have succeeded and matured, we observe a shift in leadership capabilities, as evidenced by educational attainment. Among the 32 successful US firms, we are able to determine the educational attainment of 30 CEOs. Of these, 13, or 43 percent, are graduates from an S&E discipline. Fifteen, or half, are graduates from a non-S&E discipline. Two did not attain a university degree.

Among the eight global high tech leaders in Canada, there are nine CEOs (Research in Motion has two co-CEOs) and we could ascertain educational attainment for eight of them. Of these eight, four, or half, are S&E graduates; three, or 38 percent, are from other disciplines; and one did not complete university education.

In these very successful high technology firms, as the business matured, the importance of technical skills at the top of the organization was matched by the importance of other skills.

Skills below CEO level. Below the CEO level, evidence is mounting that the economy is requiring greater numbers of sophisticated conceptual thinkers. A study of job-creation in the US economy by Johnson, Manyika and Yee of McKinsey & Company identified that of the 6.4 million jobs added to the US economy between 1998 and 2004, a net of zero percent were created in "transformational jobs" (e.g. carpentry), 30 percent in "transactional jobs" (e.g. call centre operation) and 70 percent in "tacit skills jobs" (e.g., sales people

Exhibit 4 **Science and engineering graduates are dominant founders of successful high technology firms, but are less important as firms mature**



Source: Institute for Competitiveness & Prosperity based on companies' public data. Qualifying companies identified by Institute for Competitiveness & Prosperity – Canada: Institute for Competitiveness & Prosperity "Global leaders" in high technology industries; US: Fortune 1000 companies less than 30 years old and in high technology industries.

[6] Institute for Competitiveness & Prosperity, Report on Canada 2007, *Agenda for Canada's prosperity*, March 2007, pp. 46–47.
[7] Johnson, B., Manyika, J.M, and Yee, L.A., *The next revolution in interactions*, McKinsey Quarterly 2005, Issue 4, pp. 20–33.

or nurses). Tacit skill jobs require a relatively significant level of conceptual skill and thinking to perform. Tacit jobs pay 34 percent higher than transactional jobs and 74 percent higher than transformational jobs.[7]

Recent academic research by Bernardo Blum and Marigee Bacolod shows that the most highly valued and paid jobs in the US economy are going to people with a combination of the cognitive skills of the tacit sort described above and interpersonal skills – i.e. people skills.[8] A more recent paper by Blum, Bacolod, and Will Strange concludes that the increase in productivity associated with higher wages in urban centres is most pronounced among workers with strong cognitive *and* people skills.[9]

It's not technical *or* management skills; it's both. Clearly the importance of management does not diminish the importance of scientific and technical capabilities. If a jurisdiction is very weak in the supply of innovative capacity – scientists and technically trained workers, research universities, and research laboratories – CEOs, when considering their strategies, may correctly and wisely conclude that a strategy not dependent on innovation is wisest and set their company actions accordingly.

Michael Porter, a leading authority on corporate and country competitiveness sums up the necessary interaction between technical and management skills. In his annual chapter in the World Economic Forum's "Global Competitiveness Report" for 2005/2006, Porter observes:

> "Our regressions suggest that achieving high levels of innovation is not only a matter of companies spending more on R&D. It is also closely connected to their ability to transform technological advances into attractive new products and services, using flexible work organizations and the delegation of authority, combined with sophisticated marketing and advanced production processes."[10]

Nevertheless, much of Canada's innovation strategy is based on the premise that scientific and technical skills are the only important human resource components that matter. As we shall see, Canada lacks adequate management talent to develop its innovation capabilities fully – for the benefit of the prosperity of Canada and its people.

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[8] Bacolod, Marigee and Blum, Bernardo S., *Two Sides of the Same Coin: U.S. "Residual" Inequality and the Gender Gap*. January 2005. Available at **http://www.rotman.utoronto.ca/bblum/personal/front.htm**

[9] Bacolod, Marigee, Blum, Bernardo S. and Strange, William C., *Skills in the City, March 2007*. Preliminary version available at **http://www.isop.ucla.edu/cms/files/bacolod.pdf**

[10] Porter, Michael E., "Building the Microeconomic Foundations of Prosperity: Findings from the Business Competitiveness Index". In A. Lopez-Claros (Ed.), *The Global Competitiveness Report, 2005–2006*. New York, NY: Palgrave Macmillan, p.55.

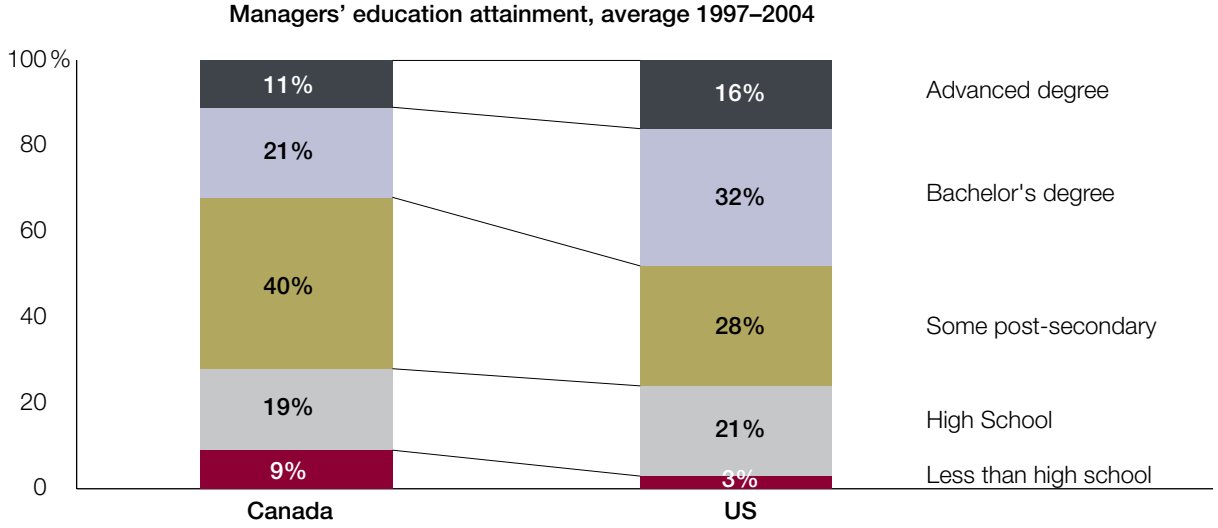
Evidence that Canada is not benefiting from sophisticated management capabilities.

In reviewing the evidence, one has to conclude that an important opportunity for improving Canada's innovation and productivity performance is in strengthening our management talent in our economy. Our managers generally have lower educational attainment than their US counterparts and CEOs of our largest corporations tend less to have formal business education at the graduate level. But, compared to their US counterparts, our firms have similar access to scientific and engineering talent. Finally, research indicates that a key challenge for growing innovative firms in Canada is having access to management talent.

Undereducated Canadian managers. Canadian managers have lower educational attainment overall than their US counterparts; only 32 percent of our managers possess a university degree versus 48 percent of US managers *(Exhibit 5)*. If the link between education and innovation can be drawn, it is quite apparent why we are less demanding of innovation in Canada. The more educated managers are, the more likely they are to think innovatively and strategically and to operate more effectively. Our lower education level of human capital resources means we are less able to compete in a technology-based knowledge economy, as well as to serve sophisticated and demanding customers in the global marketplace.

At the pinnacle of Canadian corporations we find a lower incidence of MBAs than in the US. In 2004[11], we compared the educational attainment of the CEOs of the 100 largest US companies as defined by the *Fortune 500* and the 100 largest Canadian companies as defined by the *Financial Post 100*. We found that 37 percent of US large firms were headed by an MBA versus 24 percent of Canadian firms.

Exhibit 5 **Canadian managers are less well educated than their US counterparts**



Source: Institute for Competitiveness & Prosperity based on Statistics Canada, *Labour Force Survey*, and US Bureau of Labor Statistics, *Current Population Survey*.

[11] Institute for Competitiveness & Prosperity, Working Paper 6, *Reinventing innovation and commercialization policy in Ontario* October 2004, p.40.

Scientists and engineers are well represented in Canada's work force. While there are some stark differences in the quantity of qualified management, recent research published by Statistics Canada indicates no differences in the presence of scientists and engineers.

In a report published in May 2006 by Statistics Canada, researchers concluded that in proportional terms the size of the two countries' science and engineering (S&E) workforces is, and has been, very similar. In fact, in 1980 and 1981 the proportion of the workforce as represented by workers employed as scientists and engineers or working in other S&E-related occupations was higher in Canada than in the United States – 9.8 percent of paid employment versus 9.6 percent. Employment in these occupations has been experiencing above average growth in both countries – in 1990 and 1991 they accounted for 11.7 percent of the paid workforce in Canada and 11.3 percent in the United States; in 2000 and 2001, they accounted for 13.6 percent of the workforce in both countries.[12] The researchers also found that, relative to wages in the respective countries, scientists and engineers were better paid in Canada. In 1981, scientists, engineers, and workers in S&E related occupations accounted for 13.4 percent of paid earnings (or 36.7 percent more than their employment share) while in the United States they accounted for 12.3 percent (or 28.1 percent more than their employment share.) By 2001, scientists and engineers in Canada accounted for 19.9 percent of paid earnings (or 46.3 percent more than their share of employment) while in the United States they accounted for 19.2 percent (or 41.2 percent above their employment share.)

The researchers did find differences in how intensively scientists and engineers are employed in different sectors of the economy. The sector with the largest share of scientists and engineers in both countries—professional, scientific and technical services industries—is more S&E-intensive in Canada than in the United States. Scientists and engineers make up a quarter (25.5 percent) of this sector's workforce in Canada, compared to about one-fifth (19.9 percent) in the United States. Conversely, the U.S. manufacturing sector is more S&E-intensive than Canada's manufacturing sector. Scientists and engineers make up 8.1 percent of U.S. manufacturing employment, compared to 4.8 percent in Canada. Despite the fact that manufacturing accounts for the same percentage of total employment in both countries (about 14 percent), fully 25.4 percent of all scientists and engineers in the United States are employed in manufacturing while only 14.8 percent of those in Canada are employed in the sector.

Another recent Statistics Canada study analyzed employment shares in science- and engineering-based occupations in Canadian and US cities. The study concluded that when compared to cities of similar size, Canadian cities performed as well as their U.S. counterparts. Notably, in the ranking of incidence of employment in these occupations:

- Toronto ranked 3rd out of the 10 cities with a population greater than 4 million
- Montreal ranked 8th out of 15 cities with a population between 2 and 4 million
- Ottawa–Gatineau ranked 2nd out of the 28 cities with a population between 1 and 2 million
- Calgary ranked 2nd out of 43 cities with a population between 500,000 and 999,999
- Meanwhile, Victoria ranked 17th out 78 cities with a population between 250,000 and 499,999, and
- St. John's ranked 22nd out of 142 cities with a population between 100,000 and 249,999.[13]

By measures such as R&D intensity by businesses or by patents granted, Canada's innovation performance trails that of the United States significantly[14]. Yet, proportionately we have as many, if not more, scientists and engineers in our workforce. It is hard to conclude that increasing the supply of technical talent is the priority for Canada's innovation and prosperity agenda.

Innovative firms report disadvantages in management as a key constraint. Our research among successful innovative firms indicates that the greater opportunity for success is in strengthening management capability. In 2004, the Institute for Competitiveness & Prosperity conducted research through The Strategic Counsel among successful innovative firms in Ontario. These were firms identified by Thomson Macdonald from public information sources as having successfully made the transition from startup to public ownership.[15]

The survey was designed to assess several resources critical to the success of innovative companies on two dimensions – the degree of access they

[12] Desmond Beckstead and Guy Gellatly, *Innovation Capabilities: Science and Engineering Employment in Canada and the United States*, Statistics Canada, Catalogue no. 11-622-MIE- No. 11, May 2006
[13] Desmond Beckstead and Mark Brown, *Innovation Capabilities: Comparing Science and Engineering Employment in Canadian and U.S. Cities*, Statistics Canada, 11-622-MIE2006012, May 2006.
[14] Working Paper 6, *Reinventing innovation and commercialization policy in Ontario*, October 2004, p 16.
[15] *Assessing the Experience of Successful Firms in Ontario*, September 2004. Available at **http://www.competeprosper.ca/images/uploads/InnovationInterviewStudyRep.pdf**

have to these resources and whether the resources represent an advantage or disadvantage versus their competitors (who were mostly US-based).

One of the most significant challenges they faced in their development was in gaining access to "managerial talent to hire". Importantly, this challenge area was perceived to be a significant disadvantage to their most important competitor who tended to be in the US *(Exhibit 6)*.

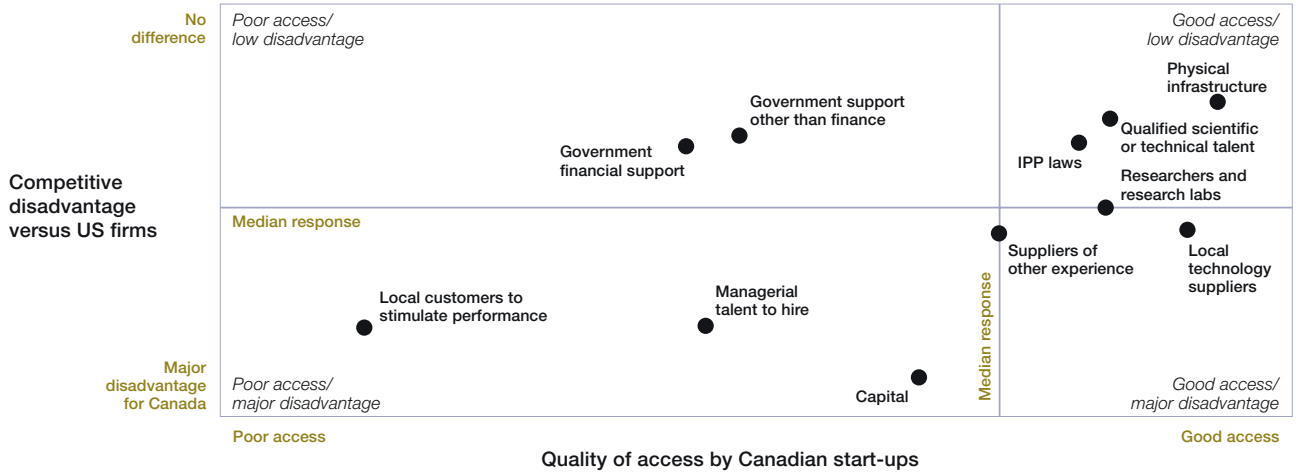
Survey respondents at these successful innovative firms indicated that:

- six of the 11 resources mentioned in the survey were relatively available in Ontario and did not represent a major disadvantage versus their competitor – "physical infrastructure", "qualified scientific or technical talent", "IPP laws", "researchers and research labs", "local technology suppliers", and "suppliers of other expertise"
- two of the 11 were seen to be of relatively low availability but this did not represent a significant weakness versus competitors – "government financial support" and "government support other than finance"
- three of the 11 were of relatively low availability and these represented major weaknesses versus competition. Two of these "local customers to stimulate performance" and "managerial talent to hire" have not been significant targets of public policy, while the third "capital" has been a major priority

These results from the Institute's survey indicate that the lack of beneficial support from managerial talent is one of the three most important gaps for growing innovative firms in Canada. Lack of beneficial pressure from local customers is the most important gap – and, as we discussed earlier, some of this is due to lack of management talent. To be sure, survey respondents report access to capital is also a significant disadvantage for Canadian innovative start-up firms – but it is not the only challenge they face.

In summary, the evidence indicates Canada is not benefiting from quantity and quality of sophisticated management skills. Relative to the United States we have a plentiful supply of technical talent in our workforce. As we shall see, this imbalance is no accident. Our public policy leans heavily towards stressing the development of scientific and technical skills.

Exhibit 6 **Canadian start-ups have low access to management talent**



Source: The Strategic Counsel, *Assessing the Experience of Successful Innovative Firms in Ontario*, September 2004, a report sponsored by the Institute for Competitiveness & Prosperity, available at http://www.competeprosper.ca/research/InnovationInterviewStudyRep.pdf

Evidence that we are under funding the development of management skills

Policy makers in Canada appear to focus mainly on one of the three elements of the innovation system – supply – and on one of the two levers – support. Furthermore, policy narrowly focuses on supporting the supply of innovation in the area of technology and hard sciences. As we review government policies and programs, we conclude that the model driving public policy toward innovation in Canada is an assumption that we do not have enough innovation because we have an inadequate supply of certain key factors that lead to innovation. More specifically, the model implicitly assumes that we lack innovation in Canada because we have an inadequate supply of scientists and engineers, we lack adequate risk investment funds, and our businesses need specific incentives to increase the amount of research and development they conduct.

Federal funding is focused on support in the hard sciences. Federal innovation funding has been primarily in two areas of specialized support: the supply of a scientific and technical labour force and the supply of funds for R&D *(Exhibit 7)*.

The federal government funds, administers and supports a host of foundations, organizations, partnerships and scholarships designed to fuel innovation and broaden Canada's R&D base. Much of the federal government's research support is organized across three funding agencies. The *Natural Sciences and Engineering Research Council* (NSERC) supports basic research and advanced training, with $902 million budgeted in 2006–07[16] to support over 11,000 professors and 23,000 students and postdoctoral fellows[17]. The *Canadian Institutes of Health Research* (CIHR) is a specialized program with 2006–07 budget of $863 million supporting up to 10,000 researchers in 13 specialized life science institutes across Canada[18]. *The Social Sciences and Humanities Research Council* (SSHRC) which supports research outside the technical and

Exhibit 7 **Federal innovation programs are aimed almost exclusively at a narrow range of innovation supply factors**

Federal Innovation Programs	Summary Description
Natural Sciences and Engineering Research Council (NSERC)	• supports basic research and training in hard sciences and engineering
Canadian Institutes of Health Research (CIHR)	• funds research at life sciences institutes
Social Sciences and Humanities Research Council (SSHRC)	• supports research and training in social sciences and humanities
Canada Research Chairs (CRC)	• supports research professorships – 77% in science, engineering and health research; 23% in social sciences and humanities
National Research Council (NRC)	• conducts research across physical and life sciences, engineering and technology, information technology and industry support
Canada Foundation for Innovation (CFI)	• provides infrastructure support; primarily in hard sciences

Source: Institute for Competitiveness & Prosperity.

[16] http://www.tbs-sct.gc.ca/rpp/0607/NSERC-CRSNG/nserc-crsng03_e.asp#table1
[17] As of Nov. 2006, See http://www.nserc.gc.ca/about/about_e.asp
[18] http://www.tbs-sct.gc.ca/rpp/0607/CIHR-IRSC/cihr-irsc03_e.asp#3b

scientific fields is, by far, the smallest of the three, with a 2006–07 budget of $327 million.[19]

An important role of the three agencies is to allocate funds in the *Canada Research Chairs* (CRC) program. This program invests about $300 million annually and has the goal of establishing 2,000 research professorships by 2008 – in part to keep the most capable and qualified Canadian researchers teaching in Canada. As of July 2006, 1,695 chairs had been established. Fully 77 percent of these chairs are in natural sciences, engineering and health research with the remainder in social sciences and humanities.[20]

The three agencies are also involved in the direction of the *National Research Council* – Canada's oldest federal research institution. With an annual budget (2006–07) of over $714 million, it supports more than 20 research institutes and national programs. Its key disciplines are physical sciences, engineering, and life sciences; in addition, the NRC provides technology support to industry.[21] Much of the funding is aimed at hard sciences and technology.

The Canada Foundation for Innovation (CFI) was founded in 1997 with an endowment of $3.7 billion. It supports 40 percent of the infrastructure costs associated with a research project (with partners from outside government covering the remainder). CFI is focused on hard sciences; since 1998, only 9.2 percent of projects accounting for 4.4 percent of funding have been in the social sciences and humanities.[22]

A key factor in the shortage of managerial talent for leading innovation and commercialization in Canada's firms is the lack of investment in business education in Canada. Within SSHRC, which is the smallest of the federal research granting agencies, only 4.8 percent of its grants and fellowships was in the business discipline in 2005–06.[23] This represents about 1 percent of total research funding from the three federal granting agencies.

Given the low rate of business research funding by SSHRC, only 20 of the 1,695 already-named Canada Research Chairs are in management studies[24] despite business degrees accounting for 15.5 percent of all degrees granted in Canada. Since 1998, the Canadian Foundation for Innovation has funded only 21 projects in the business discipline ("management of businesses and institutions") accounting for 0.15 percent of total funding. Clearly government policy has assumed that business research and education is simply not relevant to innovation and commercialization.

In summary, federal policies and programs are narrowly aimed at supporting supply of innovation, and within that support they have a narrow focus on the hard sciences, such as engineering and the natural sciences. There is pressure to ensure the academic soundness and rigour of this research based on a traditional peer review process in funding decisions. But this supply of innovation is lacking the pressure from business and from the quality of risk capital.[25]

Recent public policy has continued to focus on technical skills. The importance placed on technical skills on the innovation agenda transcends politics. The November 2005 Economic and Fiscal Update, prepared by the previous government, included significant funding for "advancing an innovative economy". For the 2005–2011 period, the government projected spending of $2.3 billion in this area. By our calculations, $2.0 billion, or 86 percent, of this was aimed at strengthening technical skills. This included increased funding through granting councils for university-based science research and the Canadian Institute for Advanced Research. Support for strengthening management skills amounted to $29 million – just over 1 percent of the total. The remaining $300 million of funding was in areas not related to science or management.

In the November 2006 update, the new government set out initiatives for developing a "knowledge advantage" for Canada. In its discussion of the initiatives for developing this advantage, the Government referred to the need for science and engineering degrees, university research equipment and facilities, and collaborative research. Yet there was no mention of closing the gap in our management capabilities.

The recent 2007 federal budget made no significant change to the relative importance of funding for the hard sciences and for other disciplines. However, it provided an additional $11million annually for SSHRC targeted to research in management, business, and finance.

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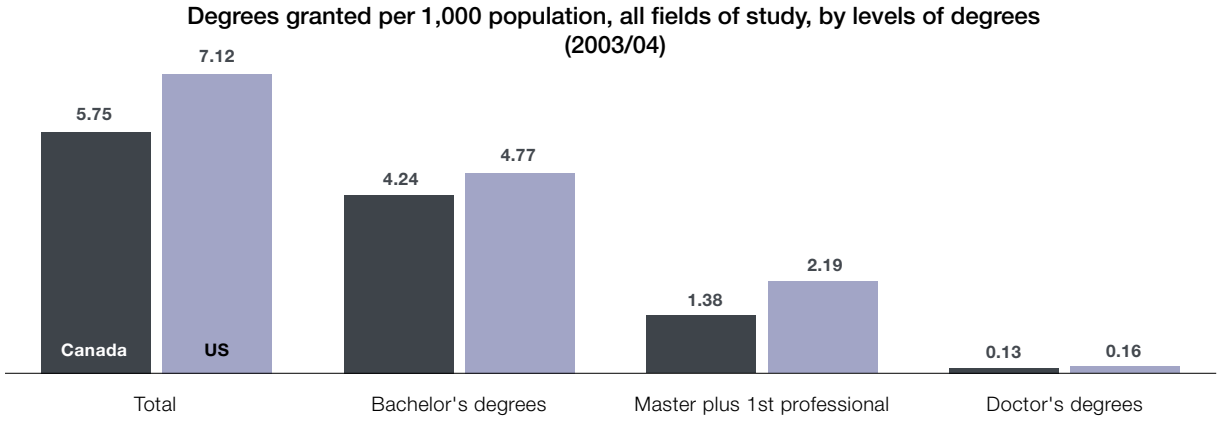
[19] **http://www.tbs-sct.gc.ca/rpp/0607/SSHRC-CRSHC/sshrc-crshc01_e.asp#table_1**
[20] **http://www.chairs.gc.ca/web/chairholders/index_e.asp**
[21] **http://www.nrc-cnrc.gc.ca/aboutUs/corporateoverview_e.html** and **http://www.tbs-sct.gc.ca/rpp/0607/NRC-CNRC/nrc-cnrc01_e.asp#summary**
[22] **http://www2.innovation.ca/pls/fci/fcienrep.base**
[23] **http://www.outil.ost.uqam.ca/CRSH/RechProj.aspx?vLangue=Anglais**
[24] Canada Research Chairs – Chairholder Profile (online) available at **http://www.chairs.gc.ca/web/chairholders/index_e.asp**
[25] Report on Canada 2007, *Agenda for Canada's prosperity*, pp. 41–43.

We under educate management capabilities. The focus of our federal innovation policy on science and technology at the expense of management skills is mirrored on our university campuses. We continue to produce more technical skills – despite the evidence indicating this is not our priority area of need.

Our research indicates that we under invest significantly in post secondary education in Canada.[26] One of the results is that in Canada we produce fewer university graduates than does the United States *(Exhibit 8)*.

Our shortfall relative to the US is above the bachelor's degree, particularly with the master's and first professional degree.

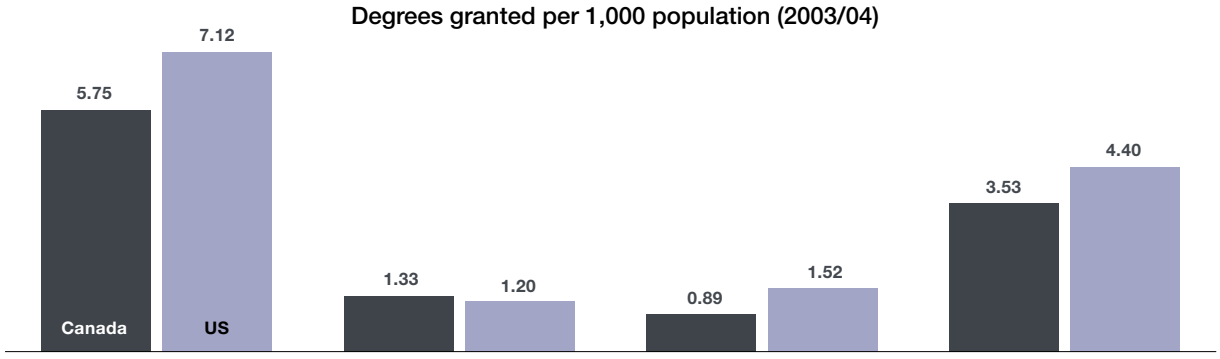
Exhibit 8 Canada produces fewer degrees than in the United States, particularly at the graduate level



Canada/US Index	81	89	63	81

Note: First professional degrees are conferred in the following fields in US: chiropractic, dentistry, law, medicine, optometry, osteopathic medicine, pharmacy, podiatry, theology, veterinary medicine; in Canada, they include law, divinity, medicine, dentistry, optometry, veterinary medicine, and education; data adjusted to make both countries comparable.
Source: Institute for Competitiveness & Prosperity analysis based on data from Statistics Canada (special tabulation); US Department of Education, National Center for Education Statistics, Digest of Education Statistics 2005.

Exhibit 9 Canada produces more science and engineering graduates and fewer business graduates than in the US



Canada/US Index	81	111	59	80

*Excludes health, social sciences, and psychology
Note: Includes bachelor's, first professional, master's, PhD.
Source: Institute for Competitiveness & Prosperity analysis based on data from Statistics Canada (special tabulation); US Department of Education, National Center for Education Statistics, Digest of Education Statistics 2005.

[26] Task Force on Competitiveness, Productivity and Economic Progress, Fifth Annual Report, *Agenda for our prosperity*, November 2006, pp. 37–38.

When we differentiate degrees by field of study we see that Canada's underperformance is in business degrees, not science and engineering. *(Exhibit 9)*

In an international context, Canada exceeds China and India, by a significant margin, in the production of natural science and engineering degrees per capita. We do, however, trail nearly all the developed economies with the exception of Germany and the United States. But given the fact that the United States "under performs" all the other advanced economies in granting science and engineering degrees and, yet, is the acknowledged innovation leader, it is hard to conclude that Canada is under producing science and engineering graduates. *(Exhibit 10)*

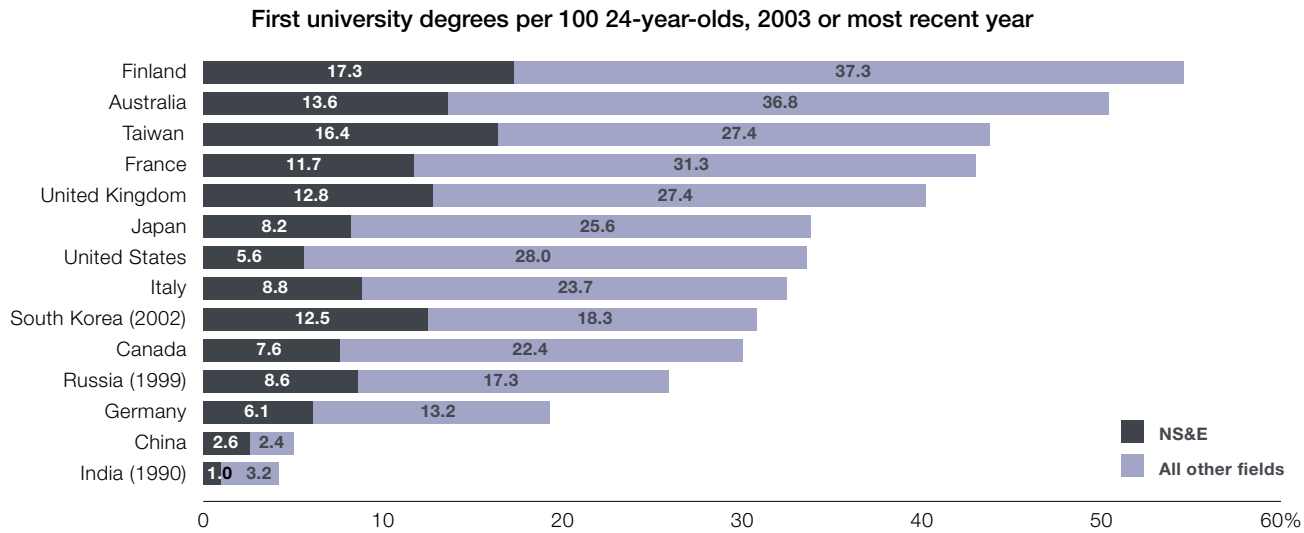
Where the US dominates internationally is in the production of business degrees with the world's most massive investment, by far, in business education. No country comes close. Each year in the United States 22 percent of undergraduate degrees and 25 percent of master's degrees are awarded in the discipline of business.[27] This is reflected in the fact that a single country – the US – holds 59 spots out of the top 100 business schools globally in the Financial Times annual ranking. Thus far, we have found no other country that approaches Canada as a distant second in investment in business education.

In the business discipline, we trail US production of degrees at all levels. *(Exhibit 11)*

In Science and Engineering, by contrast, we produce more degrees at the bachelor and PhD levels and are at parity at the master's level. *(Exhibit 12)*

Our under performance in business graduates is not a reflection of the lack of demand by Canadian students. In a study coordinated by the Institute for Competitiveness & Prosperity and conducted by the Ontario Ministry of Economic Development and Trade shows that it is more difficult to gain access to a university undergraduate business program than to engineering or arts and science. *(Exhibit 13)*

Exhibit 10 **Canada and the US trail most developed economies in the production of science and engineering graduates**



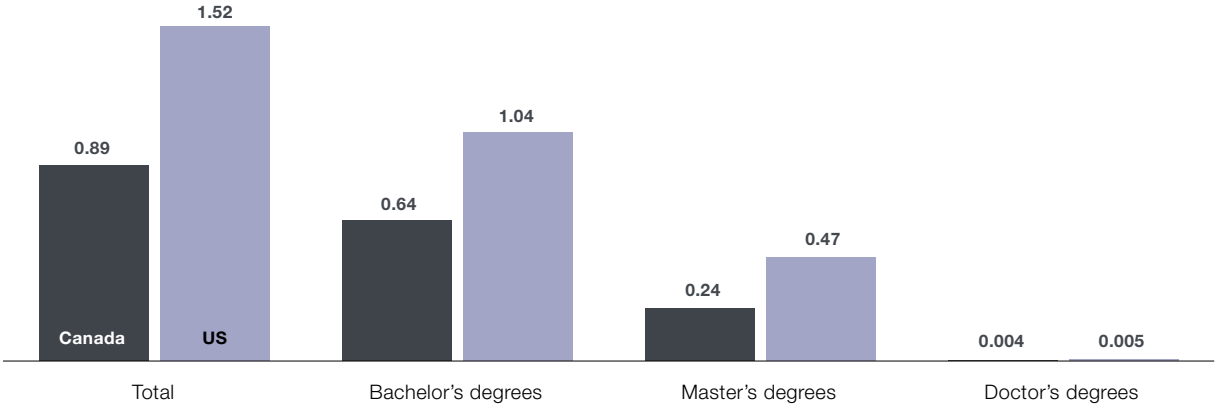
Note: NS&E (Natural Science & Engineering) includes physical, biological, agricultural and computer sciences; mathematics; and engineering. First university degree: completion of a terminal undergraduate degree program; these degrees are classified as level 5A in the International Standard Classification of Education, although individual countries use different names for the first termnal degree.

Source: US National Science Foundation, *Science and Engineering Indicators 2006*, http://www.nsf.gov/statistics/seind06 (NSF data for Canada, US, Japan, EU countries and Australia updated by Institute for Competitiveness and Prosperity based on Statistics Canada, US National Center for Education Statistics, Eurostat and Australia Department of Education, Science and Training.

[27] DeAngelo, Harry, DeAngelo, Linda, and Zimmerman, Jerold, What's Really Wrong with U.S. Business Schools?, July 2005.

Exhibit 11 **Canada produces fewer business degrees at all levels**

Business degrees granted per 1,000 population, by levels of degrees (2003/04)

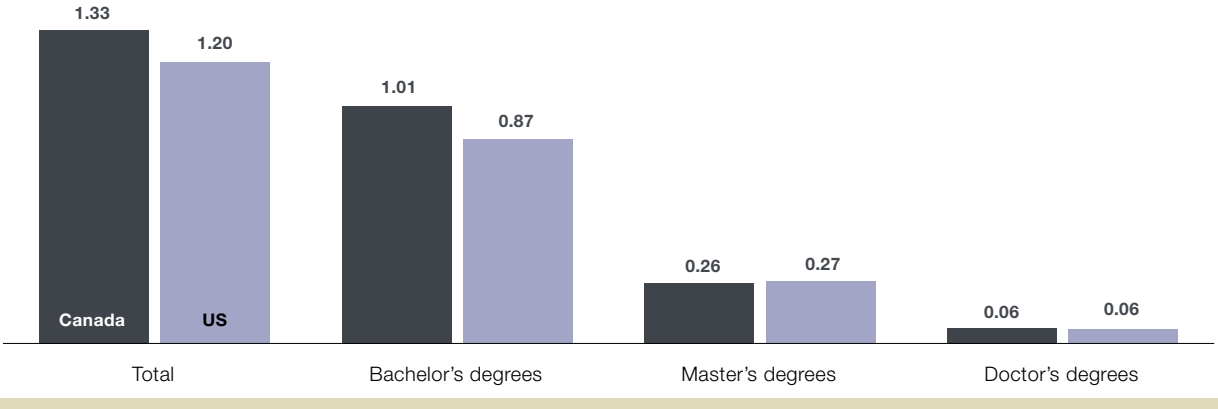


Canada/US Index	59	62	51	80

Source: Institute for Competitiveness & Prosperity analysis based on data from Statistics Canada (special tabulation); US Department of Education, National Center for Education Statistics, Digest of Education Statistics 2005.

Exhibit 12 **Canada exceeds US output of science and engineering degrees**

Science and engineering degrees granted per 1,000 population, by levels of degrees (2003/04)

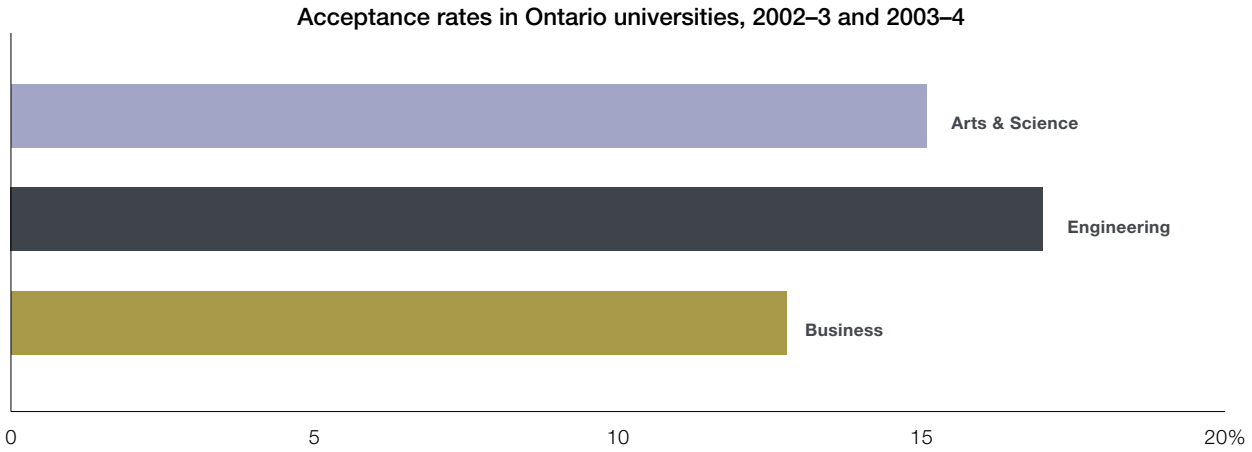


Canada/US Index	111	116	97	105

Note: Science and engineering fields exclude health and social sciences, and psychology

Source: Institute for Competitiveness & Prosperity analysis based on data from Statistics Canada (special tabulation); US Department of Education, National Center for Education Statistics, Digest of Education Statistics 2005.

Exhibit 13 **Admission to undergraduate business programs in Ontario is more difficult than to Engineering or Arts & Science**



Note: Acceptance rate is ratio of student acceptances to programs to total applications; ratio understates acceptance rate since number of applications includes double counts for students who apply to more than one university or program. Rates shown are simple averages of the two school years.
Source: Ontario Ministry of Economic Development and Trade, Institute for Competitiveness & Prosperity

Strengthening management to improve Canada's innovation, productivity, and prosperity

In summary, a key part of the solution to Canada's under performance in prosperity is in management talent. Efforts to improve management skills will pay dividends in innovation and productivity and ultimately Canadians' prosperity. More specifically, we conclude that:

Innovation policy is incredibly narrow – excessively focused on high tech and hard sciences. As we have seen, Canada's innovation policy places too much emphasis on the hard sciences and does not recognize the importance of innovations in business and management processes. Our competitiveness and prosperity is built on a solid base of excellence in the sciences. And, as we have seen, successful high technology firms are founded by science and engineering graduates. But successful innovation requires a balance of science and other skills. These other skills are important to achieve a successful transition from start-up to ongoing success.

Despite emphasis on increasing science and technical skills, the data indicate a greater priority in strengthening managerial capabilities. In comparing and contrasting human resource capabilities in Canada versus the United States, arguably the most innovative economy in the world, we find our biggest gap is in management talent. Our managers are under educated relative to their US counterparts. We produce fewer graduates in the management discipline, while no such deficit exists in science and engineering. Management skills are a critical complement to science and engineering skills in creating a high quality supply of innovation, driving a sophisticated demand for innovation, and putting in place the required quantity and quality of financing for innovation.

Until we address these weaknesses, we will not achieve our full innovative potential in producing productive and globally competitive businesses. Canada has invested significantly in building necessary capabilities for innovation. But, while these efforts are necessary, they are not sufficient. We need to enhance federal innovation policy with an adequate focus on strengthening our management capabilities.