

# **COMMERCIAL INNOVATION: A POLICY STOCKTAKING**

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### **Abstract**

To many observers, the thin parts of Industry Canada's 2001 innovation strategy framework and 2002 innovation summit reflected an on-going policy conundrum – how to influence positively and significantly the amount and pace of commercial innovation in Canada. As policy Ottawa attempts to anticipate a new administration sympathetic to developmental thinking and action, this essay looks at the evolution of federal innovation policy advice over the past 30 years, and at what should, and should not, be on the forward policy agenda regarding the commercialization and application of knowledge.

The note considers three principal layers of commercialization factors: systemic factors, comprising macro policy instruments and cultural determinants; structural factors, covering aspects of industrial structure and horizontal policy instruments; and organizational factors, within firms, networks and regions. The essay concludes with observations regarding innovation metrics and priority areas for policy analysis and initiatives, including marketplace and market access policies, intellectual property and skills development.

## **COMMERCIAL INNOVATION: A POLICY STOCKTAKING**

The purpose of this note is to outline and analyze factors determining commercial innovation performance in the Canadian business sector, and their policy implications for the federal government's Advisory Council on Science and Technology.<sup>1</sup> The note is in three parts: (1) commercialization and innovation policy; (2) commercialization factors; and, (3) policy observations. Annexes outline a typology of commercial innovation factors and the principal documents reviewed.

## **COMMERCIALIZATION AND INNOVATION POLICY**

### ***Milestones***

It is now more than 30 years since the Senate Committee on Science Policy pointed, in the Lamontagne Report, to innovation as a key driver of economic and social wellbeing in a post resource-rent Canada. Despite the vocabulary of the time, the senators recognized that innovation was not just about science, but about the commercialization of knowledge, technology and other intellectual value-added. Indeed, they were quick to acknowledge that public expenditures on research and development that did not lead to commercialization would result more in transfers to researchers (“welfare for white-coats”) than in benefits to society as a whole.

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<sup>1</sup> Helpful comments on the first draft of this paper were made by number of reviewers, notably Roy Atkinson and George Schoenhofer

Similarly, in the 1970's the Science Council of Canada examined innovation in broad terms. Some of the Science Council's work was in the domain that its name suggests, such as the consideration of "big science" projects and priorities. Much of its attention was, however, devoted to the political economy of innovation in Canada, with particular concern for the benefits and limitations of the dominance of multinationals in the secondary manufacturing sector. Strategic issues being debated currently regarding geographic and product mandates, and having the 'organizing minds' for internationally-competitive companies, had their genesis in the Science Council's attention to "innovation in a cold climate". Into the 1980's, the Council also focused on the interface between universities and industry, including university-industry research centres, technology transfer offices and spin-off firms, which are hot topics again today.

This recognition that commercialization is embedded in the notion of successful innovation has been reflected in federal policy ever since. In the 1970's, the most explicit and conspicuous technology commercialization programs were the Program for the Advancement of Industrial Technology and the Defence Industry Productivity Program, the predecessors of today's Technology Partnerships Canada. As well, much of the expanding industrial and regional programming of the 1970's and 1980's was at least nominally concerned with the development and marketing of new or improved products, processes and services – in other words, with commercial innovation.

Following the OPEC-driven energy shocks of the 1970's and the 1980-81 recession, from which Canada rebounded more slowly than the US and other industrial powers, Canadian public policy focused increasingly on a second, related performance concern—international competitiveness. In the early 1980's, a Royal Commission on Canada's Development Prospects,<sup>1</sup> (the Macdonald Commission) sponsored extensive studies of the country's economic and social circumstances and prospects, and drew attention to a wide range of policy imperatives, from health and education to trade liberalization and the reform of economic regulation.

Although the Macdonald Commission (1985) is now principally associated with "free trade" (Free Trade agreement [FTA]/North American Free Trade Agreement [NAFTA]) and foreign investment promotion (turning the Foreign Investment Review Agency [FIRA] into Investment Canada), it also set out the broader challenges for a knowledge-based Canadian economy and society in a globalizing 21<sup>st</sup> century – themes echoed more than a decade later by the National Advisory Board on Science and Technology (NABST) in "Healthy, Wealthy and Wise".

This note will focus on what has been said about commercial innovation over the past decade – and in particular, the insights provided by NABST, the Prosperity Initiative, the Conference Board and Statscan domestically, as well as the Organization for Economic Cooperation and Development's (OECD's) country-specific and comparative growth work – but for those who may be interested in a somewhat longer policy perspective (and reassurance that Canadian innovation policy

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<sup>1</sup> Canada, Royal Commission on the Economic Union and Development Prospects for Canada, *Report*, Vol. 3 (Ottawa: Minister of Supply and Services, 1985).

diagnosticians have not just recently woken up), the reports and studies of the Lamontagne Committee, the Science Council and Macdonald Commission remain salutary .

### ***The Crunch***

The recessionary environment of 1980-81 returned a decade later with a “made-in-Canada” vengeance, leading the federal government to embark on a Prosperity Initiative, which sought to mobilize the private sector to work with government to identify and address the causes of what was increasingly appearing to be a national competitiveness tailspin.

The macro causes didn’t require much sleuthing: the high cost of capital aggravated by ominous public debt and deficits crowding out risk capital markets, coupled with demanding terms of trade. (Remember the 85 cent dollar?). But the structural and micro-economic analysis of underlying factors was, if anything, even more disturbing: increasing gaps in labour and total factor productivity; weak investment in machinery and equipment; low public and private spending on Research and Development (R&D) and training. Taken together, these and related factors pointed to anemic innovation capacity and performance, at a time when innovation had become widely recognized as the principal driver of income growth.<sup>1</sup>

Concurrently, NABST was also signaling, in its 1991 statement on competitiveness, that Canada was “not meeting the competitiveness challenge”. Its bleak diagnosis, with concerns ranging from inadequate productivity and declining resource rents to low R&D spending and high costs of capital, concluded that there was a “failure of our nation as a whole to adequately employ the tools of science and technology to drive innovation through to greater value-added and stronger productivity growth”.

To its credit, NABST did not limit its attention to these rhetorical heights – it drilled down to key elements, notably the financing of industrial innovation. Here, NABST undertook cross-sectoral capital cost analysis of 42 Canadian firms (35 Canadian-owned), a tangible feature all too rare in the long bibliography of innovation policy exhortations.

The Committee recognized the value for industrial innovation financing of a macro environment of stable prices and low government debt, but did “not see such an economic environment as a probable occurrence within the short term.” In its absence, the Committee advanced five substantial recommendations to enhance financing, including an industrial innovation merchant bank. It emphasized that the objective was not a narrow sectoral one, seeking solely to better the circumstances of the “high technology” sector. Rather, the Committee asserted, “international competitiveness requires that innovation be persistent and pervasive throughout the economy; increased industrial innovation is an objective for all sectors of economic activity.”

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<sup>1</sup> Through the 1970’s and 1980’s, public investment in R&D and industrial innovation was based largely on policy intuition—the economics profession had not yet legitimized the “X” factor that, empirically, produced growth beyond the sum of the tangible factors of production. By the 1990’s, the “new growth economics” propounded by Paul Krugman (and Richard Lipsey and CIAR colleagues among others) was specifying endogenous growth models incorporating innovation as the principal means of adding value, and economic rent , beyond the physical increase of materials, labour and capital.

Both the Prosperity Initiative and NABST went on to consider the broader prescriptive implications of their analysis, respectively in the Prosperity Action Plan (1992) and in *Healthy, Wealthy and Wise* (1995). Beyond the still-dominant systemic forces (terms of trade and cost of capital), the Action Plan set out 54 structural elements; interestingly, although several of these concerned predictable topics of R&D funding and infrastructure and investment climate and marketplace issues, more than half related to skills and education, matters with which the federal government continues to grapple ineffectually for jurisdictional and programmatic reasons.

NABST's last hurrah -- *Healthy, Wealthy and Wise* -- anticipated the more recent broadening of the attention to innovation-related matters, by putting as much emphasis on quality of life as on wealth and job creation and on the advancement of knowledge. NABST recognized that, because talent was becoming one of the most mobile resources and the clustering of knowledge-based activity was increasingly observable, the importance of social and community capital had come to the fore in considerations of innovative comparative advantage.

In the event, the change in government in 1993 effectively shelved the Prosperity Initiative (meaning no Competitiveness Council or other organizing driver for its action plan), and the fiscal restraint of the mid-1990's put much of the thinking from Prosperity, NABST and others on the back burner.

### ***Recent Thinking***

In the late 1990's, the Conference Board of Canada (CBOC) picked up the innovation trail, beginning a series of annual innovation reports, funded principally by the federal government. The first of these, in 1999, reiterated the importance of innovation to prosperity, with new evidence that innovative firms perform better. Refreshingly, CBOC shifted attention away from the usual litany of public policy shortcomings stifling innovation, highlighting instead the firm-level factors affecting performance and profitability.<sup>1</sup> Without disregarding the significance of policy and marketplace environments for innovation, CBOC turned first to the organizational context supporting commercialization, identifying enterprise behaviour that produced a profitable return on new or improved products, processes and services.

The subsequent three CBOC Innovation Annual Reports have focused in turn on three important dimensions of commercial innovation: collaboration, investment and regulation. Regrettably, the knowledge value-added of these reports has been declining markedly, leaving CBOC in more of a cheerleader role. By the third report (*Investing in Innovation*, 2001), substantive analysis had been largely replaced by rhetorical encouragement, calling on Canadians to "commit to innovation" behind a "technology goal to unite all innovation players". The latest report, on innovation in regulatory frameworks, is largely an embarrassing crib of the OECD's recent review of regulatory reform in Canada. CBOC has indicated that its next volume in the series will be on

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<sup>1</sup> That year, CBOC's most important policy observation regarding the knowledge economy was to be found not in its innovation report, but in its annual outlook document (*Performance and Prospects*), which analyzed the growing displacement of provincial education budgets by health care costs – a trend which continues to this day.

commercialization – hopefully, that work will get back on track, providing insights more on the lines of its much punchier innovation challenge papers.

That the OECD out-flanked the CBOC on regulatory policy is not an isolated or surprising incident, as that organization's comparative and Canada-specific work has been among the most relevant innovation literature for some time. This work is well-grounded, building on many years of attention to sources of economic development, such as its technology economy program (TEP) of the 1990's and its drive to develop the metrics of the information economy. This is not the place to do more than touch on this work, but the brief references following illustrate the utility of continuing attention to, and involvement in, OECD project activity.

With the growing recognition that innovation is essentially an inductive process, encouraged by supportive public policies but generated at the enterprise level, the OECD now devotes much more attention to business strategies, including networks and alliances. The OECD observes that business R&D is no longer concentrated in large firms motivated by protecting established market share, but by a wider range of large and small firms in all sectors, using collaborative arrangements and expanding venture capital (VC) pools. Its 2002 Outlook finds governments responding to this activity with further inducements, through increased public funding of both industrial R&D and public research organizations (PROs), promotion of entrepreneurship and measures to boost the S&T workforce and improve worker training. It also detects a return, after more than a decade of horizontal approaches, to targeting of S&T funding to specific fields and sectors.

With regard to Canada, the OECD's analysis challenges many domestic perceptions of inadequacy. To draw one example from the 2002 Outlook, over the last 20 years total funding of R&D performed in the higher education and public sectors has grown in Canada from 0.6% to 0.8% of GDP. In the UK, the situation is reversed, and in the US, where the PRO percentage was comparable to Canada's in 1981, it had fallen slightly by 2000. As will be discussed later, the causal value of more PRO activity and expenditures may be debatable, but in Canada it is seen as a partial substitute for industrial R&D.

The OECD's review of trends and issues in tax incentives for R&D also ranks Canada highly, with one of the most favourable tax treatments of R&D among member countries, and relatively more generous R&D tax incentives to both large and small firms. That said, they also found Sweden and Finland to have high levels of business R&D without tax incentives. Of the eight most developed nations (G-8), the only country with a richer R&D tax incentive system than Canada is Italy – which consistently ranks near the bottom of R&D "performance" within the G-8.

Two more Canada-specific analyses related to innovation should be noted briefly, as their topics appear regularly in "top-five" rankings of factors impacting negatively on R&D and commercial innovation in this country. The first of these is regulation, addressed in the OECD's 2002 report on regulatory reform (*Maintaining Leadership Through Innovation*). The OECD gave Canada a strong report card. While noting specific issues (e.g. foreign ownership restrictions in telecommunications and the non-arms-length relationship between the Competition Bureau and the Industry Department), it ranked Canada behind only the UK, on a par with the US and ahead of other member countries, regarding regulatory policies generally, and on economic regulation and barriers

to entrepreneurship specifically. One cautionary flag concerned the administrative burden on start-ups, where Canada is seen to be markedly behind the U.S.

The matter of regulation is one to which this note will return repeatedly in the following sections, as it cuts across several areas of diagnostic and prescriptive concern. Regarding the evidence, some would suggest that OECD/G-8 comparisons are of limited relevance, arguing that the U.S. is the only meaningful reference with regard to investment and performance in the North American economic space. Similarly, with regard to policy prescriptions, it is argued that questions of regulatory comparability and harmonization should be assessed primarily in relation to American practice.

The other recent Canada-focus OECD study of note with regard to commercial innovation is its venture capital policy review (2003). Here, the OECD found Canada to have one of the highest levels of venture capital investment as a share of GDP among member countries. Indeed, it found that between 1995 and 2001, Canada realized “phenomenal growth in venture capital supply and the creation of over 200 new venture capital funds”, noting that “foreign investors, particularly from the US are now the major players and are targeting their funding to technology-based startups”.

Proponents of more public incentives to VC and angel investment will hasten to point out that this growth was thinly distributed (concentrated in the ICT, and latterly biotechnology [biotech], sectors), and deflated very soon after the period observed in the study. They will add that, as with regulatory regimes, the only relevant comparison is with the U.S., where technology knowledgeable VC markets dwarf those in Canada. On the other hand, skeptics will note that Canadian technology start-ups and small and medium enterprises (SMEs) are becoming increasingly successful in accessing specialized venture capital without relocating their operations south, and that the fluctuations in VC markets in recent years reflect the fluctuations in returns in high-tech sectors rather than institutional barriers or risk-averse culture. In other words, according to this view, risk capital markets are functioning as they should.

With this legacy from Lamontagne, Macdonald and Prosperity, followed in the past decade with wide acceptance of the centrality of the commercialization of knowledge in the process of wealth creation, in 2001 Industry Canada embarked on the construction of a 21st century innovation policy, culminating in an Innovation Summit in November 2002. By this time, there was little disagreement about the basic elements: (1) generation of knowledge (R&D); (2) the transmission and commercialization of knowledge; (3) the financing of and the climate for innovation; and, (4) knowledge workers and entrepreneurs – the “technopreneurs” of the knowledge-based economy and society. Around these four dimensions of innovation was a (renewed?) awareness of the spatial context of creative life. Despite the digital capabilities of our “virtual” world, it appears that many of the fundamentals of human and economic geography hold – economic surplus continues to be generated in urban agglomerations, now labeled “clusters”, or “regional systems of innovation”.

A six-page backdrop cannot adequately set the scene for assessing present and future considerations about commercial innovation, but hopefully some of the foregoing cross-references will be useful for less-initiated readers to pursue. At any rate, it is time to turn to the main purpose of this note – to

consider the factors determining commercial innovation performance in the Canadian business sector in terms of their contemporary policy relevance and implications.

## COMMERCIALIZATION FACTORS

Industry Canada's innovation strategy framework is the latest in a long line of organizing typologies on this subject. Many track the innovation process, beginning with the generation of commercially-applicable knowledge and proceeding through stages of development, financing, marketing and so on. (It was recognized early on that, in terms of time and money, the "R" of R&D typically amounted to no more than 20% of the process, though if anything the concentration of public "innovation" expenditures on research has increased). Academic studies often point to factors beyond the practical reach of public policy while, understandably, policy work tends to seek out policy-malleable factors.

When aggregate economic performance is lagging, such as in the recessions of the early 1980's and 1990's noted above, diagnostic and prescriptive analysis regarding commercial innovation has tended to converge with broader economic development policy concerns, with calls for correcting monetary and fiscal policy "fundamentals". When overall economic performance is more robust (as it is seen to be currently, at least in internationally-comparative terms), analysts point to more particular concerns, such as the shallowness of industrial R&D or projected shortages of skilled labour, factors seen to be leading to the hollowing-out of Canadian industrial performance and competitiveness over time.

As the purpose here is not to propose yet another factor typology, but to assess recognized factors in terms of their contemporary policy relevance for the ACST, this note will use a conventional three-tier factor framework:

- (1) *systemic factors: which correspond roughly to macro policy instruments and cultural determinants;*
- (2) *structural factors; which cover aspects of industrial structure and horizontal policy instruments; and,*
- (3) *organizational factors: which include the micro factors determining firm-level opportunities and performance.*

### ***Systemic Factors***

Until relatively recently, the dominant factors seen to be holding back the innovative performance of Canadian enterprises were economy-wide. Paramount among these, notably at the time of the Prosperity Initiative, were high costs of capital and unfavourable terms of trade, requiring corresponding fiscal and monetary policy shocks. (How, reasoned threshold Canadian high tech firms, can we generate retained earnings to invest in innovative products, processes and services when our bankers and/or shareholders want the first 15%?). As the only G8 country now running a fiscal surplus (while the US moves to deepen its structural deficit indefinitely and Europe struggles to deal with underfunded public pensions), and with a Canadian dollar in the mid-70's seen as a middle ground between the export-killing levels of the 1980's and the productivity-avoiding ones of



the 1990's, Canadian macro-economic policy and performance simply cannot be seen as the storm anchor of industrial innovation currently.

A second set of systemic factors concerns Canada's "innovation culture", or lack thereof. This thrust sees Canadian corporate leadership as failing to be innovative because of a succession of competitiveness crutches, from resource rents to industrial tariff protection to, more recently, trade subsidies delivered through low-dollar "policies". The record suggests otherwise, particularly with continental trade liberalization driving massive industrial restructuring in Canada in the last 15 years (including the resurgence of takeover foreign direct investment) and Statistics Canada reporting that 40% of new jobs in the 1990's were created by firms that did not exist at the beginning of the decade. There is already, in any event, no shortage of innovation culture cheerleaders now on the field, led by Industry Canada and the Conference Board, and it is not clear that their exhortations are particularly effective in reaching, let alone influencing, Canada's technopreneurs. (More on this later, in the context of industrial structure).

A third set of systemic factors, which pre-Macdonald would have been treated as structural factors, deals with markets, market access and (increasingly) market rules. Historically, this set of factors was divided into two distinct components: international trade policy and domestic corporate governance (hence their treatment as structural policies). Since at least the coming of NAFTA and the World Trade Organization in the mid-1990's, however, it is only a mild overstatement to assert that all economic policy is now linked to trade policy broadly-defined. True, the international financial institutions and their allies in national Treasuries continue to hold out against being subject to trade disciplines, as do social policy-makers, but even with the post-Seattle stalling of the world trade agenda, more and more structural and micro-economic policies are becoming subject to disciplines of non-discrimination and/or national treatment. (Simply put, government, particularly federal government, actions to directly intervene in the functioning of the Canadian economy are now much more tightly constrained by international trade rules).

Why are marketplace issues of more than passing interest to advisors on commercial innovation? The reason is that, of all the factors in the commercialization mix, perhaps none has grown in recognition over the past decade more than the importance of well-functioning markets. At one level, of course, this is trite, or even tautological, because growing, profitable sales are the litmus test of innovation. Put another way, it has long been accepted that innovation must, ultimately, be market-driven. Despite this recognition, though, trade and marketplace policies have largely been treated as outside the purview of industrial innovation. This is no longer appropriate for several reasons, including the need for:

- (1) effective access to expanding markets<sup>1</sup> (not just elimination of tariffs, but of technical barriers and restrictive practices too);
- (2) market rivalry (competition is as important to innovation as is collaboration);

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<sup>1</sup> An example: March Networks did not put its tele-health business on hold recently because of inadequate technology. It did so because it saw the domestic (provincially-run) market as too fragmented, and did not see reasonable prospects of cracking major US HMO markets within 5 years.

- (3) market integrity (investors in high-risk ventures are wary enough without being concerned about uncertain rules regarding regulation, proprietary rights and the limits on collaboration); and,
- (4) rules regarding service sector markets (the international trade community is only now getting specific about one of the fastest-growing and most innovative sectors of the global economy, which is commercial services, already US dominated).

To summarize this policy overview of systemic factors impacting commercial innovation from an ACST perspective, it is suggested that:

- (1) in recent years (i.e. in the period not covered by much of the reported data and studies), macro-economic performance and policies have been in better shape (particularly in contrast to Canada's industrial competitors) than they have been for a long time;
- (2) attitudinal deficiencies in Canada's innovation culture are likely overstated, and not particularly responsive to exhortations by policy advisors in any event, and,
- (3) policies concerning markets, including market access (liberalization) and market rules (competition and integrity) are more relevant to industrial innovation than attention to date would suggest, and are more subject to domestic policy leverage than are cultural or macro-economic factors.

### ***Structural Factors***

Of the class of commercial innovation factors traditionally labeled as "structural", there are two principal sets. The first of these concerns Canada's industrial structure. Although this set has been largely treated as policy-exogenous, it nevertheless represents the largest group of explanations put forward to account for perceived failings in the private sector's innovation capacity and performance. These include:

- a branch plant manufacturing base, applying replication strategies using parent-delivered technology and techniques (the Science Council's "weakest link");
- a commodity-exporting resource sector, strategically inclined to extract rents from raw materials rather than adding value (British Columbia has Canada's richest forest resource, but the lowest ratio of value-added to output; Manitoba which turns modest wood fibre into doors, windows and furniture, has the highest); and,
- among Canadian-based manufacturing enterprises, a preponderance of SME's (seen to be below thresholds for significant investment in R&D or training).

One result of this highly-differentiated industrial structure has been correspondingly differentiated sectorial and industrial innovation policies:

- for multi-national enterprises subsidiaries, sector-specific financial, regulatory and trade policies to encourage investment and sustain employment in both their and their suppliers' operations (Defense Industry Productivity Program, Technology Partnerships Canada,

Export Development Program for aerospace; enhanced patent protection for pharmaceutical research; the Auto Pact for automotive assemblers<sup>1</sup>);

- for resource firms, sector-specific exploration and extraction promotion policies, both federal and provincial (energy, mining and forestry), and producer protection (agriculture); and,
- for Canadian SME's, an array of special tax treatment, risk capital institutions and work force assistance,

By and large, emerging transformative technologies such as ICT, biotechnology and environmental technologies have been targeted only modestly, principally through Technology Partnerships Canada.

The other broad set of structural factors concern key factors of production, and the “horizontal” policies associated with them. Indeed, “innovation policy” is itself usually regarded as a structural policy, encompassing not only financial assistance to R&D, but also policies influencing risk capital availability, intellectual property, skilled labour and training, and so on. With the tendency towards convergence of innovation and other economic development policies in recent years (“what’s good for innovation is good for the micro-economy”), structural innovation policies are no longer the exclusive (or even principal) domain of industry departments and their agencies. (Note the intent of the Canadian Institutes of Health Research to better link health care expenditures and economic opportunities).

This micro-economic policy convergence certainly responds to earlier calls from the innovation policy community for a “knowledge economy” policy orientation across government, and is reflected specifically in the (regrettably-superficial) partnership between Industry Canada and HRDC in the innovation/skills agenda.

For the ACST, this also means that it need not devote as much attention and energy to calls for fixing general economic conditions and policies as NABST had to a decade ago. Rather, it can concentrate on those structural economic policies accepted to be most directly relevant to industrial innovation. These include:

- (1) financial incentives;
- (2) intellectual property;
- (3) support to SME innovators;
- (4) technical and entrepreneurial skills; and,
- (5) partnerships/bridging institutions.

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<sup>1</sup> Though the demise of the Auto Pact is not the direct cause of the lack of new investment in Canada by the Big 3 automakers (Canadians still make three times as many North American autos as they buy), the absence of an R&D base behind that production leaves Canada without a hook to attract new auto investment once the current overcapacity clears. (The Canadian fuel cell industry, with a small fraction of the people and sales of the Canadian auto industry, does more R&D than the latter).

Happily, these structural factors correspond roughly to the elements identified by those leading the work on commercialization pursuant to the federal innovation strategy<sup>1</sup>, and to the menu set out by the OECD in its 2002 Science, Technology and Industry Outlook. Given that on-going work, these factors need not be addressed at any length in this note, but the following observations may be useful:

- concerning financial and fiscal incentives, and access to innovation risk capital: after the generous treatment of “knowledge infrastructure” in the last 4 federal budgets (now totaling some \$2.3B/year), and the OECD’s recent findings about R&D tax treatment and venture capital, it is unlikely that the Department of Finance could be easily convinced of major gaps or inadequacies in terms of financial or capital markets for innovation. Business will always perceive a gap in risk capital,<sup>2</sup> but these impressions need better empirical underpinnings if they are to be seen as more than special-interest pleading ;
- the matter of intellectual property protection remains problematic; there appears little consensus about intellectual property reform, either generally or with regard to public research organization-generated intellectual property. (With regard to the latter, the ACST report on “Reaping the Benefits” was, if anything, counter-productive in calling on academics to don “benefit-to-Canada” straightjackets.) Interestingly, despite the fact that a majority of Canadian generators of intellectual property now file first in the US, the literature remains almost silent regarding a NAFTA patent, (or a NAFTA drug regulator), even after the EU has implemented common regimes in both areas;
- support to SME innovators holds promise for further enhancement, building on the Government of Canada’s Industrial Research Assistance Program (IRAP), Business Development Bank of Canada (BDC), CANARIE (Canada's advanced Internet development organization), PRECARN (a member-owned consortium of Canadian companies and government research organizations) and other initiatives found by the OECD to be mirrored and useful in other small, open industrialized countries concerned with promoting indigenous development opportunities;
- particularly in the Canadian federation, a concerted national commitment to education and training remains, despite sustained rhetoric at all levels of government and industry, an ever-elusive goal. Indeed, despite the universal acceptance at the time of the Prosperity Initiative of the fundamental importance of “learning well...living well”, in the following decade (driven by fiscal restraint and uncontrollable health care costs), according to newspaper reports, per student funding of post-secondary education fell by 20% in Canada, while it was growing by 20% in the US. In terms of commercialization, the Prosperity Initiative’s call to “increase the pool of experienced entrepreneurs and marketers” lacked program specification, perhaps recognizing that, while entrepreneurs are not necessarily born, they are made in the marketplace, not in the classroom; and
- regarding support partnerships and “bridging institutions”, research attention in Canada (the Social Sciences and Humanities Research Council-funded Innovation Systems Research

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<sup>1</sup> See: “Building Canada’s Capacity for Commercialization: Workshop Report” (National Research Council/March 2003).

<sup>2</sup> See CATA’s Business Plan (de la Mothe/2003)

Network, or ISRN) and abroad (notably in the UK) has noted the utility of cooperation between research organizations, government and industry through complementary investment in R&D and innovation-related activity. Intuitively, tacit knowledge is more easily transferred where there is high-density and high-quality networking within connected productive systems; hence the supportive networks and social capital (trust and communication leading to joint commitment of resources) found in local production areas appear to offer potential for innovation capacity-building.

To sum up with regard to structural factors influencing commercialization, industrial structure factors suggest a continuing need for targeted promotion policies, though perhaps with less emphasis on resource sector investments and arrangements with multi-national enterprises manufacturing subsidiaries, and more on Canadian enterprises engaged in emerging technologies and innovative services. Horizontal policy factors are now receiving considerable attention and resources, though with little coherence with regard to the key areas of intellectual property and skills development. A number of market-related factors, such as regulatory environments and regulatory harmonization, are now seen as taking on “system-level” significance

### ***Organizational Factors***

Last, but certainly not least, are the genuinely micro factors – those that most directly determine the performance and opportunities of individual firms. CBOC rightly began at the firm level in its first (and best) annual innovation report, noting the markedly different performance of ostensibly-similar firms in a variety of sectors, and the better performance of more innovative firms overall.

CBOC’s work is dwarfed, however, by the more than 50 empirical studies undertaken in the last five years on business, science and trade by the Microeconomic Analysis Division of Statistics Canada<sup>1</sup>. These studies range across small firms and their importance, patterns of growth, economic geography globalization and the effects of trade liberalization, and technology use and innovation in relation to the knowledge economy. They represent an unparalleled resource for those seeking to get beyond advocacy analysis to the micro determinants of industrial activity and innovation in Canada.

Organizational factors influencing commercial innovation can be sorted in a number of ways – the simplest being to differentiate between intra-firm factors and inter-organizational ones. Within the firm, investment in R&D is seen as important, but this can as usefully be applied R&D (adopting and adapting new technologies and equipment in commercially-innovative ways) as “break-through” research. (Recall that 98% of patentable intellectual property originates outside Canada). A receptive innovation culture is seen as equally important, and one of the most common features of successful innovating firms is their rigorous monitoring of markets and market rivals.

Marketplace awareness links intra-firm factors to inter-organizational ones. Few enterprises today, let alone smaller Canadian ones operating principally in domestic markets, can afford to rely

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<sup>1</sup> A handful of the most relevant of these are noted in Annex 2; a complete annotated listing, together with a forward research program, can be found in the 1999-2001 Program Report of the Analytical Studies Branch of Statistics Canada.

exclusively on internal ideas and resources. Firms need to be able to draw on upstream research facilities, skilled labour and management pools, patient capital and a variety of strategic technology and marketing alliances or joint ventures. Currently, policy attention and innovation infrastructure initiatives are focused on two kinds of inter-organizational arrangements: (1) university-industry linkages, and (2) knowledge-based clusters.

The substantial federal investment in university and public research organization-based knowledge infrastructure of the past few years (including the Canadian Foundation for Innovation, millennium Chairs and scholarships, granting council enrichment, CANARIE, Genome Canada, PRECARN and the like) all but requires moving beyond the soft (Networks of Centres of Excellence-type) gown-town arrangements of the past. If only to avoid an Auditor General's backlash a few years hence, these heavy investments in university-based research activity must, and must be seen to, translate into broader economic and social benefits. (Remember Lamontagne's warning of 30 years ago). Simply funding university commercialization offices seems a very narrow bridge upon which to rely for all that traffic.

Fortunately, the complex interactions between players in the innovation system are much more than a binary relationship between industry and academe. Students of knowledge-based clusters are now adept at rear-view analysis of successful clusters, though these too have their life-cycles (today's rust belts were once growth poles). There may be 50 North American cities vying to be amongst the top 5 biotech clusters on the continent, and many more world-wide, but forced growth clustering has many more failures than successes. (New Brunswick Multiplex sought to create a world-class white goods industry around Saint John, but begat Bricklin instead). Much more recently and closer to Industry Canada's Industry Portfolio home, the National Research Council's well-intentioned efforts to promote research clusters have been challenged by the government's multiple policy objectives, as ICT research infrastructure is fragmented in the Atlantic Initiative, and Edmonton lands neuroscience so that Canada's richest province is no longer National Research Council lab-less.

Does this mean that ACST should steer clear of engaging organizational innovation factors as too elusive and/or politically fraught? Not at all. Given that many of the systemic factors are in hand or out of reach, and that most structural factors are now the domain of all conscientious economic policy agencies, not just the innovation community, it is in fact the micro/organizational level where ACST has some claim to comparative advantage. Building the innovative capacity of indigenous Canadian firms and autonomous Canadian affiliates of transnational enterprises provides a variety of opportunities for the public (not just federal) sector to contribute, and the links between and among private and public entities in the innovation system appear to produce significant positive externalities, suggesting that their encouragement should not be left solely to the marketplace.

### ***Innovation Supply and Demand***

Beyond these concentric circles of organizational, structural and systemic factors, there are of course many other typologies to organize thinking and analysis about innovation determinants and prescriptions. Some innovation policy observers, particularly those of an economics persuasion, find it useful to approach the topic in terms of innovation supply and demand.

Historically, much of the focus of innovation policy has been on the supply of technology – on promoting “technology push”. Key elements of this supply have included R&D activity and the availability of highly-qualified personnel and risk capital. Most targeted innovation policy advocacy and activity has been supply-side, intended to increase these factors of innovation production.

After decades of fiscal support for supply enhancement, there is an increasing inclination to examine Canadian innovation inhibitors from a demand perspective, as Roger Martin of the Rotman School does. Despite the transparent self-interest of his analysis (which leads to a case for more funding of business education...), Martin is not alone in noting the insularity of much Canadian corporate strategy. He is probably correct that the post-FTA generation of Canadian corporate managers now emerging will be more agile and demanding than were many of their predecessors operating in a more-protected business environment.<sup>1</sup>

## **POLICY OBSERVATIONS**

This review of the last decade’s economic and policy analysis of commercial innovation suggests the following, organized around (1) diagnosis and measurement, and (2) factor prescriptions.

### ***Diagnosis and Measurement***

A concentrated reading of Canadian innovation policy material finds an unremitting “chicken little” litany –the sky has been falling for many years, and the Canadian economy will be a basket case any day now, unless... Well, it does not appear to be turning out that way. Although short-term prospects can change like tomorrow’s weather in Halifax (already we are hearing about slower growth for 2003-4, not because of Canadian “fundamentals”, but because of US stagnation), both macro and micro Canadian indicators point to both absolute and relative economic health. So, if innovation policy advocates want to soften the cold hearts of federal budgetary managers in favour of ever-more public expenditures on “innovation”, they should speak to the intrinsic benefits of innovative corporate behaviour in terms of wealth creation and economic opportunity, not just for researchers and shareholders but for Canadian society. Simply railing about “falling behind” and “gaps” will not do this, especially when the evidence is otherwise.

Unsubstantiated rhetorical over-statements also cloud our understanding of innovation causality, and hence measurement of both innovation requirements and innovation performance. When the intensity of calls for more government support for inducing innovation supply (typically risk capital) continue unabated regardless of observed changes in supply or analytical evidence of incremental utility, even Terry Matthews (Ottawa’s current entrepreneurial hero) sounds shallow and self-serving. Indeed, the advocacy arguments of the innovation support community are typically more normative than objective – “give us more because our positive externalities are...”(pick your multiples).

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<sup>1</sup> The Canadian economy is not yet an open book – Martin himself notes that “large portions of the Canadian finance, telecommunications and transportation services, and media and publishing industries are highly protected to this day.”

Oddly, the sharp-eyed entrepreneurs and sharp-pencilled accountants of the innovation community often don't seem very interested in determining returns on the public's money. Performance measurement and accountability may be terms that innovation promoters would like to confine to business schools, but when Premiers are being held to account for federal health care transfers, ACST should recognize the importance of demonstrating the value-added of both current and proposed incremental "innovation" spending. Constructing a better information base regarding public innovation activity and expenditures would be a good place to start, perhaps along the lines of the Canadian Institutes for Health Information.

The measurement issues are not trivial. The incremental utility of supply-side interventions and expenditures are challenging enough given the complexity (and, hence, co-linearity) of the innovation process. Demand factors, especially systemic ones, are even more difficult to assess. Nevertheless, there is no reason why the guardians of the public purse or promoters of public goods investments (let alone libertarians) would accept without evidence that innovation investments will generate a greater return than alternative investments, say in mental health reform or early childhood services.

A reading of the innovation angst literature also leads to a further observation: it is written largely by institutional players – government policy wonks and tenured academics –and so it tends towards institutional responses. These comfortable-pew observers (myself included) take solace in phrases such as "national innovation systems" and "systemic responses to the innovation challenge". These concepts are evidently helpful from a public policy perspective, but in that process we seem to lose sight of the reality of innovation –it does not take place in institutions, but in the minds and activities of individuals (many of whom, at least initially, have second-mortgaged their homes and cashed in their RRSPs to avoid foreclosure) and their business enterprises.

Of the over 50 innovation documents reviewed for this note, very few studies (as opposed to advocacy statements) spoke directly to the perspective of the innovation investment decision-maker (the ACST's 1991 analysis of financing industrial innovation was a notable exception). Innovation is not about national purpose; it is about convincing business investors that they will get a higher return on their investment by plowing earnings back into the business rather than taking their dividends or increased share values elsewhere. It may be inevitable that innovation policy analysis is composed by those of us who are not trying to survive in business, but it is incumbent upon us to remember that we are not building systems – we are creating environments for innovation.

In terms of results, a central question must be: "what are we measuring?" In particular, what do we mean by "successful" Canadian commercial innovation? Commercial success for indigenous Canadian firms will likely be measured by market value, but when Spar (or Connaught Laboratories or Corel for that matter) is sold and the many millions of taxpayer dollars invested in nurturing the enterprise are shared between the vendor shareholders and the acquiring foreign firm, "benefit-to-Canada" can be an elusive concept.

As a segue to prescriptions, let us also remember that Canadian-based innovators are not homogenous. They can be parsed into many sub-groups, the principal of which are: (1) resource sector managers, who may want to add value to Canada's resource patrimony, but face an unremitting secular decline in prices in their commodity markets; (2) manufacturing branch plant



managers, who must justify every dollar in Canadian production investment, let alone innovation; (3) the indigenous Canadian manufacturing/service enterprise, struggling through various alliances and networks to compete domestically and internationally, for whom success (paying off the mortgages and helping with their children's education) may well be defined as a buyout by the American with deep pockets, as noted above.

Turning now to policy prescriptions, recall that the section on commercialization factors set out three principal types, or levels, of factors impacting on commercial innovation in Canada. The following policy observations will track that typology.

### ***Systemic Factors***

This note commented on three sets of systemic factors: (1) macro factors; (2) cultural factors; and (3) market factors. It concluded that macro factors are relatively healthy (and largely outside the domain of innovation advocates in any event) and that diagnoses of Canada's "low-risk, low-innovation" culture are overstated and reflective of the country's resource and multi-national enterprises-dominant industrial structure, where innovation-promoting exhortations of the institutional sector fall on infertile ground. An emerging set of systemic factors concern markets, and ACST advisors should become more cognizant of the heretofore-arcane worlds of market access policies and marketplace rules.

A prominent dimension of marketplace rules concerns international harmonization. As noted earlier, both regional and multi-lateral trade regimes now encompass much more than commitments about reducing tariffs and non-tariff barriers. Inter alia, they discipline procurement practices, patent coverage, competition rules and industrial subsidies -- the meat in the innovation policy sandwich. ACST must be literate in these fields, and must have progressive/pro-active views about where regulatory harmonization, reciprocity and/or integration would be to Canada's innovative advantage.

### ***Structural Factors***

Policies responding to Canada's industrial structure have tended to promote production-maximization (from autos to lumber) rather than innovation-maximization. If the "new economy" means getting beyond resource extraction and branch plants manufacturing, ACST should point the way to targeting policies on next-generation technologies and processes, rather than on forestalling industrial adjustment.

### ***In terms of "horizontal" policies, ACST should be concerned with:***

- getting outside the box on intellectual property and patent policy. If Canada's is now demonstrably and irretrievably in an integrated North American economy, would there really be any meaningful economic harm or loss of political sovereignty in a North American patent regime or biotechnology approval process?
- getting beyond the rhetoric of governments on skills. Having already done useful work on highly qualified personnel, the ACST should hold up a mirror to both levels of government about their rhetoric/reality gap on post-secondary education, and on education and training

generally. (Recent newspaper headline: “Statistics Canada reports that public funds for tuition fall 32% since ‘86”). As the kids themselves say, “go figure”.

### ***Organizational Factors***

Because commercial innovation happens in businesses, not in governments or in other institutions, proposals for interventionist government support for innovation are always in danger of being oxymoronic. That said, impressionistic senses and anecdotal evidence suggesting that instruments such as IRAP and BDC can make a difference are being corroborated by the OECD and other dispassionate sources. These are not the mechanisms to relate to capital-intensive resource firms or manufacturing subsidiaries answering to foreign corporate return on investment strategists, but they do relate to Canada’s indigenous entrepreneurial heart.

Other countries do more, or different, things. The manufacturing extension program in the US (when it is not dodging Republican axes) offers more business expertise in the mix than does IRAP, and several U.S. government departments are required to allocate a percentage of their R&D procurements to SMEs. The UK, New Zealand and others differ in their specific instruments, but together they suggest that Canadian programming should continue to attempt to add value to the entrepreneurial and managerial capacity of indigenous SMEs. What OECD and other analysis also suggests is that we don’t need more raw or crude instruments – tax incentives, venture capital props, labour subsidies – but “knowledge resources” to extend the capacity and reach of growing firms. (Yesterday’s Canadian Executive Services Overseas volunteers are becoming today’s angel investors.)

Regarding inter-organizational synergies (the “networks” and “clusters” of the lecture circuit), there is concern that too many gown/town eggs are being placed in the basket of university technology transfer offices. ACST asserts (in the Fortier Report) that “universities are uniquely poised to drive economic growth and social well-being”, but this won’t happen through applying 12-step principles of good entrepreneurial citizenship for academics, or a wholesale migration of the technology professoriate to the business sector. Rather it will happen, as the National Bureau of Economic Research (US) has noted,<sup>1</sup> from a transfer of knowledge between discovering scientists and those in a position, and motivated, to develop this knowledge commercially. As PRECARN scrambles yet again to address the looming end of another term funding arrangement, ACST should be advocating for more, and better-resourced, instruments of university-industry knowledge transfer, and resisting “new public administration” models of revenue self-sufficiency and privatization in this domain.

Finally, there is the renewed recognition of metropolitan areas as innovation incubators, and of the damage done to urban intellectual infrastructure by a decade of fiscal retrenchment at all levels of government. Hopefully, a new federal administration will be able to get beyond the current mutual finger-pointing which typically characterizes the pre-action phase in Canadian inter-governmental politics. Federal budgetary remediation is now addressing the tip of the iceberg – the luring of today’s ranking researchers to, and back to, Canadian institutions – but tomorrow’s innovation elite will not come to (or stay in) Canada if taxpayer relief continues to trump public investments ranging

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<sup>1</sup> Commercializing Knowledge: University Science, Knowledge Capture and Firm Performance in Biotechnology (National Bureau of Economic Research, Working Paper 8499, 2001)

from early childhood education and public health to transportation infrastructure and environment protection.

## SUMMARY

This essay has attempted to survey the evolution of innovation policy thinking, the key determinants of the innovation process and some of their policy implications.

Stripping away the narrative from this policy stocktaking, Annex 1 sets out what the literature sees as the key systemic, structural and organizational factors influencing the commercialization of knowledge. Within this schema, it is suggested that the ACST:

(1) devote its own attentions principally to:

- indigenous manufacturing and service enterprises; • support of SME innovators, and
- university-industry linkages.

(4) become more knowledgeable about, and about how to influence:

- marketplace factors and issues;
- intellectual property;
- technical and entrepreneurial skills; and,
- knowledge-based industrial clusters.

Finally, it is stressed that analysis and advocacy, regarding both innovation supply and demand, should be matched by ACST thinking and proposals regarding innovation measurement and accountability for public resources.

**June, 2003**

### **About the Author**

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## **ANNEX 1:**

### **COMMERCIALIZATION FACTORS: A TYPOLOGY**

#### **SYSTEMIC FACTORS**

- macro-economic factors
- cultural factors
- market factors \*

#### **STRUCTURAL FACTORS**

- **industrial organization o resource-based firms**
  - multi-national enterprises manufacturing subsidiaries
  - indigenous manufacturing and service enterprises\*\*
- **factors of production/horizontal policies**
  - financial incentives
  - intellectual property\*
  - support to SME innovators\*\*
  - technical and entrepreneurial skills\*

#### **ORGANIZATIONAL FACTORS**

- **intra-firm factors**
  - R&D activity
  - employee participation
  - marketplace intelligence
- **inter-institutional factors**
  - alliance and joint ventures
  - university-industry linkages\*\*
  - knowledge-based clusters \*

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\*\* areas of ACST comparative policy analysis/advocacy advantage

\* areas where ACST should increase attention

## **ANNEX 2**

### **COMMERCIAL INNOVATION: A POLICY STOCKTAKING**

#### **Principal Documents Reviewed**

##### **Prosperity Initiative Material**

- (1) Prosperity through Innovation: The Task Force on Challenges in Science, Technology and Related Skills: Background Paper (1992)
- (2) Consultation Paper: Prosperity through Competitiveness (1991)
- (3) Consultation Paper: Learning Well...Living Well (1991)
- (4) The Prosperity Action Plan: A Progress Report (1993)

##### **Conference Board of Canada: Annual Innovation Reports**

- (1) Building the Future (1999)
- (2) Collaborating For Innovation (2000)
- (3) Investing in Innovation (2001)
- (4) Including Innovation in Regulatory Frameworks (2002)

##### **National Advisory Board on Science and Technology (NABST)**

- (1) Statement on Competitiveness (1991)
- (2) Committee on Financing of Industrial Innovation (1991)
- (3) Healthy, Wealthy and Wise: A Framework for Integrated Federal Science and Technology Policy (1995)

##### **Organization for Economic Co-operation and Development (OECD)**

- Diffusing Technology to Industry (Cervantes, 1997)
- Science, Technology and Industry Outlook (2002)
- Trends in Business R&D and Government Support for Business Innovation in OECD Countries (2002)
- Business Strategies Workshop (2001)
- Tax Incentives for Research and Development: Trends and Issues
- Regulatory Reform in Canada: Maintaining Leadership Through Innovation (2001)
- Venture Capital Policy Review: Canada (2003)
- The Impact of Public R&D Expenditure on Business R&D (2000)
- Boosting Innovation: The Cluster Approach (Case Studies/1999)

### **Advisory Council on Science and Technology (ACST)**

- Public Investments in University Research: Reaping the Benefits
- Canada's Innovation Strategy; Challenges and Opportunities in Moving Forward

### **Science Council of Canada**

- (1) Science Policies in Smaller Industrialized Northern Countries (Seminar Proceedings/1978)
- (2) Multinationals and Industrial Strategy: The Role of World Product Mandates (Working Group on Industrial Policies/1980)
- (3) University Offices for Technology Transfer: Toward the Service University (Enros and Farley/1986)
- (4) University-Industry Research Centres: An Interface Between University and Industry (Workshop Proceedings/1987)
- (5) University Spin-Off Firms: Helping the Ivory Tower Go to Market (Workshop Proceedings/1987)

### **Statistics Canada: Microeconomics Analysis Division Studies**

- The Importance of Research and Development for Innovation in Small and Large Canadian Manufacturing Firms (Research Paper Series, #108/1997)
- Growth of Advanced Technology Use in Canadian Manufacturing During the 1990's (Research Paper #105/1999)
- Business Strategies in Innovative and Non-Innovative Firms in Canada (Research Paper #73/1995)
- Innovation: The Key to Success in Small Firms (Research Paper #76/1995)
- Multinationals and the Canadian Innovation Process (Research Paper #154/2001)
- Impediments to Advanced Technology Adoption for Canadian Manufacturers (Research Paper #173/2001)

### **Industry Canada: Micro-Economic Analysis Branch**

- Restructuring in Canadian Industries: A Micro Analysis (Working Paper #23/1998)
- The Importance of Firm Size, Sectoral Patterns of R&D Industrial Structure and Foreign Ownership for Canada's R&D Performance Relative to the US (Staff Paper #59/1999)
- R&D, Prosperity and Productivity Performance of Foreign-Controlled Firms in Canada (Working Paper #33/2001)

## **Industry Canada: Industrial Analysis Centre**

- Canadian High-Growth Firms: Mapping the Entrepreneurial Landscape (White/2002)
- Technology Identification and Support in Selected Countries (Caldwell/2002)
- Review of Knowledge-Intensive Industrial Clusters in Canada (White/2001)
- Interfirm Collaboration on Product and Process Development: An Annotated Bibliography (Markel/2002)

## **Other Sources**

- The Demand for Innovation in Canada (Martin, University of Toronto, 2002)
  - Canadian Competitiveness: A Decade After the Crossroads (Martin and Porter, 1999)
  - Angel Investment in Canada: A Regional and National Perspective (Ilkay for Industry Canada, 2003)
  - Targeted Strategies for Emerging Technologies and Industries: An Economic Policy Framework (Orr/WEFA for Industry Canada, 1998)
  - Canada's Advanced Technology Business Plan (de la Mothe/CATA, 2003)
  - Canadian Fuel Cell Commercialization Roadmap (Fuel Cells Canada, 2003)
  - Innovation, Institutions and Territory: Regional Innovation Systems in Canada (Hollbrook and Wolfe eds, Queen's University, 2000)
  - The Regional Innovation Paradox: Policy and Industrial Policy (Oughton, Landabaso and Morgan/Journal of Technology Transfer, 2002)
  - Local Clusters, Innovation Systems and Sustained Competitiveness (Mytelka and Farinelli, UNU/INTECH, 2000)
- (1) Clusters of Innovation: Regional Foundations of US Competitiveness (Porter/2001)
  - (2) R&D Trends in the US Economy: Strategies and Policy Implications (NIST/1999)
  - (3) Commercializing Knowledge: University Science, Knowledge Capture and Firm Performance in Biotechnology (National Bureau of Economic Research, USA/2001)