Science Council of Canada
Conseil des sciences du Canada

Report 37

Canadian Industrial Development

Some Policy Directions

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September 1984

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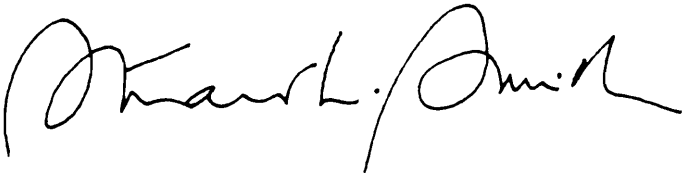
September 1984

The Honourable Edward C. Lumley
Minister of State for Science and Technology
House of Commons
Ottawa, Ontario

Dear Mr. Lumley:

In accordance with Section 13 of the Science Council of Canada Act, I take pleasure in forwarding to you the Council's Report No. 37, *Canadian Industrial Development: Some Policy Directions.*

Yours sincerely,



Stuart L. Smith
Chairman
Science Council of Canada

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Chapter 1

Obstacles and Opportunities

What distinguishes this report on industrial policy from many that have gone before is that the Science Council is not advocating a new overall approach to industrial and technology policy. It supports the general direction of the policies and programs that are already in place and focuses on what more should be done to enhance competitiveness and encourage change. The recommendations include specific proposals designed to support entrepreneurship, foster consensus and overcome certain weaknesses. In total, these recommendations will improve Canada's ability to adapt to the world of the 1980s and beyond and to seize the opportunities offered by the new technology and emerging economic conditions.

All advanced industrial countries confront new situations today as the world economic order changes rapidly. Competition has heightened. Governments have displayed limited capacities to deal with their individual financial and economic problems in isolation, and the international situation has become very fragile. At the same time, new technologies are bringing about profound changes in the economic system, creating many exciting opportunities for those who advance the technologies and know how to use them, but also requiring difficult economic adjustments.

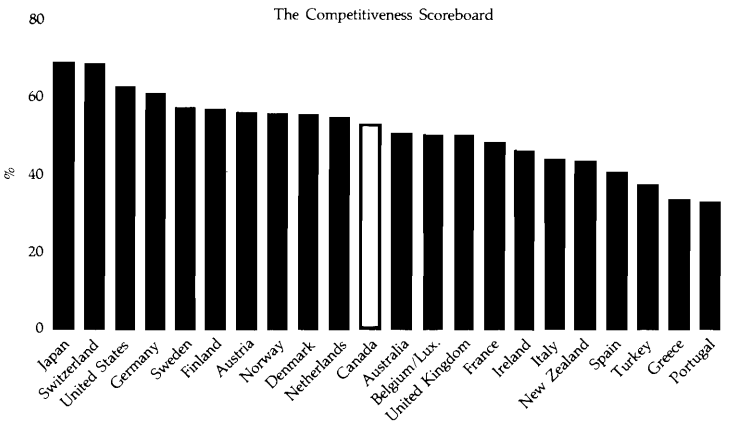
The Science Council believes that the key to Canada's ability to move with the times is to establish a climate in which technological advances, innovation and new industrial companies can flourish. Initiatives must be directed to specific areas to stimulate and support the innovative process, provide better incentives for risk takers, heighten the commitment to research and development, increase the supply of trained technical people, and improve access to domestic and foreign markets. All levels of government can participate in helping to fulfil these goals and each should avoid legislative, regulatory or other actions that curtail their fulfilment.

Canada and the Challenge of Change in the 1980s

In the early 1980s the global and domestic economies faltered. The extended recession and rapidly changing economic conditions left no country unaffected. Canada proved more vulnerable than most.[1] In its evaluation of international competitiveness, the European Management Forum calculated that Canada's rank slipped from sixth to eleventh among 22 industrial countries between 1981 and 1982[2] (Figure 1). Of the 10 principal factors that contribute to a nation's international competitiveness, Canada has for many years performed poorly in four. First, the innovative forward orientation (the extent of R&D and ability to adapt to future technological requirements) is weak. Second, the industrial sector is lagging in efficiency. From 1974 to 1982 Canada

registered zero productivity growth, the lowest among leading industrial countries (Figure 2). Third, the outward orientation (the focus on foreign trade and investments) ranks low compared with that of other countries. Finally, Canada lacks a stable sociopolitical consensus.

Figure 1 - Competitiveness of 22 Advanced Industrial Countries, 1982

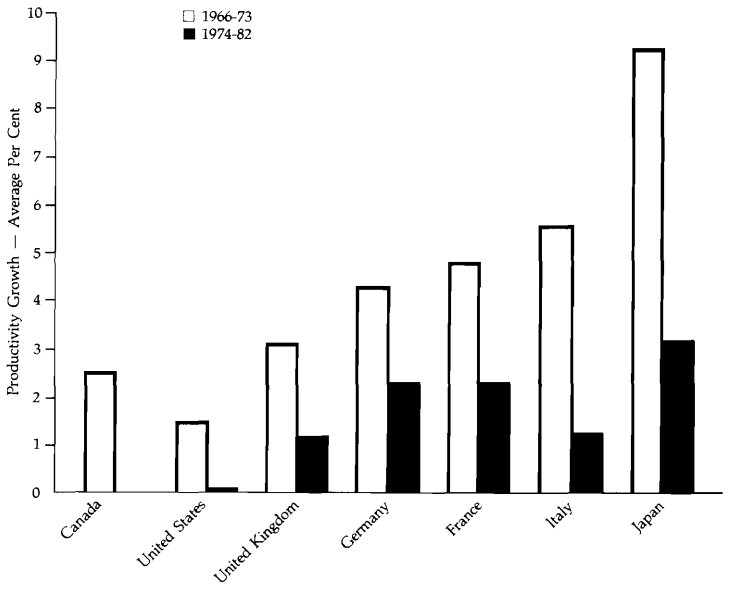


Source: European Management Forum

International shifts in industrial power and changes in world demand for products pose a serious challenge to Canada's industrial structure; they also hobble the capacity to adjust. Canadians must make some hard choices. Is it prudent, for example, to continue the heavy dependence on export staples? Should particular industries or activities be targeted for development? Should Canada reduce its many solitudes and build on distinct regional strengths? What is the Canadian response to new technology? What must Canadians do to bring the country into the 1980s and 1990s with a strong, vital and competitive economy?

The direct contribution of the resource base — agriculture, mining, energy, forestry and fisheries — to the Canadian economy has diminished during most of the past decade (Figure 3), but resources remain prominent among Canada's exports. Continuing to exploit this resource base, especially by harnessing the new technologies to speed up that development, will maintain Canada's position as a major exporter of staples. However, the further expansion of those industries is inhibited by supply constraints and lowered expectations of demand. The new technology has so increased the productivity of resources that even a reasonable increase in demand for finished products may not lead to increased demand for resources.

Figure 2 - Productivity Growth in Seven Major OECD Countries, 1966-1982

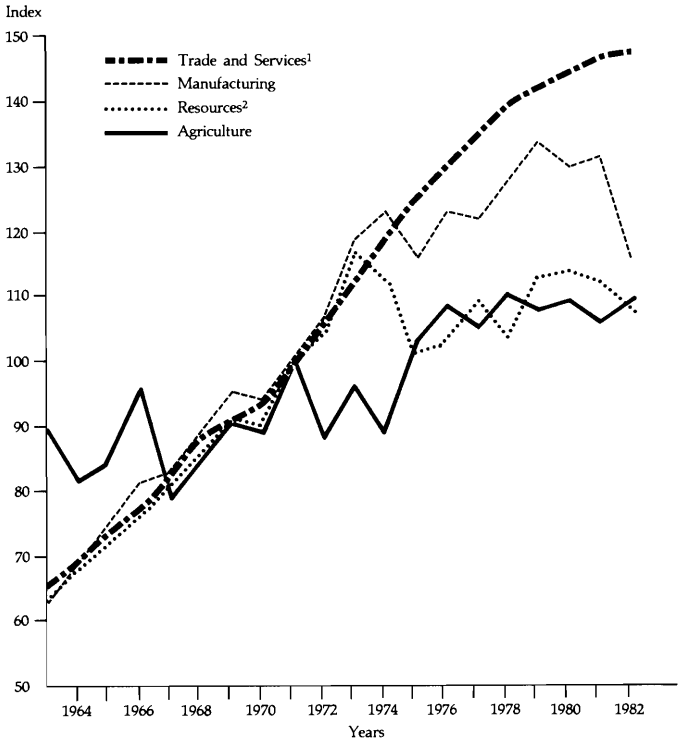


Source: Department of Finance

Already many resource industries have identified their concerns. The fishing industry is in financial difficulties and is heavily overmanned. Mining industry executives foresee a long period of little or no growth because of tough international competition from government-backed mining companies. Forest industry executives also expect more intense international competition, a significant deficit in their softwood operations within a decade, and potentially adverse changes in demand. Prairie farmers are anxious about soil deterioration. Many isolated communities dependent on these resource industries face severe adjustment problems. In the future, to compete in the world, Canada must find alternative sources of and markets for exports.

As the 1980s progress, the domestic scene will also change radically in response to technological advances. As patterns of work, leisure, education and entertainment change and the compartmentalization of these activities breaks down, new information technologies will challenge old industries, open new occupations, create new commodities and services and encourage new activities.[3] Completely new industries will come into being and notions of work will change. Distinctions between industries will blur, even between manufacturing and services, leading to greater competition for markets and a heightened pace of change. Product and service substitutes will multiply,

Figure 3: Indices of Real Domestic Product Contributed by Major Private Sectors (1971 = 100)



1. Includes wholesale and retail trade; finance, insurance and real estate; and community, business and personal services.
2. Includes forestry, fishing and trapping; and mines, quarries and oil wells.

Sources:

1. Figures for 1963-76 from *Historical Statistics of Canada*, second edition, F.H. Leacy, editor (Ottawa: Statistics Canada, 1983).
2. Figures for 1977-80 from *Indexes of Real Domestic Product* (Ottawa: Statistics Canada, 1981).
3. Figures for 1981-82 from *Canadian Statistical Review* (Ottawa: Statistics Canada, 1983).

intensifying risk and uncertainty. Increasing computerization in all sectors (from R&D through design and engineering to advertising and marketing) will raise opportunities, especially for the creativity and versatility of small firms. Indeed, the fastest rate of wealth and job creation will probably continue to come from younger and smaller firms, with lower requirements in investment per job. Finally, with speeded-up innovation and obsolescence, the need for entrepreneurial and institutional flexibility will increase.

In Canada's economic system the public sector provides the infrastructure that industry needs to create its products and services. In the past this infrastructure has worked extremely well, developing the advanced transportation and electric power systems and educational facilities that provided the necessary capital and human resources for the development of Canada's industries. Today that infrastructure must be updated to accommodate the new technologies and the ability to use them. This will involve not only new capital goods but also improvements in education and basic research in universities and government. Broad financial support from the government is also needed to improve productivity and international competitiveness in Canadian industry, because many activities (notably R&D, investment in new plants and machinery, and development of international marketing skills) are insufficiently funded by the private sector. Moreover, because innovative activity tends to be risky, governments must offset risk to encourage innovation.

Government measures designed to influence industrial development are generally termed industrial policy, and a consistent set of specific industrial policies constitutes an industrial strategy.[4] An overall strategy maximizes the benefits of industrial policy. The industrial policies chosen will decide the industrial structure. Failure to make choices or to target activities such as R&D or the development of particular sectors would leave Canada's industrial structure at the mercy of random events and the short-term political whims and often predatory initiatives of other countries.[5]

No small economy, even one the size of Canada's, can afford the luxury of a scattergun approach to industrial policy. Small advanced industrial countries must create and selectively exploit certain world market niches,[6] taking into account their assets, both human and material. For example, Canada has already developed world-class strength in certain areas, including telecommunications and space technology. A forward-looking industrial policy would emphasize R&D that opens further options, permits flexibility and reinforces strengths through business-government partnership.

A Canadian industrial policy should not, however, concentrate solely on a few high-profile successes. A number of traditional industries already involve considerable human and physical investment. Adjustment away from these activities would entail very high costs. It is in the national interest to upgrade sectors such as steel, forest products or automotive parts with new production technologies, provided that they can maintain or renew their international competitiveness.

Recently there has been speculation about the widespread abandonment of many mature manufacturing industries in advanced industrial countries as the production of standard goods is transferred to newly industrialized countries. However, with automation and innovative products, many of these industries could remain competitive in high-wage economies, as developments in the newly capital-intensive textile sector indicate. Even in the smokestack industries, well-managed companies can continue to flourish, particularly if intelligent government support gives them a chance to retain their vitality with upgraded manufacturing systems. Technological changes combined with the emergence of specialized niches caused by market fragmentation may present new opportunities for traditional industries, often with diminished direct labour costs as a proportion of total manufacturing cost and greater emphasis on quality and service.[7] In fact, some new technologies may downplay the advantages that previously accrued from large production runs, plants or firms. Canada has already gained experience and skills in short production run manufacturing.[8] What is needed is not the abandonment of all mature industries suffering from declining competitiveness, but policies to support those in which vigour can be restored by the adoption of new technology and by judicious pruning. Pruning will occur largely in response to the market, although the choices governments make in building the technological base will influence where the pruning occurs. The key is finding alternatives to standardizing productive units. That means increasing the diversity of product technology and altering the established relationship between technology and market preferences.[9]

The advanced industrial countries are also being forced to specialize in skill- and technology-intensive products and services. To do this, they must be at the innovation frontier. The global distribution of innovative activity has become more widely dispersed in the past two decades, as more countries acquire new skills, knowledge and entrepreneurial expertise.[10] (The role of this cumulative development in determining patterns of innovation will probably grow in the future, particularly as firms acquire greater global reach and knowledge of foreign markets and intense pressures continue to eliminate the differences in relative costs of resources among advanced countries.) With more countries now at the frontiers of innovation, national growth will depend on flexible entrepreneurial skills and rapid imitation — that is, the ability to stay at the frontier, rather than catch up to it.[11]

Just as the world of development and industry is changing rapidly, so are the basic tenets of international trade. It used to be assumed that comparative advantage (the difference between the relative advantage of different sectors of an economy among countries) was the driving force behind international trade and that it was predetermined by natural resource endowments. This is no longer the case. A country's comparative advantage is affected by a wide range of actions by government, business and labour.[12] For instance, the Japanese stress on engineering education has undoubtedly affected their

success in electronics industries, and American defence procurement has promoted the competitiveness of their aircraft industry. Many factors must be taken into account in international markets, but the most important today among advanced industrial countries is science and technology endowment.[13]

Another significant change for Canada is the elimination of trade protection. In the past, many exports and imports were defended by tariff barriers and dependent on American technological prowess. Now Canada is committed to dismantling those barriers, following the Tokyo Round of the General Agreement on Tariffs and Trade (GATT), and US technological dominance is seriously challenged. Canadians also face a growing climate of protectionism and new types of trading arrangements that could seriously affect exports and even cut down access to advanced technology.

To strengthen the existing industries and to diversify foreign markets, Canada must create and seize opportunities arising from technological advances. Resilience and resourcefulness are needed if Canada is to respond successfully to the inevitable shocks and surprises of the future. The information revolution in particular (the combination of microelectronics, computers, telecommunications and information technologies) has the capacity to transform the global economic scene. Canada must be ready to turn it to national advantage.

The Science Council and Industrial Policy

For nearly two decades the Science Council has been studying the effects of the technological revolution and the fundamental changes in the world economy. It has done this to define the directions in which the Canadian economy must move to generate and accommodate change and maintain the standard of living in a society that is both competitive and socially responsible. To achieve this, the Council has sought to establish the role of science and technological change as a driving force in the emerging international division of labour. It has also shown how Canada fits into the international network in producing and diffusing technology, and has attempted to assuage fears about difficult adjustments in order to make technological change more acceptable. The Council has long advocated the development of a coherent industrial policy for Canada. As well, it has outlined the critical role of Canadian governments in providing programs to help Canadians make the difficult transition to the new global situation. The details of the Council's approach have been publicized in a series of reports, studies, workshops and debates over the last decade.

In a 1971 report, *Innovation in a Cold Climate*, the Council advocated a national industrial strategy to cope with emerging structural problems.[14] Its main concern was how to overcome these problems, which it attributed in part to poor innovative capacity and policies concerned with resource exports rather than with the potential of secondary manufacturing. The Council stressed

the need to involve both federal and provincial governments and industry in the process of developing and implementing an industrial strategy. Subsequently, in *Technology Transfer*, the Council recognized that if Canadian industry were to develop successfully it must have an independent indigenous technological base from which to exploit national strengths.[15]

In 1979, in *Forging the Links*, the Science Council argued that the need for an industrial strategy had become more pressing in the face of the further deterioration of Canadian industry.[16] The Council lamented the unparalleled degree of foreign ownership and control of Canadian industry, which it claimed had weakened Canada's competitive position in world markets and undermined technological capabilities still further. At that time the Science Council recommended a technology policy with the following objectives:

- to increase the demand for indigenous Canadian technology;
- to expand the country's potential to produce technology;
- to strengthen the capacity of Canadian firms to absorb technology;
- to increase the ability of Canadian firms to import technology under conditions favourable to Canadian industrial development.

Since 1979 the Council has contributed to the ongoing debate on technology and industrial policy in four primary areas:

- the urgency of adopting new technologies;
- the dependence on subsidiaries and imported technology;
- the promotion of indigenous small and medium-sized firms;
- the politics of industrial policy.

The Council has also conferred with experts about the impact of the microelectronics revolution on work and working, on the domestic electronics industry, on computer-aided learning, and on the development of capabilities in artificial intelligence.[17] In a 1982 report, *Planning Now for an Information Society*, the Council lamented the minuscule amount of government support for new technologies compared with that in other countries.[18] It urged federal and provincial governments to participate in preparing for an information society. A subsequent study for the Council, *Governments and Microelectronics*, pointed out the greater sense of urgency and degree of commitment in some European countries to developing and adopting microelectronics and revealed some very different approaches to policy implementation.[19] The report showed that the effects of similar policies often differ because of the method of implementation, particularly at the local level.

The Council has also criticized the failure of most foreign subsidiaries to innovate and develop distinctive products geared to export markets. In a 1980 statement, *Multinationals and Industrial Strategy*, a Council working group stressed the need for foreign subsidiaries to earn world product mandates in order to lower unit costs, improve domestic capabilities and exploit long-term export opportunities.[20] A subsequent publication, *The Adoption of Foreign Technology by Canadian Industry*, discussed the decline of Canada's position

as a recipient of American technology via US-based multinationals, the potential and problems of alternative modes of transferring technology, and the experience of some firms in building up domestic capability from transferred technology.[21] The Industrial Policies Committee then produced *Hard Times, Hard Choices*, which called attention to the rapid deterioration of Canada's trade balance in the high-technology manufacturing sector.[22] It highlighted in particular the problems of the industrial structure in the fast-changing world situation and Canada's failure to provide support for research-intensive industries for which world demand and international competition was increasing. It argued, first, that the low exchange rate for the Canadian dollar, although it may benefit some industries, can only be fully exploited within the framework of a coherent, regionally sensitive and aggressive industrial policy; and second, that policies for science and technology need to be more closely integrated with tax and expenditure policies in order to form a unified economic development strategy.

Reports for the Council have also assessed the performance of small and medium-sized firms in technology-intensive sectors and their in-house R&D design and engineering capabilities. One study, *Threshold Firms*, recommended refinement of a number of government measures to support them, including personal tax measures to help raise equity capital, integrated assistance packages, and a broader interpretation of R&D for tax and grant purposes.[23] Another study, *Partners in Industrial Strategy*, examined the role of the eight provincial research organizations, which serve the needs of small firms, most of which do not have, and are unlikely ever to have, the capability for in-house R&D.[24] It revealed how these organizations serve as research arms for thousands of small and medium-sized firms, and how they could participate better in the implementation of federal and provincial industrial development policies.

Moreover, as early as 1979, a Council publication on *The Politics of an Industrial Strategy* outlined the key regional and institutional problems confronting Canadian attempts to develop consensus on an industrial strategy.[25] *The Limits of Consultation* then analysed Canada's first significant effort at consultation between levels of government and between the private sector and governments.[26] It revealed the primitive nature of this process, particularly the inability of business and labour to bargain effectively with one another or with government, and the potential conflict of provincial industrial plans for development with federal industrial policies.

A later study for the Council, *The Challenge of Diversity*, described the political demands that industrial policy formulation and implementation place on governments, and assessed how regional tensions in the Canadian economy are expressed in political terms through federal-provincial conflict.[27] After examining various attempts at interprovincial and federal-provincial cooperation, and showing how the provinces have taken a more active role

in industrial strategy, the author concluded that most of the progress in federal-provincial relations over industrial policy occurred bilaterally. The fact that the federal government is not taking the lead in industrial policy development is not because of jurisdictional issues or limited financial resources. Rather, the author argues, it reflects two significant barriers: the lack of federal political commitment and institutional weaknesses that hinder the ability to develop and implement an industrial strategy.

Shared Concerns and Constructive Reordering

Many of the Council's concerns about promoting the development and diffusion of technology and building consensus are now shared by others. Business and governments have started, especially since 1981, to move in the direction recommended by the Council. Adversity has helped reshape attitudes.

Big business has attempted to develop a more unified position on significant issues by establishing the Business Council on National Issues (BCNI). The BCNI and some labour leaders have also made progress in establishing a mechanism to come to grips with productivity and labour market issues. The federal government has introduced new policies and programs, such as a new five-year plan designed to increase R&D spending in Canada, and made a commitment to raise the level of R&D expenditure to 1.5 per cent of GNP by 1985. In 1983 it introduced a technology policy and proposed changes to strengthen its R&D tax policies. The R&D flow-through tax credits introduced early in 1984 received a very rapid, positive response from the private sector.

Provincial governments have also become very active. The British Columbia government has formed its own science council to stimulate the province's R&D efforts; the Ontario government has established a number of technology centres and formed a special unit to bring 50 world product mandates to the province by 1986; the Quebec government has drawn up a statement of policy objectives and a plan to strengthen scientific and industrial technological capacity (including the creation of six advanced research centres); and the Nova Scotia government has developed initiatives that support innovative small firms and target assistance to a few large core enterprises.

The Science Council is encouraged by many of the steps taken and believes that Canadian technology and industrial policy is now generally moving in the right direction with greater stress on backing winners and supporting technological innovation and adjustment to the new technological society. Yet in comparison with the activity of its leading competitors, Canada has done too little, and taken too long to do even that. An astonishing and extreme example is that it took the federal government 13 years after the identification of microelectronics technology as a key area to introduce a microelectronics program — more than a decade lost. As is so often the case, rather than seizing the initiative, Canadians have been excessively reactive. Worse, these reactions have rarely been in concert; they are largely ad hoc responses by one level

of government to particular problems or opportunities. Moreover, the very proliferation of policies and programs has contributed to the complexity of the business environment and often to the further alienation of the business community.

Canadian governments and business must take stronger measures to meet the requirements of the new technology and the changes in the international arena, and improve the mix of programs and instruments with which governments are promoting technological change and delivering policy. As the economy becomes more buoyant and as the balance of international competition shifts, Canada must remain alert, ready to act quickly to its further advantage and overcome the divisiveness and fear that weaken the inducement to invest.

The Task Ahead

The central theme of this report expresses the Council's agreement on a sense of direction and purpose for Canada. Canadians must learn to use emerging technology and compete in the international arena by cooperating to create and seize opportunities through policies that support entrepreneurship and are more forward- and outward-looking than those of the past. To this end, the report focuses on three broad areas: forward orientation, outward orientation and the question of political consensus and stability — all areas in which Canada's international ranking is weak.

Industrial and technology policy covers a wide range of sectors, activities and functions. In this report the Council focuses on only a few elements of policy that need firm handling or significant changes; the success of industrial policy is largely in getting the many little things right. The Council believes that in most circumstances the best help for the private sector is self-help and that Canadian management must use new and advanced technology and forward-looking labour relations to achieve higher productivity and efficiency. Self-help will not be easy, however, in view of low profit levels in recent years, unused production capacity and lack of internal funds capable of financing expansion. The task of this report is to identify what steps should be taken now to:

- enhance indigenous capability;
- improve the supporting environment for entrepreneurship, particularly the creation and successful operation of small and medium-sized knowledge-intensive firms;
- reduce the element of risk in order to stimulate and hasten innovation;
- increase knowledge of global market niches and the Canadian ability to fill them.

There are, of course, other important priorities in science, technology and industrial policy that are addressed in this report. Clearly, the science and technology infrastructure should be upgraded, particularly by improving the quality

of science education. (The Council has recently recommended how this might be done at elementary and secondary school levels in the report *Science for Every Student: Educating Canadians for Tomorrow's World.*[28]) Governments and business should support redistribution of the workload, job sharing, paid educational leave, apprenticeship systems and the formation of joint company-union ventures to share in the making of decisions that affect working conditions. Similarly, the industrial and public awareness of uses of microelectronics should be raised and a high proportion of middle-aged and older engineers who are not well versed in microelectronics should be re-educated. Action in any of these areas would enhance the overall approach.

There are three key ways to accomplish the Council's objectives. First, governments must integrate long-term science and technology policy with more traditional short-term monetary and fiscal policies. This is a common concern of advanced industrial countries.[29] Paradoxically, just as modern western governments have begun to recognize the limits of their capacity for short-term management, new pressures are forcing them to give greater attention to long-term management.[30] This approach encompasses entirely different functions, requiring new skills and techniques.[31] For example, governments must now pay particular attention to technology infrastructure and to the development of intangible resources — i.e., know-how and information systems.

A second key task for the Canadian government is the formation of industrial and technology policy to strengthen the private sector's ability to identify, create and develop world market niches, and to build the technological base to help raise new opportunities for traditional industries. Many other countries have been attempting to upgrade their comparative advantage in the world economy by investing in infrastructure and related markets and firms.[32] There are three ways that this could be accomplished in Canada: the creation, adaptation and diffusion of technology; investment or financing; and international marketing.

A third area in which governments could make an important contribution is to increase efforts to foster a consensus on industrial policy. Clearly no exhortations by the Science Council will bring all the disparate interests in Canada's economy into agreement. Nevertheless, there are good prospects for achieving some agreement, especially in fostering and building on initiatives at the local level.

Chapter 2

Enhancing Entrepreneurship

If Canada is to stimulate innovation and build new industries, more support for entrepreneurship and the formation of new firms will be required from government and business than has been forthcoming in the past. A government strategy to promote commercially oriented technological developments and the creation of knowledge-intensive Canadian companies, whether in manufacturing or services, must consider both the supply and demand sides of the market. It must include policies and programs that will directly assist the development of new technologies and the adaptation of existing ones, that is, benefit the supply side — an area that will be examined in the next chapter. Equally important, it must also include policies and programs to create a market for and to accelerate the diffusion of new as well as existing technologies. These tactics, aimed at the demand side, are discussed here.

In recent years a number of programs to encourage additional demand for Canadian technology have been introduced. The Council believes that further action is needed. Two areas in particular — technology transfer and procurement, and financing — warrant greater attention.

Technology Transfer and Government Procurement

Federal and provincial interest in improving the transfer of technology is reflected in many recent initiatives to create programs, centres and institutes. For years the Science Council has encouraged these types of initiatives. At the federal level there are now 11 industrial research institutes, 15 centres for advanced technology, 10 microelectronics centres, and two Canadian industrial innovation centres. Most provinces already have their own well-established provincial research organizations, and some have also created several advanced research or technology centres. Ontario has six. Quebec has plans for six. These initiatives are intended especially to support entrepreneurs in small Canadian-controlled firms.

The Council is seriously concerned now, however, about the need for monitoring and evaluation to ensure that the emerging technology transfer network is achieving what it set out to do and that there is no excessive duplication of programs and effort. The centres should build on strengths and emphasize excellence. Governments must ensure that centres are not competing to attract a limited number of experts in certain fields, such as biotechnology; that the private sector is not crowded out as skilled researchers are drawn to work in the centres; that the institutional responsibilities of governments do not overlap; and that, in cases such as microelectronics, efforts are not so widely dispersed that the industry will fail to reap the benefits. The coordination of federal-provincial and interprovincial approaches is therefore

crucial to allocate areas of specialization and rationalize the technology transfer system.

These are not the only means of facilitating technology transfer to Canadian companies and raising indigenous capability. Consider, for example, the support the Japanese government gave to the development of robotics and its assistance in the diffusion of robot technology. In 1980 it set up the Japan Robot Leasing Company (JAROL) to enable companies to lease industrial robots more cheaply and for shorter periods than was possible through private leasing companies. The Japan Development Bank provides low-interest loans to JAROL to cover its operating expenses. In addition, two public financial institutions provide loans at low prime rates of interest, to small and medium-sized manufacturers to purchase robots in order to automate processes dangerous to humans. Finally, as well as ordinary depreciation write-offs, special additional depreciation insurance is available for buyers of robots.

A Canadian version of this type of approach is warranted for Canadian-made machinery and equipment, not just robotics. New manufacturers producing state-of-the-art machinery or equipment have no proven track record. They find it hard to arrange for leasing of their products because a leasing company has difficulty estimating their products' resale potential. The federal government should develop a leasing process to provide extra incentive for potential users of new Canadian-made machinery and equipment. It would help to expand the domestic market opportunities for Canadian firms with products at an early stage of development and market testing. By reducing the capital outlay of initial users, it would increase demand in domestic markets and speed the diffusion of domestic technology.

New domestic market opportunities are an indispensable component of industrial policy.[1] Creating them involves expanding domestic procurement to help companies orient their R&D toward reliable commercial prospects and learn more rapidly. As they gain technological expertise they can also become more efficient. Building up domestic markets can often enhance penetration of foreign markets, as several Canadian firms have found and the Japanese have successfully shown in a variety of sectors.[2] In exploiting domestic procurement, government programs should not limit their attention to manufacturing, although that sector accounts for the main component of imported public sector purchases (Table 1). In 1979 the total spent on purchases of goods and services, excluding wages and salaries, amounted to $43.5 billion. Estimates of the foreign content in each dollar of public sector purchases suggest that $0.57 are in high-technology industry and $0.34 in low-technology industry.[3]

Examples of serious efforts by either federal, provincial or municipal governments to coordinate their purchasing in order to enhance longer term capability are still too few to stimulate industrial development. However, significant improvements, particularly at the federal level, have been designed to encourage the development of key sectors. The federal government has,

Table 1 - The Public Market, 1979

1. In 1979, the public sector purchased goods and services for $43.5 billion (excluding salaries and wages paid to its own employees).

2. Public sector categories that spent these funds were:

	$Billions	% of Total
Federal Government	5.6	12.9
Provincial Governments	8.0	18.5
Local Governments	5.6	12.9
Hospitals	1.9	4.3
Universities	0.8	1.7
Federal Government Enterprises	8.6	19.7
Provincial Government Enterprises	10.8	24.8
Local Government Enterprises	2.2	5.2
Total	43.5	100.0

3. The industry sectors that supplied the public sector market were:

Service Industry	21.4	49.5
Manufacturing Industry	18.7	43.0
Primary Industry	3.4	7.8
Total	43.5	100.0

4. The goods and services were produced by almost all classes of industries and were supplied from domestic and foreign sources, as follows:

Domestic Sources	36.1	83.0
Direct Imports	7.4	17.0
Total	43.5	100.0

5. By industry sector, the direct imports of $7.4 billion are distributed as follows:

Primary Industry	0.8	10.8
Manufacturing Industry	5.7	77.0
Service Industry	0.9	12.2
Total	7.4	100.0

Source: Canada, Department of Supply and Services, *Summary Report on the Size and Structure of the Public Sector Market 1979*, Hull, 1983.

for example, explored the feasibility of reducing imports by a national information system designed to make large public institutions and corporations more aware, not only of procurement needs, but also of what domestic industry (especially small business) has to offer. Specific internal procedures have been developed to direct contracts to the small business sector; the goal is that eventually 40 per cent of the procurement requirements of the Department of Supply and Services will be filled by Canadian small business. The federal government has also increased funding for the Source Development Fund (SDF), which, by promoting federal use of a new product, can help a firm penetrate the domestic market and thereby establish credibility with foreign buyers.

The Science Council strongly supports these efforts of the federal government. Nevertheless, much more can be done by all governments to increase the level of Canadian content and support new product development. For instance, incentives should be offered to provincial governments or provincially owned enterprises to support joint procurement from domestic sources in cases where domestic purchases by a province may not directly benefit that province, but would generate significant net benefits elsewhere in the country. Therefore,

1. The Science Council recommends that the federal Department of Supply and Services:
   - offer incentives to provincial governments to negotiate bilateral or multilateral agreements with other provinces to cooperate in joint procurement;
   - devote further effort to cooperating with the provinces and municipalities to identify public sector purchases of imported goods and services that warrant a joint effort to replace them with domestic sources;
   - encourage the development of a more sophisticated leasing market to assist in the early diffusion of Canadian developed machinery and equipment in the domestic market.

Financing, New Ventures and Venture Lending

Canadian entrepreneurs need better financial support at many stages of their development projects. Although there have been significant federal and provincial initiatives in recent years, there is still a critical gap in Canada's capital market for the equity and debt financing of new ventures and technologies. Innovation and technological change are the essential ingredients for the survival of knowledge-intensive firms. Such firms, especially the small and medium-sized ones, face serious financial strains as they attempt to maintain ongoing R&D and improve marketing. Moreover, increasingly large investments in production equipment are required because of the rapidity with which equipment becomes obsolete. Most small and medium-sized companies cannot finance these investments on their own. When they resort to outside sources of funds, they often encounter serious difficulties. Even if venture capital is available, it may not come quickly enough or it may be insufficient for the long period of investment and negative cash flow associated with pioneering new products and breaking into new markets.

In response to this difficulty, the venture capital industry must cooperate with those lenders who are ready to share the risks with entrepreneurial companies. One way to do this is by venture lending, which would provide "patient," long-term capital in the form of loans for expansion, working capital, or the purchase of equipment in companies in which venture capitalists hold equity.[4] Banks, other financial institutions, and pension funds are all

potential sources of private sector venture lending in Canada. However, their lending and investment practices will have to change.

As an alternative to loans, banks should be encouraged to provide funds in return for participating debentures (financial instruments that deliver part of the return at a fixed rate below prime and the remainder on a profit-sharing basis). As well, to promote the growth of risky enterprises, competition among Canadian bankers should be enhanced by allowing financial institutions other than banks to establish investment banking operations, contingent upon their allocating a given portion of the funds to venture lending.

Canada should also tap pension funds for investment to support the growth of knowledge-intensive firms. In 1981 the funds held by private trustee pension plans amounted to $61 billion, or about 17 per cent of GNP. Some estimate that the amount will exceed 30 per cent of GNP by the turn of the century. Currently, statutory regulations require that at least 93 per cent of these funds be invested in blue-chip securities. But pension funds could devote a substantially higher proportion of their capital issues without affecting their security. This is particularly true if they are allowed to pool their capital for risky investments.

The current savings rate in Canada is high, indicating that Canadians are willing to forgo current consumption for long-term planning. In fact, Canadian savings amount to enough to produce the necessary capital pool for future growth. Yet this capital has yet to be mobilized to stimulate higher levels of risk-taking for industrial development. Therefore,

2. The Science Council recommends that the federal government alter current legislation to permit and encourage venture lending and the development of profit-sharing instruments by banks, other financial institutions and pension funds in Canada in order to improve the climate for the growth of small and medium-sized companies.

The Council is also concerned that there may be a serious gap in the capital market for high-risk early development money as well as for later support. Governments in many countries have been attempting to fill such a gap.[5] Although this deficiency in Canada is not easily identified, it may be especially serious, given the underdevelopment of Canadian venture capital industry relative to that in the United States and the recent evidence in the United States of the existence of a systematic pattern of underinvestment in small firms of relatively high risk.[6] There are several possible reasons for such gaps in the capital market. Minimum investments in venture capital funds are generally quite large (about $250 000 and up), therefore the number of individuals able to invest is limited. Also, tax incentives distort risk/return possibilities for different types of investment. Investors are excessively averse to taking risk and thus each successive, small increment in risk requires increasingly large increments in rates of return.

One approach to overcoming the aversion to risk that creates gaps in the capital market is to adopt a policy whereby society shares the risk. If the government assumes a portion of the risk, the private sector is more likely to take on challenges. Programs involving joint industry-government financing arrangements are common in many countries, although they are usually oriented to high-risk, large-scale projects and process innovations. The scope of such programs could be extended to small firms.

The capital shortage affects two stages in the early development of firms: when a firm is just starting up and then when it is tentatively established. For very small enterprises that are just starting, with assets measured in the tens or at the most hundreds of thousands of dollars, early development investment is particularly difficult to encourage. Small, knowledge-intensive firms are extraordinarily risky and usually show little return in their early years, so that tax relief is of little use to them. However, a substantial inducement for associated investors in this type of firm would be more favourable treatment of the losses incurred in many of these investments. Currently these losses are treated as capital losses, with only 50 per cent (up to a maximum of $2000) annually deductible from capital gains income. The Council believes that this should be changed to allow start-up companies to deduct 100 per cent of their losses from all other income. To prevent this risk reduction for start-up entrepreneurs from becoming an expensive tax haven, a ceiling of about $10 000 should be placed on such deductions.

Another approach to early financing that warrants support involves expansion of the Deferred Profit Sharing Plan (DPSP). The DPSP differs from the Employee Profit Participation Plans (EPPP) proposed in the February 1984 budget. EPPPs encourage the use of broadly based gain-sharing plans in companies by giving a special 10 per cent income tax credit, shared between employers and employees, for plans that provide for profit sharing with workers. EPPPs are useful in improving productivity and competitiveness, but they do not directly address the equity gap problem. The DPSP does. The current DPSP allows firms to channel some employee compensation into a tax-deferred equity investment in the company. The Canadian Federation of Independent Business (CFIB) explains the advantages:

> The employee benefits both in terms of annual bonus and in terms of a share in the future success of the firm through equity participation. The employer benefits by having a portion of annual profits reinvested through the DPSP in the future growth of the firm. It is a mechanism already familiar to 20 to 25 per cent of the small firm constituency and could be used to great effect in the promotion of productivity.[7]

To prevent the DPSP from being used primarily as a tax haven for owners and senior managers, the deduction is no longer allowed for principal shareholders. To make the program fairer and more likely to achieve its original

goals, the deductions should be allowed on the condition that the benefits are diffused broadly among employees. The Science Council agrees with the CFIB that annual contributions of up to $3500 in DPSPs should be permitted, providing that at least 70 per cent of eligible employees are enrolled. Therefore,

3. The Science Council recommends that to enhance the formation and early development of small firms, investment losses in start-up (new section 125) knowledge-intensive companies be fully deductible from other income up to a maximum of $10 000; and that annual contributions of up to $3500 in Deferred Profit Sharing Plans be allowed, providing that at least 70 per cent of eligible employees are enrolled. Capital gains made by employees in investments under these plans should be inflation-adjusted for computation of capital gains tax.

A second category of early development funding problems arises for firms past the start-up stage, but not yet ready or able to offer shares publicly. Virtually no venture capital is available for this phase of development. The Federal Business Development Bank (FBDB) is attempting to solve these problems and has been successful with its current experiment of acting as a matchmaker, linking investors with companies seeking capital. It has recently been directed to expand its efforts and to act as the federal government's chosen instrument for supporting the early development of firms, including knowledge-intensive, high-risk enterprises, by offering equity capital. The advantages of taking an equity position, instead of or in addition to providing debt capital, are that the need for debt servicing is limited and the public sector shares in the benefits as well as the risks. The duration of government equity participation should be limited to five to seven years. Indeed, most private companies do not want the government as a permanent partner. There should be a provision for buying out in the hands of management. Moreover, the need for government participation in the early development of enterprises should decrease over time. As the government's interest in one venture diminishes, capital can be redeployed in other new ventures, thus limiting the aggregate infusion of funds by the government into this instrument.

Therefore,

4. The Science Council recommends that in order to support the growth of small, indigenous, knowledge-intensive firms beyond the start-up phase of development that are planning significant expansion, the federal government expand the Federal Business Development Bank's appropriation of capital for investment in equity. The FBDB should offer to take equity in the form of nonvoting, redeemable, fully participating shares.

A Beginning

The Council believes that business and federal and provincial governments are working in the right direction to enhance the development of knowledge-intensive industries in this country. Nevertheless, such ventures are risky and cannot be undertaken by the private sector alone. The Council's recommendations focus on ways that the government can inject additional venture capital into the market, especially to support the early development of private knowledge-intensive firms. But even if these measures infuse some necessary capital into the capital market, additional measures will still be needed to reap the benefits of the technological revolution. Governments and business together must do more by undertaking more research and development and exploring new market and trading arrangements.

Chapter 3

Looking Forward

Today Canada produces only a very small fraction of world technology, originating little more than 1 per cent to 3 per cent of the world total. Nevertheless, since the late 1970s Canada has been devoting more resources to R&D design and engineering. Recent North American evidence has revealed the links between new technology and increased productivity, providing a strong incentive for Canada to undertake additional R&D. Still, several questions remain unresolved. To what extent should Canada develop its own technology rather than import it? Is there still too little spent in Canada on R&D? If so, how much is the shortfall? What can governments do to help build technological strength and innovative capability?

The common thread running through the economic strategies of advanced industrial countries is a commitment to exploit the new technologies to the maximum national advantage. Domestic R&D and the importation and diffusion of foreign technology lie at the heart of the process of economic development. In fact, technology transfer and R&D are complementary activities — most firms performing R&D are also heavy importers of technology. However, these two activities offer different risks and rewards to firms. A key issue is to determine the suitable balance between how much technology should come from abroad and how much should be developed at home. Should firms produce the technology with their own research in the hope of realizing considerable profits if their gamble pays off? Or should they import technology that is proven but will not give them as great a competitive advantage, since others share the technology?

These types of decisions are most efficiently made by private actors in response to their markets. However, individual market-induced decisions may not promote rapid enough technical advance. When this is the case, governments should become involved. Then, if governments decide to support a program to increase the rate of technical advance, they too must choose between importing more technology or funding more R&D to support domestic development.

In Canada the federal and provincial governments have decided that intervention on both counts is necessary. There is a close and complex relationship between government support for science and technology, innovation, competitiveness and the creation of wealth, and the level and security of Canadian incomes. Still the debate continues on whether governments should be spending scarce public funds on subsidizing R&D or whether they should be encouraging the import of technology. The conclusions vary, depending upon the relative merits of the trade-offs.

R&D and the Transfer of Technology

Canada must adopt technology from abroad as well as undertake R&D, despite the apparent problem of the lags that occur and impede competitive development. When technology is brought from abroad, there will always be a lag in getting production under way until the technology has been fully integrated into the Canadian economy. Simply because Canada has a longer adoption lag than average for some other OECD nations does not mean that the lag is unwarranted. The length of the lag will vary, according to a host of factors, and a long adoption lag cannot be assessed until its causes are determined.

An underlying assumption of much of the literature on diffusion is that differing lag rates for different technologies in various countries and industries are a function of the knowledge, ability and receptiveness of the adopters. This implies that astute managers can locate and transfer innovations quickly and show foresight in assessing future market potential. Studies indicate, however, that differences in diffusion rates over time and between countries are just as likely to depend on variations in the suitability of the technology and the need for adaptation or changes in the innovations being adopted.[1] In its earliest stages, the technology may not be appropriate or profitable to transfer. As the technology matures, the transfer process becomes cheaper, the scale of the technology more flexible, and the prospective benefits more assured.[2] Overall, comparative lag rates among national economies and even among regions within an economy may be more closely related to the structure of industry or other factors than to an inadequacy in the receptiveness of firms or institutions. The problems involved in scaling down technology for a smaller market, shifts in factor prices, and competing corporate demands for funds may delay adoption. Thus longer lags for adopting an innovation may be unavoidable within a market.

Even so, a market may not work very well on its own, and lags may become excessively long for a number of reasons, such as aversion to risk and knowledge gaps in the market. A recent Canadian study concluded that public subsidies to share risk would reduce lags only minimally.[3] In terms of the transfer of knowledge, links between larger and smaller firms in Canada are weak and the market fails to supply the needed information. In response, much recent federal and provincial industrial policy has been created to improve the transmission of information about new products and processes to firms, especially those of small and medium size.

Despite the lags and their accompanying problems, Canada will continue to be a large importer of technology. However, Canada must develop an indigenous research capability to remain or become competitive in many activities, whether in the primary, secondary or service industries. R&D can generate results that cannot be obtained with technology transfer and is essential to gain access to or to assist in the transfer of foreign technology.

One reason R&D is necessary is that in industries in which Canadians compete in world markets, imitation or adoption of technology may not be a competitive long-term strategy. The fastest-growing area of world demand is for R&D-intensive manufactured goods, and competition for these is often based on proprietary knowledge gained from corporate research. Technology may be transferred from either the foreign or domestic enterprises that hold it through licensing agreements. However, even though licensing may be less expensive, the latest technology is not always available, and licensees are frequently faced with export restrictions and requirements that they transfer back to the licenser any improvements they make to the technology they have licensed.[4] Although manufacturing under licence may provide a continuous flow of technology for firms that do not have any capacity for R&D, it is not a secure strategy for long-term growth. Most of the firms that have succeeded in this way received licences early in the life cycle of their product and did not face export restrictions in the licensing agreement.[5]

Indigenous R&D is usually a prerequisite for the absorption of foreign technology. Nations and firms that spend large amounts on R&D tend to be quick to begin producing a new product, even if they are not the innovator.[6] In Canada, firms that carry out R&D are more likely to adopt foreign product and process technologies than are those that do not.[7]

Buying outside technology is valuable, but it is not a simple or acceptable substitute for undertaking domestic R&D. This point is now being reiterated forcefully by those running new technology centres in Canada. Technology diffusion slows down if potential adopters do not have in-house engineers and technicians who understand the information useful to the potential adopter, let alone know how to use the new technology. A firm may decide that adoption or imitation is the cheapest way to acquire a particular technology; nevertheless, some level of R&D spending is usually necessary to assimilate the innovation into its operation.[8]

R&D is a diverse activity that also includes acting as a listening post on other developments elsewhere in the field. Therefore, even in a small open economy with a disadvantage in the production of technology, some basic level of industrial R&D competence is needed to be able to locate and quickly transfer the technology developed elsewhere.

Foreign Ownership and R&D

Foreign ownership of Canadian industry affects the form and extent of R&D and technology transfer in this country. Whereas a study based on data for 1959 found that there was little difference in R&D performance between similarly placed Canadian firms and foreign-owned subsidiaries,[9] more recent work reveals a negative relationship between foreign ownership and R&D.[10]

Foreign-controlled firms in Canada, mostly multinational enterprises (MNEs), perform less R&D relative to output than comparable Canadian-

controlled firms. This is not surprising in view of the economic environment within which MNEs have operated in the past. MNEs usually centralize their R&D in the country of the parent corporation in order to reap the benefits of economies of scale. The need for centralization is reinforced when the home country is also the firm's largest market. By contrast, the few Canadian-controlled firms that undertake significant amounts of R&D usually do so in Canada. Most do not have the benefits of an international corporate structure or of large-scale production.

Industrial R&D is a basis for growth and a key source of increased productivity. In Canada the question now being raised is whether this country benefits from the heavy dependence by foreign subsidiaries on technology transferred from their parent or associated companies or whether there is a net cost to Canada in lost potential for domestic growth and productivity improvement.

The debate about the cost and technology benefits of MNE activity ultimately devolves on the question of the relative productivity of foreign and domestic firms in Canada. If foreign-controlled firms can obtain and transfer knowledge quickly and cheaply, they should be more productive than equivalent domestically controlled firms. However, there is no consistent evidence to show that this is the case.[11]

A comparison of the productivity of industries in Canada with that of their counterparts in the United States showed that, for manufacturing, the productivity gap between the two countries is about 25 per cent.[12] A number of factors contribute to poor productivity performance in Canada, but possibly the most surprising is the effect of foreign control. As Saunders has found, high foreign control of an industry in Canada contributes to Canada's poor productivity performance. Saunders attributes these results to tariffs and oligopoly:

> Foreign direct investment was originally attracted to Canada in part because of high Canadian tariffs. However, much of this investment occurred before the postwar reductions in Canadian tariff protection. In the case of industries dominated by Canadian-owned firms, these tariff reductions, by exposing the industry to greater competition for imports, would tend to cause the most inefficient firms to be eliminated, thus improving observed productivity. However, industries dominated by foreign-owned firms would largely escape this competitive influence, since the source of the potential imports would, in most cases, be the parent firms who would be expected to be unwilling to sacrifice their fixed investment in production facilities in Canada.[13]

What this indicates is that the technological benefits associated with MNEs have been lost through the lack of competition in the Canadian market. Intra-corporate transfer of technology shortens the delay in the transfer of new technological processes that reduce production unit costs. Although these processes

should directly increase observed productivity, this has not been the case. Saunder's work raises serious questions about the presumed benefits of foreign ownership.

The negative effect of foreign control on productivity will put Canada at a disadvantage in sectors that are heavily foreign-controlled, unless the behaviour of foreign subsidiaries changes, even though the technological benefits of the intracorporate transfers of MNEs may outweigh those of arm's-length transfers. If the technological benefits of foreign ownership are the only subjects of analysis, the policy conclusion is that the government should not restrict the activities of MNEs through the Foreign Investment Review Agency (FIRA) or any other mechanism. However, by looking at all aspects of MNE activity and the evidence on productivity, it is not possible to remain sanguine about the continuing high extent of foreign direct investment in Canada.

The Shortfall in R&D

Left to themselves, individual firms are unlikely to spend enough on R&D to benefit society as a whole. But only recently has sufficient evidence been collected to estimate how much additional expenditure on R&D would be best for Canada.

This estimate assesses the return to society yielded by each extra dollar spent on R&D. If the return on an extra dollar spent on R&D is above that for a dollar spent on physical capital, then more money should be invested in R&D. To gain the most from its resources, Canada should increase the amount of R&D on all projects that will yield a higher expected rate of return from R&D than from capital expenditures.

However, difficulties arise in determining the rate of return on R&D. Early estimates, which varied wildly and often put the figure at more than 1000 per cent, were calculated by measuring the payoff for small numbers of successful projects.[14] Such procedures are suspect because some R&D projects have huge payoffs while others have little or none.[15] What is needed is an estimate of the probable increase in production that will result if an extra dollar is spent on R&D without increasing capital, labour or material costs. This can be obtained only by calculating the effect of R&D on production for a large group of firms, with other important factors held constant.

Estimation is further complicated by the fact that much of the increased productivity arising from R&D is likely to occur in industries other than the one carrying out the R&D, because a firm that buys intermediate products is, in effect, also using the R&D of the supplier firm. A firm's productivity depends on the R&D it uses and not simply the R&D it undertakes on its own. The R&D used by a manufacturing firm will generally consist of some of its own R&D and some from suppliers.

Some studies have traced R&D expenditures to intermediate users and found social rates of return on investment in R&D in excess of 70 per cent.

The best and most recent of these studies, one by F.M. Scherer, estimated the rate of return at about 100 per cent for users in the United States.[16] A similar study for the Economic Council of Canada, although it used less detailed data, still found a direct link between productivity and used R&D.[17] Its results suggest that the rate of return on R&D is well above that on capital.[18]

Most Canadian R&D expenditure appears to be process-oriented — that is, concerned with reducing the operating costs of an individual firm rather than with creating new products.[19] The benefits of this type of innovation are more likely to be concentrated within the firm that does the R&D. Even so, the return on R&D to the individual firm alone is greater than that on capital investments. A recent study for the Science Council found that the private return on R&D is generally considerably higher than that on capital investment. The rate of return on an extra dollar spent on R&D was as high as 64 per cent in the chemical industry and 24 per cent on average for all R&D-intensive industries in 1979.[20] This compares to an equivalent rate of return on capital of about 15 per cent for the same year and group of industries.[21] These preliminary estimates indicate that industrial R&D could be increased by about two-thirds above 1979 levels.[22] This is an extremely conservative figure because it does not take into account the benefits of one firm's R&D that accrue to other firms.

Industrial R&D has increased about 35 per cent in real terms between 1979 and 1982[23]; nevertheless, further expansion of Canada's industrial R&D effort is needed.

What Governments and Business Can Do

The purpose of government grant programs is to stimulate R&D of a particular type or in a particular industry. The evidence for Canada indicates that grant programs also increase the private investment of firms in R&D.[24] (The positive relationship between R&D and grants may be a result of a firm's technological opportunity rather than an indication that the grants cause higher R&D spending. However, there is no evidence for the alternative hypothesis that firms use the grants to replace part of their own expenditures on R&D.)

The simplest way for governments to increase industrial R&D is by tax incentives. However, returns on additional R&D vary considerably among industries and therefore some industries would benefit more than others. Moreover, technological opportunity is not equally distributed among Canadian industries. Efficient public policies to overcome Canada's underinvestment in R&D must take this into account. A general tax subsidy for R&D supplies a base level of support for innovative activities in all sectors, but these general subsidies must be supplemented by specific R&D grants that make allowance for the uneven nature of technological opportunity and benefits if all of Canada's industries are to approach a more satisfactory level of technical advancement.

Governments can also support the private sector and create technological opportunities for firms by contracting out their own R&D. Although there is no definite evidence of the effectiveness of this policy in encouraging firms to expand their own R&D budgets, Canada has used this approach less than most other advanced nations, such as the United States, France, Germany and Great Britain.[25]

The federal government has recently implemented several changes to the Income Tax Act proposed in the April 1983 budget. By increasing the flexibility of R&D financing, the changes will be particularly attractive to Canadian-owned firms that are R&D-intensive, lack profits at the early stages of their development, and are still subject to the small business tax rate. This move should help to reduce further the shortfall in Canadian industrial R&D.

In addition, grants to support strategic technologies — including the application of advanced technologies in the resource sectors — and the formation of clusters of innovative firms for priority funding are needed. Both sectoral and regional strategic areas must be identified. In these areas Canada should aspire to leadership, or at least to being in the forefront, to enable us to be quick and ready adapters of foreign advances.

This task should be undertaken primarily by the Department of Regional Industrial Expansion (DRIE), which has the analytical capacity and the appropriate grant mechanism to evaluate potential benefits and costs. In the 1970s the proliferation of federal industrial and regional development programs confused potential applicants. However, in 1982-83 the federal government reorganized its economic administration. It amalgamated two departments to form DRIE and sought to provide a basis for the development of more regionally responsive industrial policies and programs. In 1983 it introduced the Industrial and Regional Development Program (IRDP) that consolidated many of the grant and loan programs introduced in the 1970s. The IRDP is now the federal government's principal program of direct assistance to private sector firms. One of its potential strengths is its emphasis on the full range of the industrial innovation process — not just the initial R&D elements — and on the business plan and performance of a firm — not just the individual project being considered for funding. (However, initial evaluation of the program suggests there are some serious problems for small technology-intensive firms in obtaining a prompt response to requests.) At this time the Science Council believes that further expansion of government-assisted R&D should be funded primarily by the IRDP, providing the program is audited to streamline procedures. Therefore,

5. The Science Council recommends that the Department of Regional Industrial Expansion identify key areas for assistance in conjunction with the provinces and be prepared to offer consistent long-term government support to develop technological leadership in these designated areas. Any further increase in federal R&D subsidies deemed necessary to correct

Canada's underinvestment in innovation should take place primarily through grants administered through the Industrial and Regional Development Program. The IRDP must be given the resources and competence to do the job well.

Action is also needed to resolve some of the problems caused by the extent of foreign ownership of industry in Canada. The Science Council, among others, has argued that the very large share of foreign-controlled subsidiaries in Canadian industry has reduced the technological opportunity for industry in Canada and overall productivity in some industries.[26]

The combination of the prolonged recession and the progressive reduction of tariffs following the Tokyo round of the General Agreement on Tariffs and Trade (GATT) in 1979 has forced many foreign subsidiaries to reconsider their basis for operating in Canada. Should they maintain their traditional strategy of product diversity within Canada's insulated domestic market? Should they concentrate on fewer products and export a large proportion of the output? Or should they award world product mandates to the subsidiaries in Canada? Canadian preference is clearly for the latter choice. The Science Council has emphasized the need for governments to work with foreign-owned subsidiaries, assisting them to earn specialized North American missions or world product mandates that incorporate R&D responsibilities in Canada.[27]

There are signs of positive change: "A number of US firms are examining radically different structural arrangements for their subsidiaries . . . which promise a much more creative role for subsidiary managers, and which will lead to greater R&D, international competitiveness and export performance in Canada."[28] In the 1970s, some firms were inclined to decentralize their R&D, if only to enable their subsidiaries to be better prepared to receive technology.[29] Now certain firms are realizing that it is in their own interest, in certain circumstances, to develop skills and capabilities abroad that are not necessarily duplicated at home. This is useful when, for example, the parent holds trust in the subsidiary's management and in the viability of its investments.

The onus to promote the improvement of R&D performance by foreign-owned subsidiaries lies increasingly on Canadian managers. They must convince their foreign parent of their domestic capabilities and opportunities. Successful managers of Canadian subsidiaries emphasize that acquiring the more diverse range of functions associated with specialized missions and world product mandates can strengthen the subsidiary by:

- increasing its domestic hiring power, particularly the ability to attract first-class graduates, because it can offer greater diversity of opportunity;
- raising its marketing power and flexibility, because having good systems engineers, for instance, can extend its marketing capability and identify opportunities to fill new technology niches;

- building rapport with the parent company, which the subsidiary can often help out in critical situations to mutual benefit;
- extending its expertise by providing a test-bed for the parent for strategies to overcome international business problems;
- improving access to technology developed by Canadian government institutions such as the National Research Council or the Department of Communications;
- enhancing its endorsement by government bureaucrats as a good corporate citizen (some argue that referring customers to government officials ready to endorse a subsidiary's performance has often provided companies with far more significant leverage to obtain new business than has the government's provision of grants).

The Council hopes to convince the managers of some of Canada's largest foreign-owned subsidiaries to undertake additional R&D in Canada. There is also the issue of how to encourage changes among the remainder, which perform largely sales or branch plant functions. This category includes rapidly growing new companies whose exports to Canada contribute heavily to the trade deficit in end-product manufacturing. Some foreign firms might be persuaded to undertake production here, if prospects for growth are good. Their Canadian managers must convince their parent of the advantages of having a more broadly based but specialized and export-oriented subsidiary in Canada. A persuasive argument is the example of others who have succeeded.

More important for Canada, mandated firms could lead to important spin-offs, acting as incubators for new knowledge-intensive Canadian-owned firms. Spin-off firms usually exploit technology developed by the subsidiary, which in turn may diversify by taking a stake in its spin-off. Therefore,

6. The Science Council recommends that the Canadian Manufacturers' Association offer advice and assistance to leading executives of foreign-owned subsidiaries to help them present the case to their parent firm for building a strong export-oriented subsidiary in Canada.

Clearly, there will be situations in which the strong performance of a foreign firm in Canadian markets will not be countered by the emergence of strong domestic competitors. In some of these situations, the government can seek the substitution of direct foreign investment for imports, using whatever incentives and leverage it has available. The best example is a situation in which the presence of a foreign-owned subsidiary would create significant complementary linkages with existing Canadian firms and help build a stronger cluster of interactive, innovative firms, as in the case of the helicopter industry. For this to happen, therefore,

7. The Science Council recommends that the federal Department of Regional Industrial Expansion put more resources into identifying potential strategic clusters of innovation in Canada and growing foreign firms with strong existing or potential sales in Canada. It should then seek, through the negotiation of a company agreement with the government on matters such as procurement or provision of assistance through the Industrial and Regional Development Program, to encourage firms to establish facilities in Canada and the full range of functions necessary to support a world product mandate or specialized North American mission.

In sum, Canada's technological advancement must come from the adoption of foreign technology as well as indigenous innovation. Both activities are necessary and, in fact, complementary. Although market forces impel this process, they cannot by themselves ensure the needed degree of technological development. Further strategic support for research, development, design and engineering is required and governments have a role in identifying potential clusters of innovation and supporting their development.

Chapter 4

Looking Outward

Industrial R&D is only one of many elements in the process of developing opportunities for the Canadian economy. Effective R&D depends on a knowledge of customer needs for exports of products and services. At a time of growing interdependence that intensifies the need to specialize and export, this knowledge will increasingly provide the impetus for Canadian industrial R&D. Further, the more Canada develops appropriate technology, the greater is the prospect of selling it to earn the revenue required to fund the next round of technological development.

The need for a strategy to facilitate the export of technology, goods and services raises certain questions. Should Canada, with its open economy, open its markets still further or at least refrain from imposing new restraints against goods from countries that offer suitable potential for Canadian exports? Is there a conflict between an inward-oriented and an outward-looking industrial policy? Would an outward-looking policy antagonize Canada's partners? And finally, what can governments do to raise Canada's export potential?

Developments in the world trading scene present new considerations for Canada. During the 1980s tariff barriers will decline further following the Tokyo round of multilateral tariff negotiations in 1979. In addition, Canadian industry faces potential contingency protection in the United States. While trade liberalization is a positive development, Canada, like other countries, must take full advantage of its rights under the General Agreement on Tariffs and Trade (GATT). Canada also needs a system of contingency protection (anti-dumping and countervailing duties) that is at least equivalent to that of its trading partners. It must also find new ways to penetrate export markets and engage in countertrade arrangements.

Contingency Protection

Lower tariffs between Canada and its major trading partners should increase long-term efficiency and competitiveness. Better access to foreign markets should boost the productivity of Canadian firms and lead to an increase in both exports and imports. Lower tariffs would open Canada's economy even wider than before. Maintaining the health of the multilateral trading environment will be a prime concern, especially if certain countries resort to unfair trading practices.

In an era of slow economic growth, most countries have adopted protectionist policies. Nontariff barriers, such as import quotas and voluntary export restraints, have been substituted for declining tariff barriers. Adjustments must be made in Canada to compensate. An industrial policy that increases the

efficiency of markets and indemnifies the losers in the adjustment process may be the only politically acceptable option to protectionism.

Some instruments of industrial policy such as R&D and export subsidies are often thought to be protectionist tools.[1] In reality, the industrial policy-maker's toolkit can be employed in a variety of ways — to block change in protectionist desperation or to aid market adjustment to new industrial realities. Although defensive protectionism has obvious political appeal, it cannot promise Canadians that they will be better off; it may in fact make them worse off. For example, many Canadian import restrictions, such as nontariff measures, are directed against Pacific Rim countries that are some of Canada's best potential trading partners. These countries can hardly be expected to buy more of Canada's manufactured exports or services if their ability to sell to Canadians is hindered. The choice is between a protectionist, inward-looking industrial policy and an expansionist, outward-looking policy.

What Canada may claim to be a forward-looking industrial policy may, however, be seen by its trading partners as a beggar-my-neighbour policy. Does this industrial policy, in fact, antagonize Canada's trading partners? The answer is no if Canadian industrial policy is construed as being designed to improve the function of markets. For instance, R&D subsidies may be viewed as a policy response to a perceived market inadequacy. Alternatively, they may be seen as a hidden export subsidy. In the first case, Canada's trading partners might welcome the fact that Canada is contributing to the development of technology that will benefit them as well as Canadians; in the second, they might impose offsetting protection to safeguard a domestic competitor. Similarly, Canada must be sensitive to the industrial policies of other nations that are concerned with increasing the efficiency of their markets, yet at the same time recognize and defend against abusive foreign initiatives.

Canada must be able to adjust its contingency import protection[2] to react to government subsidies to foreign industries that would give them a competitive advantage over Canadian industries; Canada must also be ready to impose similar duties to those instituted by other countries. In the past, it has proved difficult to identify the element of subsidy in government assistance programs and relate it to domestic injury. Small countries have found it especially difficult to countervail foreign subsidies when those subsidies mainly hurt the small countries' exports in third markets. Nevertheless, tougher measures will help to prevent unfair competition and speed the process for investigating and assessing antidumping complaints.

Canada must also ensure that its policies are responses to market inadequacies and are not predatory promotion. The multinational tariff negotiation agreements clarified the rules under which governments can deal with injurious imports. Canada's current import policy was formed before the latest agreements and now needs modernizing. For example, at present Canada is not exercising its full rights to protect heavy machinery producers from predatory imports. The Special Import Measures Act, eagerly awaited by busi-

ness for several years and recently introduced by the federal government, would provide this protection, provided that Revenue Canada is given suitable resources to ensure speedy implementation. Therefore,

8. The Science Council recommends that Canada take full advantage of its rights under the GATT and its ancillary agreements to legislate antidumping duties, countervailing duties and safeguarding measures that will protect Canadian industries from unfair trade practices and serve as a bargaining instrument to negotiate improved access to foreign markets for Canadian exports. Revenue Canada should be given suitable resources to speed the process of investigating and assessing antidumping complaints.

Export Trade and Marketing

The export trade must play an increasing role in Canada's economic development. To compete in world markets Canadian firms will have to develop innovative products or services that can be readily differentiated from those of foreign competitors.[3] However, the successful production of those goods and services is ineffective without skilful global marketing. Knowledge of user needs in global markets usually provides the drive and direction for the development, design and engineering of competitive goods and services, even though the intricate workings of foreign markets and the complex logistics and finances of foreign trade pose formidable barriers to Canadian exports.[4]

The current size, ownership, structure and mandate of many Canadian industries inhibit the building of strong links between R&D and export marketing. Most Canadian-owned firms in knowledge-intensive sectors are small, and the quality of their export marketing talent and effort is uneven. Our small domestic market compounds the problem: most knowledge-intensive firms must look to external markets for sales at the earliest stages of their development.[5] Ignorance of export opportunities is an obstacle for small and medium-sized firms. Among the foreign subsidiaries, many lack a mandate to export; as a result, they either fail to develop export marketing capabilities or depend on parent or associate company export marketing talent and services.

Canada does have capable export marketing expertise, but much if not most of it is oriented to commodity markets rather than markets for knowledge-intensive goods and services. At the same time, Canada's system of export education is not geared to train people to market knowledge-intensive exports; indeed, the system has tended to be too limited, theoretical and overly concentrated in some regions.[6] The shortage of seasoned international marketing talent in Canada must be addressed by federal and provincial governments. Therefore,

9. The Science Council recommends that the Department of External Affairs diversify Canada's export marketing expertise. It should:

- offer grants through the Program for Export Market Development to provide Canadian employees of Canadian firms with more extended foreign marketing assignments;
- give priority to programs designed to raise practical experience in international marketing.

Although the United States is by far Canada's largest trading partner and will remain so, Canada must retain broad access to that market and enhance the trade relationship. Already the export growth of several industries, such as surface transport equipment, telecommunications, and power generation and transmission equipment is inhibited by American trade barriers, including tariffs and government procurement restraints. Although the Science Council rejects total free trade with the United States, it endorses the current initiative by the federal government to explore the possibilities for limited, sectoral free trade in stronger sectors; and to identify ways to promote reciprocal trade expansion, increase the efficiency of Canadian industries and enhance regional economic prospects. Increased specialization and product mandating have raised pressures to allow two-way duty remission schemes. It is not clear, however, that there are significant economic or political advantages for the Americans to pursue this initiative, beyond the possibility of securing greater protection for their investments and trade with Canada.

The Council believes that access to foreign markets for advanced technology products is crucial for Canadian development. Canada must improve its export trade not only with the relatively slow-growing markets of the United States and Western Europe but also with developing countries that offer potential long-term markets. However, nontariff barriers, particularly restrictive foreign government procurement practices, severely constrain increased exports of many of these products. Therefore,

10. The Science Council recommends that the federal government vigorously pursue efforts to explore any potential advantages to Canada of expanding the Government Procurement Agreement of GATT to include sectors in which Canada has advanced capabilities.

Shrinking product life cycles and the changing rules for penetrating foreign markets impede the development of Canada's knowledge-intensive exports. As product life cycles shrink, firms will need to realize revenues quickly if they are to maintain their investment in new R&D to stay in business. To earn those revenues, Canadian firms must capture a significant market share, particularly in the United States. However, because most firms lack direct international marketing expertise, they have been delegating exports to agents or distributors. Finding the right distributor, particularly in Third World countries, is a time-consuming process, often much too slow in this increasingly competitive environment. Further, in some technology categories and regions,

exporting and direct foreign investment through wholly owned subsidiaries are becoming less acceptable approaches to market penetration. A range of subtle nontariff barriers is emerging.

How is Canada to commercialize its technology abroad as rapidly as possible, taking into account the constraints of the Canadian firm and the needs of foreign firms seeking to commercialize the technology? Joint ventures offer one solution. Such ventures, which incorporate domestic equity participation, are increasingly used, even in Europe.[7] They may also be useful in gaining access to other technologies. For a country without the resources to undertake R&D across the entire spectrum of industries, such ventures maintain a window on many new technologies, especially the ones that entail a high degree of risk and cost. Joint ventures can be particularly attractive insofar as they allow for a greater degree of control than licensing arrangements or sales through foreign agents, yet mitigate the risks and expense associated with a wholly owned subsidiary. Then too, in politicized market environments, a Canadian firm can benefit from its partner's knowledge of the local market.

Canadian producers need assistance to find potential partners, especially in the Third World. Canada has few project development or other experts with a proven record in any country outside its major trading partners. Trade commissioners, although helpful, have a necessarily limited role. Public authorities should seek ways to harness appropriate talent from the private sector and encourage the creation of strong trading houses, including technology trading houses. Therefore,

11. The Science Council recommends that the Department of External Affairs, to assist Canadian firms seeking to develop joint ventures to facilitate foreign sales and technology transfer, assemble a directory of private sector "experts" with a documented track record in various markets and technology categories. Entry requirements should include references from customers.

Shorter product life cycles also raise difficulties when there are opportunities to serve foreign markets through foreign aid programs. An increasing number of Canadian manufacturing and service companies offer products and services that could appropriately fulfil communications, transportation, energy and agricultural needs of Third World countries. The Aid-Trade Fund established in the 1984 federal budget should be a positive step in providing the linkage between these needs and Canadian capabilities. However, other useful steps could be taken, using aid as a pump primer for Canadian knowledge-intensive goods and services.

The project planning and approval procedures for bilateral programs through the Canadian International Development Agency (CIDA) are generally too time-consuming to respond swiftly to opportunities to match appropriate advanced Canadian technology with needs in the developing world. Trade

consultants often find that aid agencies in other countries have greater front-end flexibility and can move more quickly to arrange concessional financing for a recipient country than Canadian firms, and thereby beat Canadians to lucrative engineering and equipment contracts. As well, exports to the Third World need to be supplemented by joint ventures to satisfy the legitimate concerns of these countries for their own industrial development. CIDA can play a significant role in supporting this kind of cooperation. Canada's development assistance over the years has created good will in the Third World. This intangible resource should not go to waste. Therefore,

12. The Science Council recommends that CIDA evaluate its bilateral programs to ensure the establishment of joint ventures and the linking of advanced Canadian technology and know-how to the many needs and opportunities of the developing world.

Countertrade and Trading Houses

The global slump of the early 1980s highlighted two related elements of the new economic interdependence of countries: the international debt problem, and the resurrection of countertrade. The debt problems of developing countries, particularly some newly industrializing countries (NICs), reached serious proportions in 1982. Many of these countries, in their efforts to expand, modernize and stimulate their economies, borrowed heavily at floating interest rates from banks in North America and Europe. When interest rates soared, servicing these debts became onerous, especially for a few NICs with exports that were acutely affected by the recession. Several countries on the verge of default were temporarily bailed out. The banks, after their splurge of foreign loans, found themselves with large amounts of their capital at risk in countries that were having difficulty with repayment. So far the international financial system has muddled through this crisis of strained liquidity, but dangers remain. Discrepancies between the maturities on the banks' own borrowings and those on their loans destabilizes the global economic system.

Many developing countries, in their efforts to overcome staggering debt loads, have restricted imports or tied them to counterpurchases of domestic products[8]: shoes in exchange for satellites; aluminum for buses. Commonly the countertrade involves two separate contracts, linked by a protocol, with the original exporter receiving a cash payment but in return having to buy a predetermined quantity of goods within a given time. However, the exchange is not necessarily a simple two-way flow. Transactions sometimes involve up to four different importers and exporters, five different banks, and two or more governments. Nor are countertraded goods necessarily taken back to the advanced industrial country in the exchange: they may be traded to another country.

Many multinational firms are active in countertrade, and a number have recently set up their own countertrade operations.[9] But the extent of such countertrade, though growing very rapidly, is not easily identified, in part because of imprecise definitions and business secrecy. Nevertheless, in conjunction with related barter trade between the OECD countries and Eastern Europe, countertrade has, according to some estimates, reached as high as 30 per cent of world trade.[10]

Although Canadian experience with countertrade has been limited — it is used mainly to offset defence procurement — there is growing recognition of the potential importance of this practice for Canada. However, Canadian companies, unfamiliar with the practice, have tended to regard countertrade as an awkward and complicated way of doing business. Some, moreover, view it as a regressive step.

In recent years, the emphasis on countertrade has changed: it can no longer be categorized as "dumping." Rather, it has become a new way of doing business with countries that do not have the funds to conduct all their trade on a cash-payment basis. For such countries, countertrade is a necessary means of obtaining or improving access to markets for a broad range of products for which they lack their own established marketing and delivery systems. This is especially so in the case of the emerging economies of China or countries in the Asia-Pacific region or Latin America, with their wide variety of potential exports and their increasing importance to Canada.

If Canada is to expand the level and diversity of its export products and services, a new approach to countertrade is needed. At a time when Eastern European and developing countries are anxious to improve their balance of payments, a more pragmatic Canadian openness to countertrade might be a good way of entering and developing newer markets and of taking advantage of countertrade-dependent sales opportunities. Countertrade might also provide greater access to longer-term, reliable sources of supply and possibly lead to subsequent and mutually satisfactory industrial cooperation agreements. A flexible Canadian attitude to countertrade may be the only way to keep such markets open in the short term, if not longer. In essence, countertrade should be seen as an integral part of Canada's development strategy, a part of particular importance to small and medium-sized exporters. Therefore,

13. The Science Council recommends that the federal government develop a positive Canadian stance toward countertrade, to facilitate technology and knowledge-intensive exports, to expand training capabilities in this kind of business expansion, and to provide a mechanism for managing countertrade imports. The Department of External Affairs should establish a full-time countertrade desk and an information database system for prospective buyers and sellers involved in international countertrade.

In addition,

14. The Science Council recommends that the Export Development Corporation be encouraged to develop insurance instruments and services to provide risk coverage on delivery obligations resulting from countertrade obligations assumed by Canadian exporters as payment for their exports.

Canadian banks could play an important role in countertrade and coordinating transactions. However, they face certain limitations in relation to the more favourable position of their European and (since passage of the US Export Trading Company Act in 1982) American competitors. Canadian banks are barred from taking title to goods, a measure that prevents their participating in international transactions. Moreover, Canadian banks may not own more than 10 per cent of a Canadian corporation, including a trading company (unlike many of their foreign competitors, which may own such companies). As countertrade becomes more important, foreign banks will increasingly attract Canadian corporations, and that will weaken the competitive position of Canadian banks — not only for export trade but for their Canadian operations.

Given that the various stages of trade transactions are rarely simultaneous, financing is necessary. At some point in the chain of a countertrade transaction, title to goods must be taken. Most small- or medium-sized Canadian exporters either cannot or do not want to take title, particularly when the countertrade goods may have to be sold outside Canada. The purchaser in a third country, albeit interested and committed, enters into the agreement later. Accordingly, the ability of Canadian banks to take title temporarily would serve as a constructive bridging mechanism, enhancing their traditional role as trade coordinators.

The need for stronger Canadian trading companies has often been discussed. Government export promotion programs rarely combine both financing and marketing services to help small and medium-sized firms overcome the risks of international trade. The ultimate strength of a trading company comes from its ability to link financial expertise and effective information pools that include marketing expertise.[11]

Canada already has many small private trading houses. These houses are highly specialized according to geographical region of marketing expertise or to the particular commodity exported. Action is needed now to pool private and public sector resources to build larger trading houses. One trade-related mechanism that has received a lot of publicity over the last few years is the concept of a national trading corporation. A special House of Commons committee recommended the creation of such an instrument, but the private sector strongly rejected the idea.

The need remains for larger, more diversified trading houses that allow for the pooling of risk and the capture of economies of scale in marketing

information. To promote the emergence of larger Canadian trading houses, as well as to assist those engaged in countertrade, Canada should remove restrictions on bank ownership of companies engaged in trade. This should help improve the banks' service to Canada's exporting community. Adopting legislation to mirror that in the United States would reduce the likelihood of retaliation. Therefore,

15. The Science Council recommends the removal of present legislative restrictions on the banks' involvement in trading houses and countertrade by amending the Bank Act to allow Canadian banks to take title to goods temporarily, in the course of arranging and financing an export transaction, and to allow them to own trading companies.

Chapter 5

Pulling Together

The international experience of recent decades shows what can be accomplished when the main actors within countries consciously pull together. The examples of Japan and West Germany, on the one hand, and the United States and United Kingdom, on the other, demonstrate the strengths and limitations of conducting science policies (including R&D policies) in harmony with or in isolation from national economic policies. Both Japan and West Germany "seem to have gone further than the USA in articulating national priorities and coordinating their scientific effort by a combination of consensus, concerted action and centralized control over large or vital parts of public R&D spending."[1] By contrast, difficulties in maintaining international competitiveness in both the United States and the United Kingdom have been blamed on their piecemeal approaches to science and economic policies.

What are the prospects within Canada for building social consensus among business, labour and government? Is there a useful role for some trilateral institution to develop industrial priorities? How can governments conduct science policies that are consistent with economic policies?

Employment and Adjustment

Nowhere is pulling together more important than in business-labour relations. Little else can be accomplished either practically or politically unless there is a strong sense that the Canadian labour force will not be unduly disrupted by technological change.

One of the most contentious public debates has concentrated on the interconnections between unemployment and productivity increases derived from technological change. There is widespread public concern about the labour-displacing effects of various technological developments from robots to office automation and computer-assisted learning. Many people fear that Canada will continue to experience a high unemployment rate well into the 1990s.

It is unclear whether the drive for increased productivity and heightened international competitiveness will continue to eliminate jobs or ultimately save them. Certainly the past record shows that increasing productivity is related to higher employment levels. The promotion of knowledge-intensive firms to enhance structural adjustment will receive public support if the potential for increased income and productivity is emphasized, but this support may crumble if Canada is thought to be adjusting into a high-unemployment industrial structure. This concern is not new. The 1960s saw similar anxiety over the issue of technological unemployment, an anxiety that turned out to be unwarranted.

What worries people in the 1980s is the unique nature of the new technologies, which may make history a poor indicator for future policy. In the past, the effect of technological change on employment gave Canada little direct cause for alarm or public policy response. Now, however, it is impossible to predict whether technological unemployment will increase as investment in automated systems increases.

The jump in Canada's unemployment rate from 7 per cent in mid-1981 to 12.6 per cent in mid-1983 was not caused by industrial robots, but by anti-inflationary monetary policy. Even so, with each economic cycle the base unemployment rate appears to be increasing, and this raises questions about the role of technological change in this process. The net unemployment effect of such change is unpredictable. Some alarming forecasts warn of the labour-displacing effects of robotics and information technology and generalize about a forthcoming "collapse of work." Others are quite sanguine about the medium-term adjustment to technological change, particularly in view of demographic trends, which indicate that fewer people will be entering the labour force as the century ends. Optimistic forecasts predict that increases in income and demand will create jobs. By increasing productivity, new technology may make it possible for workers to obtain higher wages and for capital owners to obtain higher profits. These wages and profits when spent will create jobs. Also, new technology may lower the selling prices of products, which will increase domestic and export sales. Again, jobs will be created in other parts of the business and in the economy generally.

The process of displacing and creating jobs as technology changes affects more than net unemployment. The process will determine not only the number of jobs in the economy but also their quality. Some economists have argued that middle-level blue-collar jobs are the most susceptible to displacement by automation and that the labour market will ultimately be characterized by a multitude of low- and high-paying jobs but fewer middle-level jobs. Others have discussed the threat to clerical jobs and suggest that women particularly will be affected and that the sexual duality of the labour market will increase.

New technologies cannot be used effectively in an environment of social suspicion and labour unrest. Resisting their adoption would be counterproductive, diminishing competitiveness and threatening wealth creation and job security rather than enhancing growth prospects and improving productivity. The management of Canadian firms must work toward progressive labour relations, particularly by encouraging labour participation in discussions about technological change.

Fundamental changes in management styles are under way in some sectors. For example, workers are increasingly invited to participate in decision-making processes. Worker involvement programs have increased productivity for some firms. Firms introducing technological change are learning that they must maintain adequate notification and consultation procedures and provide suitable periods of notice and employment adjustment assistance.

Collective bargaining also has an important role to play in the adjustment process, by inducing management to negotiate methods of easing adjustment to proposed changes, and encouraging the cooperation of the unions.

The provisions concerning technological change in the Canada Labour Code and equivalent provincial codes need certain revisions if they are to speed the pace of the adoption of new technology and achieve their stated goal of encouraging free collective bargaining as a way of ensuring a just division of the fruits of progress.[2] For instance, a recent survey of the technological change provisions in collective agreements under the Canada Labour Code revealed that most collective agreements under federal jurisdiction contain neither procedural nor substantive provisions on technological change. The definition of technological change in the Canada Labour Code is frequently viewed by trade unionists as being too restrictive.

The Science Council believes that the original intention of the Canada Labour Code legislation — to adjust to technological change through collective bargaining — has not been properly tested or discredited, and that it would be sensible to alter the legislative restrictions by following the provisions now contained in certain provincial codes to give collective bargaining a chance to work.

The language of the Canada Code is one of the barriers that discourages parties from using the technological change provisions. The British Columbia Code, for instance, defines technological change in a broader way than the Canada Code. It includes changes in the manner an employee carries on his or her work in relation to equipment or materials. The BC definition not only encompasses more employee activities, but the Canada Code's requirement that the change be directly related to the new equipment or material introduced has been omitted as well. The BC Code allows for a change to affect the employees indirectly and still be considered a technological change. Moreover, the BC Labour Board is more precise about the point at which the provisions on technological change apply. As in the federal and many other provincial codes, the BC Code requires that the technological change must affect "a significant number" of employees to whom the collective agreement applies. The phrase has never been interpreted in the federal code, so it is unclear what "a significant number" means. In BC, however, the phrase has been interpreted, following a 1979 case, to apply even when only one employee is affected.

There are other ways in which legislative restrictions might be adjusted to reinforce the unions' acceptance of technological change. For instance, the "opting out" clauses could be reduced by specifying minimum requirements that cannot be bargained away. The current provisions on "opting out" tend to discourage use of the federal and provincial codes. Another way might be to allow bargaining to begin automatically if notice of technological change has been given or is deemed to have been given, as the Saskatchewan and Manitoba codes permit. This avoids the cumbersome two-step process of

having to return to the board for permission to serve notice to bargain. A further way is to allow midterm bargaining to encompass the whole collective agreement, rather than restricting the negotiations to issues related only to the technological change, as the Canada Code appears to do. It would allow more flexible trade-off negotiations to be undertaken. Under the Manitoba Code, the agreement terminates once notice to bargain is given.

The provincial codes, which in many areas are the same as the federal code, have not generated many cases. The BC Board, working with what are probably the broadest provisions for technological change, has heard more cases than any other provincial board; however, even so, only eight to 10 decisions have been made under these sections.

Because less than one-third of the Canadian workforce is unionized, improving collective bargaining is not in itself adequate as an instrument to deal with technological change. Nevertheless, the Science Council believes that changes are needed in these codes to encourage and enable Canadians to accommodate technological change through collective bargaining. Therefore,

16. The Science Council recommends that the federal and provincial governments, to assist the process of technological change, to accommodate it by free collective bargaining and to help ensure a just sharing of the fruits of progress, adjust the legislative provisions on technological change in their labour codes by broadening their definition and interpretation of what constitutes a technological change.

To meet its international trade obligations, to avoid new protectionist measures in structurally weak industries, and to facilitate the multilateral negotiation of further tariff and nontariff reductions, Canada will need an adjustment policy for displaced workers that distributes the benefits of trade liberalization according to the costs of adjustment. The only practical political alternative to continued protection is a policy that ensures that workers in industries and regions affected by trade are compensated for their financial losses.

At present, the displaced worker can draw on a number of programs to compensate for job loss and to find employment elsewhere. Unemployment benefits, retraining programs and mobility assistance are all currently available. However, all these programs still may not fully compensate the total loss to a worker from job displacement. Other programs designed to compensate workers for trade-related injury are so tightly restricted that very few workers are eligible. For example, the federal government's labour adjustment benefits program, instituted in 1971, is directed specifically at job losses resulting from import competition. However, the number of workers benefiting in any particular year has been very small.

Canada's trade-related adjustment programs are much smaller than those of other industrial countries, including the United States.[3] If trade liberaliza-

tion benefits Canada, then some of these benefits should be redistributed to those workers directly and indirectly bearing the cost of job loss. Adjustment assistance programs that compensate workers must be designed not to reduce individual incentive to look for work. Compensation paid as a one-time lump sum and tied to requirements for retraining would be a better incentive to look for work than a regular weekly supplement.

More generous labour adjustment assistance to older workers in specific communities most adversely affected by trade-related injury should reduce the pressures for defensive protectionism. Progressive removal of nontariff barriers will not result in the abandonment of all structurally weak industries, for the strongest firms will survive. It will, however, mean that the industries must become leaner, and the remaining firms more innovative and internationally competitive as they adopt modern technology and develop stronger marketing skills. Therefore,

17. The Science Council recommends that, as the economy recovers, the federal government adopt a timetable to reduce the use of nontariff barriers for those structurally weak industries most subject to competition from the Third World. It should also extend adjustment assistance, especially for retraining or early retirement, to a more broadly defined group of older employees in communities most adversely affected by trade-related injury involving those industries.

These measures would demonstrate the willingness of the government to cooperate with labour to improve the economy during a period of technological change. Partnership mechanisms and intergovernmental collaboration will aid in this objective, as will proposed local involvement through metropolitan technology councils.

Partnership Mechanisms

In the past, close partnership has not been a Canadian tradition. Canadian institutions (despite the existence of common interests, shared goals and similar values among Canadians across the country) excessively emphasize competition.[4] Without a process to accommodate their differences, alienation often prevails among business, labour and government, and between levels of government. Without workable consensus mechanisms to integrate and reconcile different interests across the country, Canadians will be seriously handicapped in global competition.

Workable consensus mechanisms can provide an alternative to market forces as a means of coping with change.[5] Such mechanisms should be derived from a well-developed structure of political interest groups to link representative business associations with labour unions. Only then can policy consensus be built and public support rallied. However, Canada has no tradition

of strong and widely representative unions; nor are business or trade associations strong enough or adequately staffed to act as sounding boards or agents. Governments thus have few groups with whom they may bargain.[6] Without such mechanisms, governments are preoccupied with procedure and more recently with a revival of consultative processes. Too much emphasis is placed on process as opposed to substance.[7]

Effective consultation is also hindered by the distribution of a small population over a vast territory, the extensive foreign investment and control of industry and labour unions (which means that participants are not usually the principals responsible for making key decisions), and the existence of several levels of government. However, attempts continue to be made to establish continuing and formal consultative processes. The Science Council endorses such efforts, which include the establishment of the Canadian Labour Market and Productivity Centre and steps toward prebudget consultations.

Yet, if the European experience proves anything, it is that consensus tends to come from joint decision-making and bargaining rather than from procedures of consultation.[8] There are, of course, great institutional differences between Europe and Canada, and even more between Canada and Japan. Compared with those areas, Canada is a novice in industrial policy.

> The consequences for industry-government relations are clear. Even in the relatively homogeneous economies of Europe and Japan, building a consensus on industrial issues is never easy. But at least in these countries the structure of traditional industry-government relations, and the bias toward manufacturing, allows the development of a consensus on specific issues. In Canada, manufacturing interests are overshadowed by the resource sector and fractured by disputes between large and small business and domestic and foreign-owned firms.[9]

These problems for the making of Canadian industrial policy are compounded by the conflicts arising from the different regional patterns of economic development and associated interests in the provinces. Regional industrial interest-group activity makes it difficult to address the industrial policy question for specific firms and sectors in Canada without tackling federal-provincial and interprovincial relations.

Recent experience also reveals the limits of trilateral (government, business, labour) sectoral consultative processes, given Canada's economic, geographical, political and social circumstances.[10] Continuous dialogue between opinion leaders is still important, for their communication maintains an awareness of issues and promotes changes of attitude. Many bilateral exchanges between business and labour and some ad hoc trilateral exchanges with higher levels of government have occurred. However, the establishment of a tripartite institution to reach fundamental agreement on national development priorities (science, technology and industrial policy) poses a problem.

Such an institution would almost certainly be dominated by participants anxious to reinforce the status quo. Influential political committees would be far more likely to emerge in support of the old and troubled industries rather than those of the next generation. And if only one of the higher levels of government were to participate, such an institution would be far less likely to make a positive contribution to the economy. Any tripartite consultation in the process of building a national consensus requires that Canadians be prepared to make substantial institutional changes, including the creation of new mechanisms and representative associations able to negotiate and bargain with government.

At this time the Science Council is not proposing a central mechanism. Although the formation of the Canadian Labour Market and Productivity Centre opens avenues of cooperation between big business and labour, the private sector still remains fragmented. Canada lacks the kind of strong central organizations that represent the private sector in many other advanced countries. Therefore,

18. The Science Council recommends that, to assist in the process of building a national consensus on science, technology and industrial policies, the private sector seriously consider the need to build much stronger organizations that would better serve their interests and aid the process of negotiating and bargaining with government.

Business-Bureaucracy Interchange

It is easy to say that innovation will thrive in the right climate, but governments are still desperately searching for that climate. Although an appropriate macroeconomic environment is clearly necessary, it is by no means sufficient. Advocating only broad climate measures to stimulate innovation reflects a lack of understanding of the complexities of the innovation process.[11] Each industry has unique characteristics that shape its innovation pattern and capability, and influence its concept of the appropriate climate for innovation to be created by government action.[12]

A continuing obstacle to the making of industrial policy is the dichotomy between businesses and bureaucracies. Many senior bureaucrats lack industrial experience, particularly of risk-taking in the industrial innovation process, and businessmen lack experience in the public sector. Senior executive officers now require a good sense of public issues, just as bureaucrats should be well versed on the cut and thrust of modern business.[13]

This dichotomy is exacerbated by geographic isolation. Of course, some disagreement may be constructive and effective.[14] But when conflict arises from misunderstanding of the other's pressures, goals and motives, both groups would benefit from interchanges of senior personnel. Whereas the federal government's executive interchange program has proved successful, to date

there has been little participation by firms in the manufacturing and business services sectors.[15] Therefore,

19. The Science Council recommends that public and private sector service and manufacturing firms greatly increase their commitment to executive and other interchange programs; that serious attempts be made to ensure that those senior federal and provincial bureaucrats with responsibilities for industrial policy-making and delivery have private sector experience; and that large private sector firms consider a tour of duty in the federal or a provincial bureaucracy a desirable attribute of top managers.

Intergovernmental Collaboration

In Canada's current circumstances, the forging of productive alliances between interest groups must start with imaginative federal leadership. Most provinces have introduced industrial strategies that directly affect specific industries and stress the development of their own resource, service or manufacturing specializations. This adds to competition among the provinces and there have been few significant federal-provincial or interprovincial attempts at cooperation (in procurement or R&D, for instance) to offset that competition. The provinces can also thwart federal initiatives and impede national approaches to industrial problems. As a result, intergovernmental cooperation to harness the energies of both higher levels of government is essential for the success of industrial policy in Canada.[16]

Review of the evidence on intergovernmental cooperation suggests that the best opportunity for developing an industrial policy lies in the bilateral cooperation of federal and provincial governments.[17] With such an approach, the federal government could tailor its policies to the needs and potential of each province, supporting those initiatives that fit in well with national objectives.

What are those national objectives and how are they formed? Few are specific enough to offer guidance for planning. Federal leadership is required to strengthen the regional and metropolitan dimension of policy and program development, to establish strategic objectives for long-term management (particularly for the joint planning of science and technology infrastructure), and to foster the development of Canada's human resources. Without such leadership and a strategic framework of objectives, there is little basis on which to evaluate either the results of extensive consultation with the private sector or any sectoral task force recommendations.

At the moment, the federal government has become more active in seeking out regional development opportunities and anticipating structural change. It has altered its approach to regional industrial development and plans now to focus on a few priority industrial sectors or areas of infrastructure in each province. In attempting to avoid the ad hoc approach of the past, it has raised

concerns as to whether federal and provincial economic strategies will ever be complementary. It remains to be seen whether politics will drive the new system and confrontation will continue to stifle Canada's development. Nevertheless, the significance of this new approach should not be underestimated. Regional strengths are only partly the result of natural endowments. They can and should also be the result of public policy choice. All federal economic departments are now responsible for contributing to regional development and their efforts are being coordinated by the Ministry of State for Economic and Regional Development (MSERD).

A senior bureaucrat from MSERD, a Federal Economic Development Coordinator, has been assigned to each province. These officials are responsible in part for helping to plan Ottawa's regional development role with the provincial government and for preparing a five-year framework agreement, an Economic and Regional Development Agreement (ERDA). These ERDAs, the first of which was recently signed with Manitoba, provide for federal and provincial development funding. Under this new approach (unlike the preceding General Development Agreements initiated between a province and the former federal Department of Regional Economic Expansion), there is greater emphasis on each level of government handling its own projects, with federal assistance delivered directly where feasible.

At this time it is not clear whether the ERDAs are being negotiated within an overall framework to complement one another, or that MSERD can really deliver a coordinated package. Are the ERDAs being linked, for instance, with other federal programs, including those outside the economic envelope — such as the training and employment development programs of Employment and Immigration Canada?

Current operational procedures leave the system open to accusations that it has more to do with short-term political expediency in the allocation of funds and choice of priorities than with long-term planning. It is worth noting the hostility of officials in the Atlantic provinces and Quebec. The Science Council is also concerned by the secrecy underlying the planning process and choice of federal and provincial priorities. The procedure should be opened up to encourage debate on objectives and priorities. Therefore,

20. The Science Council recommends that:
    - there be more public, legislative and parliamentary discussion of the Economic and Regional Development Agreements (ERDAs) while they are being negotiated between the federal and provincial governments;
    - the provinces, in establishing their medium- and long-term priorities and objectives for ERDAs, including science and technology policies, seek proposals from business and labour constituencies and from regional and metropolitan advisory councils;
    - the federal government ensure that the ERDAs complement each other and together form a coherent national framework;

- the federal government ensure that its negotiators are able to deliver those elements of the federal provisions that will make the ERDAs work, including necessary elements not contained within the federal economic envelope.

Metropolitan Technology Councils

The trend in the prevailing social and economic climate in Canada, just as in the United States and Western Europe, is toward multipartite participation and greater local control in regional development. Although a national policy is required, the public also sees the need for stronger local initiatives. Those initiatives need not lead to a win-or-lose game in which some cities are able to win only if others lose. Lower levels of government are assuming greater responsibility for sustaining a suitable environment in which R&D-based development can flourish and the work of scientists and engineers can enhance the vitality of the community. A wise national policy will take account of these local initiatives, build on them and attempt to ensure they are complementary. In this climate, development initiatives should come as much from the grass roots up as from the top down.

More and more Canadians appear to want a participative and multipartite decision-making approach. Such an approach would evolve most practically at the level of Canada's 24 metropolitan areas. Metropolitan technology councils could form the base of the hierarchical information network required to support a mechanism of partnership planning oriented to long-term management, especially strategic planning for Canada's intangible resources.

Efforts to develop teamwork and break down barriers between business, labour, government and higher education institutions might usefully take place at this metropolitan level. Indeed, there are already a number of helpful initiatives under way, particularly the links being forged between business and universities.[18] These links are crucial in an era of quickening scientific and technological change and rapidly diminishing lags between basic research and technological application. To exploit many of today's opportunities, unhampered communication of fundamental knowledge is paramount and speed is essential.

Canada's metropolises are the site of most economic activity and the location of most fixed and human assets. These assets require continuous upgrading. In 1981 the 24 census metropolitan areas contained more than half the population and three-quarters of Canada's scientists and engineers. In fact, half of all Canadian scientists and engineers are located in the six largest metropolises (Table 2).

New approaches are needed in urban policies to cope with the forces generating profound structural transformations. Leaders in Canada's major urban areas are aware of this and are searching for cooperative strategies involving local government, the private sector and the community. At this level, re-

gional promotion and regeneration may involve identifying strengths and weaknesses, then building a local consensus on priorities and ways to coordinate action to provide a favourable environment for innovation and production. Special policies are needed to suit the needs and potential of each metropolitan area.

The success of innovation policy lies in the regionalization and decentralization of schemes, and especially in the ability to tap potential and meet the

Table 2 - Population and Employment in Natural Science, Engineering and Mathematics Occupations, by 24 Census Metropolitan Areas, 1981

CMA	A Population	B % Canadian Population	C No. of NS, E & Ms*	D % Canadian NS, E & Ms	E Representation D/B
Toronto	2 998 947	12.35	71 020	17.69	1.43
Montréal	2 828 349	11.65	50 070	12.47	1.07
Vancouver	1 268 183	5.22	25 185	6.27	1.20
Ottawa-Hull	717 978	2.96	23 735	5.91	2.00
Edmonton	657 057	2.71	17 790	4.43	1.63
Calgary	592 743	2.44	26 200	6.53	2.68
Winnipeg	584 842	2.41	10 280	2.56	1.06
Québec	576 075	2.37	12 545	3.12	1.32
Hamilton	542 095	2.23	9 855	2.45	1.10
St.Catharines-Niagara	304 353	1.25	4 845	1.20	.86
Kitchener	287 801	1.19	5 275	1.31	1.10
London	283 668	1.17	4 330	1.08	.92
Halifax	277 727	1.14	5 675	1.41	1.24
Windsor	246 110	1.00	2 650	.66	.66
Victoria	233 481	.96	4 835	1.20	1.25
Regina	164 313	.68	3 355	.84	1.24
St. John's	154 820	.64	2 590	.64	1.00
Oshawa	154 217	.64	2 495	.62	.97
Saskatoon	154 210	.64	3 195	.80	1.25
Sudbury	149 923	.62	2 065	.51	.82
Chicoutimi-Jonquière	135 172	.56	2 120	.53	.95
Thunder Bay	121 379	.50	1 705	.42	.84
Saint John	114 048	.47	1 385	.34	.72
Trois Rivières	111 453	.46	1 350	.34	.74
Total CMAs	13 658 944	56.25%	294 550	73.37%	1.30
Total Canada	24 280 600	100.00%	401 460	100.00%	

Source: Statistics Canada, *Census Metropolitan Areas with Components*, 1981 Census of Canada, catalogue 95-943.

* Natural scientists, engineers and mathematicians, based on 20 per cent sample data.

needs of small and medium-sized firms.[19] Local competence in responding to small-business needs is crucial to enhance the creation and maintenance of jobs in both manufacturing and services. Many communities are now seeking to promote an entrepreneurial spirit, stimulate indigenous innovation and create or attract new technology-based firms and knowledge-intensive industries. The establishment of such firms often requires that a community establish a strong network of public/private cooperation, as was the case with Ottawa's Silicon Valley North.[20]

Within Canada there is a growing dispersion of federally and provincially funded research labs and technology centres. If they are fully integrated within their communities, they can contribute to the innovation infrastructure and help to fulfil regional technology needs. However, even strong research capabilities, particularly in the case of more depressed regions, are probably insufficient to stimulate economic development if there is no appropriate industrial and skill infrastructure to build on the research results.

Metropolitan and local government organizations can enhance the success or rejuvenation of existing firms and the probability of location and growth of innovative firms and industries in their areas by supporting the training and retraining of skilled labour, establishing centres of excellence within higher education, and creating a receptive environment. Close attention to the changing educational and specific training requirements of existing activities in their area is also important. Training tends to be most effective when it is the result of concerted efforts between local educators and representatives of labour and industry.[21] Adjustment to rapidly changing conditions places great pressure on a region's resilience and the ability to form creative links between local institutions and key actors. It takes foresight and collective action to ensure that the skills taught are those needed in the metropolitan marketplace, to retrain workers displaced by new technology, and to be aware of pending skill shortages. The emphasis must be on communication and cooperation, on building better information networks and joint decision-making, and on institutionalized linkages between important actors and agencies to coordinate the use of funds from different sources.

A metropolitan technology council must oversee the workings of the technological infrastructure, such as R&D facilities, educational institutions, training programs, technology-intensive business enterprises and public agencies, as well as transportation, communication and other supportive structures and services. Such a council would need to:

- assess the strengths and weaknesses of its science and technology infrastructure;
- evaluate the quality of locally based resources necessary to the innovation process;
- recommend directions for the future development of its technological assets;

- strengthen networks linking these assets, and assist in the formation and development of technology-intensive enterprises;
- promote the preparation of plans to achieve objectives set out as a result of consensus-building within the community;
- help ensure the updating and implementation of those plans.

The organizational structure of a metropolitan technology council could be similar to that of a traditional development corporation, including an independent board of directors (representing a cross-section of influential organizations appointed for three years and with the chairman elected from the representatives nominated), a full-time general manager and professional staff. Its operating budget depends on the needs, capabilities and strategy adopted by the community. It should be funded by senior governments and local municipalities, with supplements from corporate and institutional member subscriptions. Good relationships with the senior governments and local interest groups are essential. With contributions from all levels of government as well as corporate partners and affiliates, key agreements and working relationships must be developed between the interest groups.

Currently, a similar type of institution, a Community Adjustment Committee, has been created by the federal government under the auspices of the Industry and Labour Adjustment Program (ILAP) to deliver a variety of programs at the local level. Although these committees are of recent creation, reaction to them is generally positive.[22] However, the concept has only been applied in a few communities faced by crisis conditions. The concept now should be extended from rescuing a community in crisis to preventing the community reaching a state of crisis. There are examples of similar organizations emerging in several areas — from Vancouver's Economic Advisory Commission to Ottawa's Commercial and Industrial Development Corporation and Québec City's Groupe d'action pour l'avenir technologique et industriel de la région de Québec. The purpose of these organizations differs from that of the earlier promotional efforts of municipalities and regions, which were designed simply to attract investors. The new organizations involve a broad range of community interests and work to define and achieve broader objectives, including technology development. These grass-roots developments are evidence of community awareness of the need for a new institution to link key regional players and to discern how best to augment their science and technology base to sustain a path of flexible long-term economic adjustment. Therefore,

21. The Science Council recommends that mayors and chairpersons of cities or metropolitan regions consider the feasibility of establishing an advisory body to be called a Metropolitan Technology Council in their region. The council's mandate should be to elucidate through a participatory process a set of regional science and technology goals and to promote the

cooperation of higher levels of government in working toward the achievement of those goals. Membership on a council should be voluntary and include elected representatives as well as representatives from business, labour and higher education, and other professionals and community leaders. Officials from federal and provincial governments should be invited to participate in an ex-officio capacity as resource people.

Canadian Metropolitan Agency

Metropolitan technology councils, in conjunction with chambers of commerce, could also help Canada to look outward. For instance, they might pull together the talents and resources of their community and institutions in partnerships with foreign sister cities, designed to strengthen import and export capabilities in goods and services. Small and medium-sized enterprises and institutions would be the main beneficiaries of trade elements in a program of twinning cities. By establishing links with a carefully chosen selection of foreign partners across the world, Canadian metropolitan areas could arrange a variety of exchange programs to improve Canadian knowledge of foreign conditions and opportunities.

The concept of cities joining together to achieve mutual objectives is not new. Nor are trade promotion, technical exchange and business stimulation the only or even primary purposes of such efforts as the sister-cities program; however, they tend to be a natural byproduct of the building of new contact networks. Canada has made little use of such a program, particularly its trade elements, compared to the United States, Japan and many European countries. In the United States, for instance, the program, now 28 years old, involves 721 communities affiliated as sister cities with 1018 cities in 81 nations in a planned program of mutual cooperation and understanding. There are 25 American-Canadian sister cities, but many are small communities twinned simply because they share a common name. An example of recent developments in the expanding sister-cities program is the agreement between the chambers of commerce of Louisville, Kentucky, and Montpellier, France, to provide increased technical assistance and actively encourage businesses that are interested in developing and maintaining international trade relationships; and to co-ordinate and maximize the aid available from governments, public and private agencies, and other entities for such activities as cross-licensing and trade shows.

Municipalities provide the infrastructure that sustains much of Canada's production of goods and services and attracts new investment. Yet there is not enough data on Canada's metropolitan municipalities to carry out a detailed evaluation of metropolitan strengths and weaknesses in terms of science and technology infrastructure or other dimensions of development. A new national agency is needed to assist the work of the metropolitan technology councils,

to inject the metropolitan dimension into the development and delivery of programs and policies by higher levels of government, and to provide a basis for intermetropolitan comparisons. Past experience has shown the value of a federal secretariat as a support mechanism to provide advice and information to local councils, committees or corporations. The ILAP Secretariat is a case in point. The Federation of Community Development Corporations of Canada has advocated the establishment of a secretariat to serve, among other functions, as a clearinghouse for ideas and approaches that CDCs have considered and attempted in various communities in Canada and abroad. The Federation of Canadian Municipalities has also advocated that the federal government serve as a channel of communication between senior governments and municipalities and provide a forum for the exchange of data and ideas among communities.

To this end, one significant contribution to the metropolitan technology councils process should be the establishment of a federal or federal-provincial secretariat with the following features:

- staff should have experience in the field (the secondment of personnel with backgrounds in the type of tasks to be carried out by the metropolitan technology councils would be an excellent way to achieve this goal);
- the secretariat would defuse potentially competitive situations between communities and promote cooperation by (a) the provision of advisory services to communities in the process of designing and implementing technology, infrastructure and development strategies, and (b) the maintenance of various related databases to assist the work of all councils.

Therefore, to make this scheme work,

22. The Science Council recommends the formation of a Canadian Metropolitan Agency, to be jointly funded by federal, provincial and metropolitan governments. Its mandate should include:
    - undertaking primary research on Canada's metropolitan areas, particularly in response to the requirements identified by Metropolitan Technology Councils;
    - acting as a clearinghouse for information exchange, a data bank and a resource centre;
    - identifying opportunities for Canadian metropolitan areas to cooperate with foreign cities, establish twinning systems, undertake trade missions and increase technical assistance;
    - assisting with intermetropolitan initiatives in areas such as municipal procurement.

Chapter 6

Conclusions and Recommendations

To secure Canada's future in the emerging information society, Canadians must marshal public policy tools to compete as effectively in the future using Canada's intellectual resources as in the past with Canada's rich natural heritage. Canada's global competitiveness has slipped badly. Emerging trends run counter to those in which Canada has traditionally done well. The devalued dollar has for several years propped up some major resource and assembly industries. Governments have submitted to heavy pressures to retain or extend protective barriers to industries that are otherwise unable to compete internationally. It is no longer prudent to depend, as in the past, on the security of shipping out natural resources.

As in many countries, and at both government and company levels, a mastery of technology has become a way to compete with imports, revitalize stagnant industries, create new jobs and industries, raise productivity, and set the economy on a solid foundation for the next two decades. It was not always so, even as little as three years ago in Canada. It was certainly not so when the Science Council first promoted movement in this direction. In this report the Science Council has defined some policy options that address four areas of distinct weaknesses hindering Canada's ability to create wealth and productive employment, while remaining competitive in international markets. The Council's recommendations are directed toward:

- enhancing entrepreneurship;
- strengthening the capacity to look forward;
- encouraging industries to look outward;
- pulling together to take advantage of the technological revolution and to adjust to the current international situation.

These recommendations are no more than steps in the right direction, necessary complements to the many initiatives that will be needed in other areas of scientific, economic and social policy.

Enhancing Entrepreneurship

The first set of recommendations is concerned with ways to enhance entrepreneurship by encouraging further import replacement, raising the level of Canadian content and supporting new product development through leasing and public procurement. The Science Council proposes the following recommendations:

1. The federal Department of Supply and Services should:
   - offer incentives to provincial governments to negotiate bilateral or multilateral agreements with other provinces to cooperate in joint procurement;
   - devote further effort to cooperating with the provinces and municipalities to identify public sector purchases of imported goods and services that warrant a joint effort to replace them with domestic sources;
   - encourage the development of a more sophisticated leasing market to assist in the early diffusion of Canadian developed machinery and equipment in the domestic market.

2. The federal government should alter current legislation to permit and encourage venture lending and the development of profit-sharing instruments by banks, other financial institutions, and pension funds in Canada in order to improve the climate for the growth of small and medium-sized companies.

3. To enhance the formation and early development of small firms, investment losses in start-up (new section 125) knowledge-intensive companies should be fully deductible from other income up to a maximum of $10 000; and that annual contributions of up to $3500 in Deferred Profit Sharing Plans should be allowed, providing that at least 70 per cent of eligible employees are enrolled. Capital gains made by employees in investments under these plans should be inflation-adjusted for computation of capital gains tax.

4. In order to support the growth of small, indigenous, knowledge-intensive firms beyond the start-up phase of development that are planning significant expansion, the federal government should expand the Federal Business Development Bank's appropriation of capital for investment in equity. The FBDB should offer to take equity in the form of nonvoting, redeemable, fully participating shares.

Looking Forward

The next group of recommendations is designed to strengthen the capacity to look forward, by forging a greater commitment to exploit emerging technologies and seize new opportunities.

5. The Department of Regional Industrial Expansion should identify key areas for assistance in conjunction with the provinces and be prepared to offer consistent long-term government support to develop technological leadership in these designated areas. Any further increase in federal R&D subsidies deemed necessary to correct Canada's underinvestment in

innovation should take place primarily through grants administered through the Industrial and Regional Development Program. The IRDP must be given the resources and competence to do the job well.

6. The Canadian Manufacturers' Association should offer advice and assistance to leading executives of foreign subsidiaries to help them present the case to their parent firm for building a strong export-oriented subsidiary in Canada.

7. The federal Department of Regional Industrial Expansion should put more resources into identifying potential strategic clusters of innovation in Canada and growing foreign firms with strong existing or potential sales in Canada. It should then seek, through the negotiation of a company agreement with the government on matters such as procurement or provision of assistance through the Industrial and Regional Development Program, to encourage firms to establish facilities in Canada and the full range of functions necessary to support a world product mandate or specialized North American mission.

Looking Outward

The third group of recommendations will help provide greater incentives and rewards for Canadian innovation and reinforce Canada's outward orientation.

8. Canada should take full advantage of its rights under the GATT and its ancillary agreements to legislate antidumping duties, countervailing duties and safeguarding measures that will protect Canadian industries from unfair trade practices and serve as a bargaining instrument to negotiate improved access to foreign markets for Canadian exports. Revenue Canada should be given suitable resources to speed the process of investigating and assessing antidumping complaints.

9. The Department of External Affairs should diversify Canada's export marketing expertise. It should:
   - offer grants through the Program for Export Market Development to provide Canadian employees of Canadian firms with more extended foreign marketing assignments;
   - give priority funding to programs designed to raise practical experience in international marketing.

10. The federal government should vigorously pursue efforts to explore any potential advantages to Canada of expanding the Government Procurement Agreement of GATT to include sectors in which Canada has advanced capabilities.

11. The Department of External Affairs, to assist Canadian firms seeking to develop joint ventures to facilitate foreign sales and technology transfer, should assemble a directory of private sector "experts" with a documented track record in various markets and technology categories. Entry requirements should include references from customers.

12. CIDA should evaluate its bilateral programs to ensure the establishment of joint ventures and the linking of advanced Canadian technology and know-how to the many needs and opportunities of the developing world.

13. The federal government should develop a positive Canadian stance toward countertrade, to facilitate technology and knowledge-intensive exports, to expand training capabilities in this kind of business expansion, and to provide a mechanism for managing countertrade imports. The Department of External Affairs should establish a full-time countertrade desk and an information database system for prospective buyers and sellers involved in international countertrade.

14. The Export Development Corporation should be encouraged to develop insurance instruments and services to provide risk coverage on delivery obligations resulting from countertrade obligations assumed by Canadian exporters as payment for their exports.

15. Present legislative restrictions on the banks' involvement in trading houses and countertrade should be removed by amending the Bank Act to allow Canadian banks to take title to goods temporarily, in the course of arranging and financing an export transaction, and to allow them to own trading companies.

Pulling Together

The final recommendations address the problems of sociopolitical consensus, the need for teamwork to pull the various actors in the Canadian economy together in the face of heightened international competition during a period of technological and economic transition.

16. The federal and provincial governments, to assist the process of technological change, to accommodate it by free collective bargaining and to help ensure a just sharing of the fruits of progress, should adjust the legislative provisions on technological change in their labour codes by broadening their definition and interpretation of what constitutes a technological change.

17. As the economy recovers, the federal government should adopt a timetable to reduce the use of nontariff barriers for those structurally weak industries most subject to competition from the Third World. It should also extend adjustment assistance, especially for retraining or early retirement, to a more broadly defined group of older employees in communities most adversely affected by trade-related injury involving those industries.

18. To assist in the process of building a national consensus on science, technology and industrial policies, the private sector should seriously consider the need to build much stronger organizations that would better serve their interests and aid the process of negotiating and bargaining with government.

19. Public and private sector service and manufacturing firms should greatly increase their commitment to executive and other interchange programs; serious attempts should be made to ensure that those senior federal and provincial bureaucrats with responsibilities for industrial policy-making and delivery have private sector experience; and large private sector firms should consider a tour of duty in the federal or a provincial bureaucracy a desirable attribute of top managers.

20. To encourage debate on the objectives and priorities of ERDAs:
    - There should be more public, legislative and parliamentary discussion of the Economic and Regional Development Agreements (ERDAs) while they are being negotiated between the federal and provincial governments.
    - The provinces, in establishing their medium- and long-term priorities and objectives for ERDAs, including science and technology policies, should seek proposals from business and labour constituencies and from regional and metropolitan advisory councils.
    - The federal government should ensure that the ERDAs complement each other and together form a coherent national framework.
    - The federal government should ensure that its negotiators are able to deliver those elements of the federal provisions that will make the ERDAs work, including necessary elements not contained within the federal economic envelope.

21. Mayors and chairpersons of cities or metropolitan regions should consider the feasibility of establishing an advisory body to be called a Metropolitan Technology Council in their region. The council's mandate should be to elucidate through a participatory process a set of regional science and technology goals and to promote the cooperation of higher levels of government in working toward the achievement of those goals.

Membership on a council should be voluntary and include elected representatives as well as representatives from business, labour and higher education, and other professionals and community leaders. Officials from federal and provincial governments should be invited to participate in an ex-officio capacity as resource people.

22. A Canadian Metropolitan Agency should be formed, to be jointly funded by federal, provincial and metropolitan governments. Its mandate should include:
    - undertaking primary research on Canada's metropolitan areas, particularly in response to the requirements identified by Metropolitan Technology Councils;
    - acting as a clearinghouse for information exchange, a data bank and a resource centre;
    - identifying opportunities for Canadian metropolitan areas to cooperate with foreign cities, establish twinning systems, undertake trade missions and increase technical assistance;
    - assisting with intermetropolitan initiatives in areas such as municipal procurement.

Notes

1. Obstacles and Opportunities

1. In 1982 we headed the misery index among the leading 15 western industrial nations. The index consists of the unemployment rate plus the inflation rate minus the growth rate. Canada's index rose to 26.8 in 1982, far above the unweighted average of 17.0. *Business Week*, 14 February 1983, 71.
2. The European Management Forum, *EMF's Report on International Industrial Competitiveness* (Geneva, 1984). The scoreboard is computed by weighting 10 principal factors. If a country ranked first in all 10, it would score 100 per cent; if it came last in all, it would score zero per cent.
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4. The Council recognizes the amorphous character of industrial policy and that the concept is not clearly definable. See W. Grant, "The Political Analysis of Industrial Policy," *Public Administration Bulletin* 38 (April 1982): 7-21.
5. G. Dosi, "Technology Industrial Structures and International Economic Performance" (Brighton: European Research Centre, Sussex University, 1981); J.J. Shepherd, *The Transition to Reality* (Ottawa: Canadian Institute for Economic Policy, 1980).
6. D. de Vos, *Governments and Microelectronics: The European Experience* (Ottawa: Science Council of Canada, 1983).
7. B. Gold, "Bootstrap Advice for Mature Industries," *Planning Review* 11 (1983): 24-30, 48.
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11. K. Pavitt, "Technical Innovation and Industrial Development," *Futures* 11 (1979): 458-70 and 12 (1980): 35-40.
12. G. Ohlin, "National Industrial Policies and International Trade," in *Toward a New World Trade Policy*, ed. C.F. Bergsten (Lexington: Lexington Books, 1975).
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14. Science Council of Canada, *Innovation in a Cold Climate: The Dilemma of Canadian Manufacturing* (Ottawa, 1971).
15. Science Council of Canada, *Technology Transfer: Government Laboratories to Manufacturing Industry* (Ottawa, 1975).
16. Science Council of Canada, *Forging the Links: A Technology Policy for Canada* (Ottawa, 1979).
17. Science Council of Canada, *The Impact of the Microelectronics Revolution on Work and Working* (Ottawa, 1980); *The Impact of the Microelectronics Revolution on the Canadian Electronics Industry* (Ottawa, 1981); *Policy Issues in Computer-Aided Learning* (Ottawa, 1981); *Artificial Intelligence* (Ottawa, 1983).

18. Science Council of Canada, *Planning Now for an Information Society: Tomorrow Is Too Late* (Ottawa, 1982).
19. de Vos, *op. cit.*
20. Science Council of Canada, *Multinationals and Industrial Strategy: The Role of World Product Mandates* (Ottawa, 1980).
21. Science Council of Canada, *The Adoption of Foreign Technology by Canadian Industry* (Ottawa, 1981).
22. Science Council of Canada, *Hard Times, Hard Choices: Technology and the Balance of Payments* (Ottawa, 1981).
23. G.P.F. Steed, *Threshold Firms: Backing Canada's Winners* (Ottawa: Science Council of Canada, 1982).
24. D.J. LeRoy and P. Dufour, *Partners in Industrial Strategy: The Special Role of the Provincial Research Organizations* (Ottawa: Science Council of Canada, 1983).
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26. D. Brown and J. Eastman, *The Limits of Consultation: A Debate Among Ottawa, the Provinces and the Private Sector on an Industrial Strategy* (Ottawa: Science Council of Canada and the Institute of Intergovernmental Relations, Queen's University, 1981).
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2. Enhancing Entrepreneurship

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2. Steed, *op. cit.*; Y. Tsurumi and R.R. Tsurumi, *Sogoshosa: Engines of Export-Based Growth* (Ottawa: Institute for Research on Public Policy, 1980).
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4. A similar problem exists in the United States. See the testimony of Don Gervitz at the hearings before the Joint Economic Committee, Congress of the United States, 30 September 1983.
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7. Canadian Federation of Independent Business, *A Full Employment Future: Submission to the Royal Commission on the Economic Union and Development Prospects for Canada* (Ottawa, 1983).

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4. R.E. Caves *et al.*, *Competition in the Open Economy: A Model Applied to Canada* (Cambridge, Mass.: Harvard University Press, 1980), 173; and R.E. Caves, H. Crookell, and J.P. Killing, "The Imperfect Market for Technology Licences" (Cambridge, Mass.: Harvard Institute of Economic Research, 1982).
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A Nuclear Dialogue: Proceedings of a Workshop on Issues in Nuclear Power for Canada, 75 p.

1977

An Overview of the Canadian Mercury Problem, by Clarence T. Charlebois, 20 p.
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Materials Recycling: History, Status, Potential, by F.T. Gerson Limited, 98 p.

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Auto Sub-Conference Proceedings: 2, 136 p.
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Science Council of Canada

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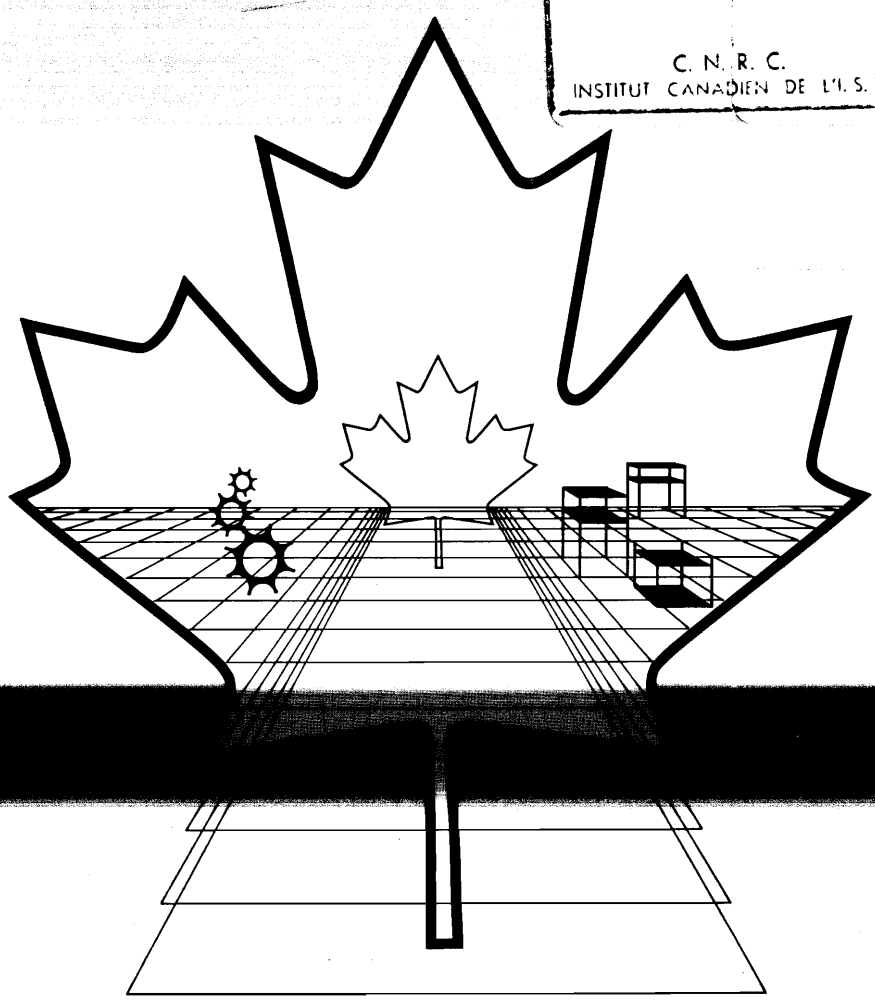
Summary of Report 37

Some Policy Directions



The complete text of Report 37, *Canadian Industrial Development: Some Policy Directions*, is available from:

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In the early 1980s, all advanced industrial countries felt the effects of the extended recession and rapidly changing economic conditions. Canada proved more vulnerable than most. In terms of international competitiveness, Canada's rank slipped from sixth to eleventh between 1981 and 1982. Canada has also been very slow in pulling out of the recession.

In four key areas that contribute to international competitiveness, Canada has performed poorly for years.

First, the industrial sector is lagging in improving efficiency. From 1974 to 1982, Canada registered zero productivity growth, the lowest among leading industrial countries.

Second, this country's innovative forward orientation — the extent of R&D and ability to adapt to future technological requirements — remains weak.

Third, the outward orientation — the focus on foreign trade and investments — ranks low among the industrial countries.

Finally, Canada lacks a stable sociopolitical consensus. Conflict rather than agreement and cooperation is the standard approach to setting priorities.

For nearly two decades the Science Council has been studying the health of science and technology and the effects of the technological revolution. The knowledge gained has helped the Science Council to recommend the directions in which the Canadian economy must move. A number of the Council's publications have contributed to the national debate on industrial policy and adaptation. Report 37, *Canadian Industrial Development: Some Policy Directions,* is in line with the general trend of these publications. Many of the Council's concerns about the need to promote the development and diffusion of technology and to build consensus are now shared by others. Since 1981, Canadian business and governments have begun to move in the directions recommended by the Council. However, the Council believes that more must be done to enhance Canadian industrial competitiveness and encourage change. In particular, *Canadian Industrial Development* addresses the four areas of weakness described above and makes recommendations designed to

- enhance entrepreneurship;
- improve Canada's technological capacity for future development;
- encourage industry to look outward to international markets;
- promote cooperation among the various interest groups in the Canadian industrial structure.

This summary introduces the Council's recommendations and briefly describes some of the thinking behind them.

Enhancing Entrepreneurship

If Canada is to stimulate innovation and build new industries, more support for entrepreneurship and the formation of new firms will be required from governments and businesses than has been the case in the past.

The Council believes that increasing the demand for products and services is an excellent way to enhance entrepreneurship. Government strategy must include policies and programs that will create a market for and accelerate the diffusion of new and existing technologies.

Technology Transfer and Government Procurement

Technology transfer has received considerable impetus from federal and provincial initiatives in creating research programs and institutes. However, governments can do more to encourage the use of new technology in industry. For example, a government-supported leasing company for state-of-the-art machinery or equipment, run along the lines of the Japan Robot Leasing Company, would speed the diffusion of domestic technology.

Creating new domestic market opportunities is another way to promote technology transfer. Government purchasing is an important part of this strategy. The federal Department of Supply and Services has already developed procedures to direct contracts to small business, but much more can be done by all levels of government to increase the level of Canadian content in government procurement and to support new product development.

1. The Science Council recommends that the federal Department of Supply and Services:
   - offer incentives to provincial governments to negotiate bilateral or multilateral agreements with other provinces to co-operate in joint procurement;
   - devote further effort to cooperating with the provinces and municipalities to identify those public sector purchases of goods and services currently imported that warrant a joint effort to replace them with domestic sources;
   - encourage the development of a more sophisticated leasing market to assist in the early diffusion of Canadian developed machinery and equipment in the domestic market.

Financing, New Ventures and Venture Lending

Canadian entrepreneurs need better financial support at many stages in the development of projects. Investment in innovation and technological change is essential to the survival of knowledge-intensive firms, yet most small and medium-sized companies cannot finance this investment on their own. There is a critical need in Canada's capital market for both equity and debt financing of new ventures and technologies.

Banks, other financial institutions and pension funds are all potential sources of private sector venture lending.

2. The Science Council recommends that the federal government alter current legislation to permit and encourage venture lending and the development of profit-sharing instruments by banks, other financial institutions and pension funds in Canada in order to improve the climate for the growth of small and medium-sized companies.

The Council is also concerned that there may be a serious shortage of venture capital available for investment in small knowledge-intensive firms. Such firms are especially risky and often generate little return in their early years. A strong inducement for investors would be favourable tax treatment of investment losses. Currently only 50 per cent of these losses can be deducted up to a maximum of $2000 annually.

Deferred profit sharing plans could also help with early financing. These plans allow firms to channel some employee compensation into a tax-deferred equity investment in the company. An estimated 20 to 25 per cent of small firms in Canada already use deferred profit sharing.

3. The Science Council recommends that to enhance the formation and early development of small firms, investment losses in start-up, knowledge-intensive companies be fully deductible from other income to a maximum of $10 000; and that annual contributions of up to $3500 in Deferred Profit Sharing Plans be allowed, providing that at least 70 per cent of eligible employees are enrolled. Capital gains made by employees in investments under these plans should be inflation-adjusted for computation of capital gains tax.

Early funding problems also beset firms that are past the start-up stage, but not yet ready or able to offer shares publicly. The Federal Business Development Bank (FBDB) has recently been directed to act as the federal government's instrument for supporting the early development of firms by offering equity as well as venture capital. The duration of government equity participation should, however, be limited to a period of five to seven years.

4. The Science Council recommends that in order to support the growth of small, indigenous, knowledge-intensive firms beyond the start-up phase of development that are planning significant expansion, the federal government should expand the Federal Business Development Bank's appropriation of capital for investment in equity. The FBDB should offer to take equity in the form of nonvoting, redeemable, fully participating shares.

Looking Forward

It is generally accepted that there is a strong link between the use of new technology and increased industrial productivity. Canada must move forward by more rapidly identifying and seizing the opportunities offered by new processes and new equipment.

An important consideration in the adoption of new technology is the balance that must be struck between the transfer of technology from abroad and the contribution of domestic R&D. Both are necessary — in fact, indigenous R&D is usually a prerequisite for the absorption of foreign technology.

Recent studies have shown that R&D investment produces a considerably higher rate of return for companies than does capital investment. On the basis of these analyses, the Science Council believes that R&D in Canada should be increased by about two-thirds above 1979 levels in order for companies to reap the maximum benefits from investments.

What Governments and Business Can Do

The simplest way for the government to encourage industrial innovation is by providing tax incentives for R&D. However, general tax subsidies must be supplemented by specific R&D grants to offset the unevenness of technological benefits and opportunities among different industries and between smaller and larger businesses. The grouping of innovative firms for priority funding, and grants to support technologies of strategic importance to Canada are also needed. Sectors in which Canada could take the lead must be identified, and grants channelled to support R&D in these areas. The Industrial and Regional Development Program (IRDP) administered by the Department of Regional Industrial Expansion, would be the best way to provide this assistance.

5. The Science Council recommends that the Department of Regional Industrial Expansion identify key areas for assistance in conjunction with the provinces and be prepared to offer consistent long-term government support to develop technological leadership in these designated areas. Any further increase in federal R&D subsidies deemed necessary to correct Canada's underinvestment in innovation should take place primarily through grants administered through the Industrial and Regional Development Program. The IRDP must be given the resources and the competence to do the job well.

Foreign-owned firms can also contribute to Canada's technological advancement. Many subsidiaries of foreign-owned companies are re-examining their basis for operating in Canada. One alternative to the traditional strategy of maintaining product diversity in Canada's

domestic market is to assign world product mandates (including R&D responsibilities) to Canadian subsidiaries.

This option applies not only to long-established subsidiaries but also to the many new companies whose exports to Canada contribute heavily to this country's trade deficit in end-product manufacturing. Rapidly growing new foreign firms might be persuaded to undertake production here to build on Canadian capabilities. More Canadian managers must convince their parent companies of the advantages of developing the export orientation of subsidiaries.

6. The Science Council recommends that the Canadian Manufacturers' Association offer advice and assistance to leading executives of foreign subsidiaries to help them present the case to their parent firms for building a strong export-oriented subsidiary in Canada.

7. The Science Council further recommends that the federal Department of Regional Industrial Expansion put more resources into identifying potential strategic clusters of innovation in Canada and growing foreign firms with strong existing or potential sales in Canada. It should then seek, through the negotiation of a company agreement with the government on matters such as procurement or provision of assistance through the Industrial and Regional Development Program, to encourage firms to establish facilities in Canada and the full range of functions necessary to support a world product mandate or specialized North American mission.

Looking Outward

World trade has faltered in recent years, despite becoming increasingly liberalized following the Tokyo round of the General Agreement on Tariffs and Trade (GATT) negotiations. Canada has agreed to do its part in dismantling tariff barriers to trade.

In the new international trade environment, Canada must expand its export markets, develop international marketing skills and find new trading partners. At the same time, this country must get used to new ways of doing business internationally and protect itself against the sometimes unfair trade practices of other countries.

Contingency Protection

Lower tariffs between Canada and its major trading partners should increase Canada's long-term production efficiency. In the current period of slow economic growth, however, many countries are adopting protectionist measures such as import quotas and voluntary

export restraints and instituting policies to increase the competitiveness of their own industries. Although many of these policies are designed to correct market inadequacies, Canada should strengthen its guard against injurious imports and unfair competition.

8. The Science Council recommends that Canada take full advantage of its rights under the GATT and its ancillary agreements to legislate antidumping duties, countervailing duties, and safeguarding measures that will protect Canadian industries from unfair trade practices and serve as a bargaining instrument to negotiate improved access to foreign markets for Canadian exports. Revenue Canada should be given suitable resources to speed the process of investigating and assessing antidumping complaints.

Export Trade and Marketing

Export trade in manufactured goods and services must play an increasing role in Canada's economic development. If it is to improve its international competitiveness, Canada will have to develop and market distinctive goods and services. Greater knowledge of user needs in global markets will provide the pull and direction for the design and engineering of such competitive products.

Ignorance of export opportunities is a particular problem for smaller firms. Because of Canada's small domestic market, many Canadian-owned firms in knowledge-intensive sectors must look to export markets for sales at an early stage in their development, while their skills in export marketing talent and effort are still undeveloped. What is needed is a way of building a larger pool of seasoned marketing experts with international experience.

9. The Science Council recommends that the Department of External Affairs diversify Canada's export marketing expertise. It should:
   - offer grants through the Program for Export Market Development to provide Canadian employees of Canadian firms with more extended foreign marketing assignments;
   - develop programs designed to raise practical experience in international marketing.

Canada has developed advanced capabilities in several industries, including surface transport equipment, telecommunications, and power generation and transmission equipment. The export growth of these industries is inhibited, however, by trade barriers, including tariffs and government procurement restraints. The Council believes that improved access to markets for advanced technology products in the United States, Western Europe and developing countries is crucial to Canadian development.

10. The Science Council recommends that the federal government vigorously pursue efforts to explore any potential advantages to Canada of expanding the Government Procurement Agreement of GATT to include sectors in which Canada has advanced capabilities.

Joint ventures allow knowledge-intensive firms to commercialize their technology abroad and earn the revenues they need to finance new R&D. Such ventures, which are also useful in gaining access to other technologies, permit greater control over exports than licensing arrangements or sales through foreign agents. At the same time, they reduce the risk and expense associated with a wholly-owned subsidiary. However, Canada needs more experts, particularly with marketing experience, to find potential partners for joint ventures, especially in the Third World.

11. The Science Council recommends that the Department of External Affairs, to assist Canadian firms seeking to develop joint ventures to facilitate foreign sales and technology transfer, assemble a directory of private sector experts with a documented track record in various markets and technology categories. Entry requirements should include references from customers.

Many Canadian companies offer products and services that could meet communication, transportation, energy and agricultural needs of Third World countries. The bilateral programs of the Canadian International Development Agency (CIDA) offer one way of linking these needs with Canadian capabilities. Aid agencies in other countries seem to have greater flexibility and their firms often beat Canadian ones to lucrative engineering and equipment contracts. CIDA could increase Canadian opportunities to serve foreign markets through foreign aid programs by revising its planning and approval procedures for bilateral programs and by encouraging joint ventures to help Third World countries with their own industrial development.

12. The Science Council recommends that CIDA evaluate its bilateral programs to ensure the establishment of joint ventures and the linking of advanced Canadian technology and know-how to the many needs and opportunities of the developing world.

Countertrade and Trading Houses

In 1982, the debt problems of developing countries reached serious proportions. In an effort to overcome their staggering debt loads, many developing countries have restricted imports or tied them to counterpurchases of domestic products: shoes in exchange for satellites; aluminum for buses.

The countertrade may involve up to four different importers and exporters, five different banks and two or more governments. In some cases, countertraded goods are not simply exchanged between two countries; rather, they may be traded by the industrialized country to yet another country.

According to some estimates, countertrade now represents 30 per cent of world trade. However, Canada's experience with countertrade has been limited mainly to offsets in defence procurement. Canadian companies, most of them unfamiliar with the practice, have avoided countertrade, regarding it as a complicated way to do business.

Countertrade is more than an instrument of trade for countries in which cash is scarce. It provides access to new markets for a broad range of products made by companies that lack their own established marketing and delivery systems.

Canadian exporters should adopt a more pragmatic view of countertrade. Countertrade could open up new markets and provide long-term, reliable sources of supply. It should be seen as an integral part of Canada's development strategy.

13. The Science Council recommends that the federal government develop a positive Canadian stance toward countertrade, to facilitate technology and knowledge-intensive exports, to expand training capabilities in this kind of business expansion, and to provide a mechanism for managing countertrade imports. The Department of External Affairs should establish a full-time countertrade desk and an information/database system that will inform prospective buyers and sellers involved in international countertrade.

14. In addition, the Council recommends that the Export Development Corporation be encouraged to develop insurance instruments and services to provide risk coverage on delivery obligations resulting from countertrade obligations assumed by Canadian exporters as payment for their exports.

Trading companies play an important role in export trade. Canada already has many small private trading houses. Larger, more diversified houses able to pool risk and capture economies of scale are needed. These could be developed using the financial and marketing expertise of banks, but modifications to the Bank Act must be made first.

As it now stands, the Act prohibits Canadian banks from owning more than 10 per cent of any corporation, including a trading company. Moreover, Canadian banks, unlike their US competitors since 1982, may not take title to goods temporarily during trade transactions. Removal of these restrictions would facilitate the development and operation of large Canadian trading houses that could stimulate Canadian involvement in international trade.

15. The Science Council recommends the removal of present legislative restrictions on the banks' involvement in trading houses and countertrade by amending the Bank Act to allow Canadian banks to take title to goods temporarily in the course of arranging and financing an export transaction, and to allow them to own trading companies.

Pulling Together

The international experience of recent decades shows that much can be accomplished when the main actors within countries reach a consensus on priorities and then consciously pull together, and when science policies and national economic policies are conducted in harmony. Nowhere is pulling together more important than in business-labour relations.

Employment and Adjustment

Canada's ability to take advantage of the technological revolution depends largely on how adjustment to technological change in the labour force is handled. Technological change may destroy jobs or it may create jobs. Either way, it will clearly lead to a redistribution of work and income.

Collective bargaining has an important role to play in the adjustment process. However, the provisions in the Canada Labour Code and the provincial codes that deal with technological change must be revised. In certain cases the wording is ambiguous — for example, definitions of what exactly constitutes a technological change and of the number of employees who must be affected before bargaining can start are unclear. The codes must be more precise yet not narrowly restrictive if they are to work.

16. The Science Council recommends that the federal and provincial governments, to assist the process of technological change, to accommodate it through free collective bargaining, and to help ensure a just sharing of the fruits of progress, adjust the legislative provisions on technological change in their labour codes by broadening their definition and interpretation of what constitutes a technological change.

Workers in industries and regions adversely affected by trade liberalization should be reasonably compensated for their financial loss. Although a number of federal programs provide adjustment assistance, the total loss to a worker from job displacement may be higher than they can compensate for. More generous adjustment assistance is needed, especially for older workers. This would reduce

the pressure for protectionist measures in structurally weak industries and would facilitate multilateral negotiation of reduced trade barriers.

17. The Science Council recommends that, as the economy recovers, the federal government adopt a timetable to reduce the use of nontariff barriers for those structurally weak industries most subject to competition from the Third World. It should also extend adjustment assistance, especially for retraining or early retirement, to a more broadly defined group of older employees in communities most adversely affected by trade-related injury involving those industries.

Partnership Mechanisms

Consensus mechanisms are a useful way of coping with change. At present, however, this country's institutions emphasize conflict, despite the fact that Canadians have many common interests, shared goals and similar values. As the European countries have shown, consensus is based on joint decision-making and bargaining, rather than on procedures of consultation.

18. The Science Council recommends that, to assist in the process of building a national consensus on science, technology and industrial policies, the private sector seriously consider the need to build much stronger organizations that would better serve their interests and aid the process of negotiating and bargaining with government.

Business-Bureaucracy Interchange

A continuing obstacle to the making of industrial policy is the alienation of business and bureaucracy. Senior bureaucrats need private sector experience, particularly with risk-taking in the industrial innovation process, just as people in business need to understand public issues.

19. The Science Council recommends that public and private sector service and manufacturing firms greatly increase their commitment to executive and other interchange programs; that serious attempts be made to ensure that those senior federal and provincial bureaucrats with responsibilities for industrial policy-making and delivery have private sector experience; and that large private sector firms consider a tour of duty in the federal or a provincial bureaucracy a desirable attribute of top managers.

Intergovernmental Collaboration

Most provinces promote the development of their own resource, service or manufacturing specializations. This approach creates a potential for conflict among them as well as an impediment to any federal approach to industrial problems. Canada needs complementary federal and provincial economic strategies that have a regional and metropolitan dimension.

It remains to be seen whether the federal government's new approach to regional development will achieve the cooperation and coherence needed. The federal government now aims to focus its development efforts on a few priority industrial sectors or elements of infrastructure in each province.

All federal economic departments are expected to contribute to regional development under the coordination of the Ministry of State for Economic and Regional Development. A senior officer from this department has been assigned to work with each province in planning Ottawa's role and preparing a five-year Economic and Regional Development Agreement (ERDA). One concern the Council has is that this process is too secretive. The procedure should be opened up to encourage debate on objectives and priorities.

20. The Science Council recommends that, to encourage debate on the objectives and priorities of ERDAs:
    - there be more public, legislative and parliamentary discussion of the Economic and Regional Development Agreements while they are being negotiated between the federal and provincial governments;
    - the provinces, in establishing their medium- and long-term priorities and objectives for ERDAs, including science and technology policies, seek proposals from business and labour constituencies and from regional and metropolitan advisory councils;
    - the federal government ensure that ERDAs complement each other and together form a coherent national framework; and
    - the federal government ensure that its negotiators are able to deliver other elements of the federal provisions that will make the ERDAs work, including elements not contained within the federal economic envelope.

Metropolitan Technology Councils

In 1981, Canada's 24 census metropolitan areas contained over half the population and three-quarters of Canada's scientists and engineers. Metropolitan areas are also the site of most of Canada's economic activity. Today, the lower levels of government are assuming greater responsibility for sustaining a suitable environment in which

the work of scientists and engineers can enhance the vitality of the community. New approaches are needed in urban policies to build a local consensus on priorities for development and to forge strong links between the key economic players — business, labour, government and institutions of higher education.

The Council recommends the creation of metropolitan technology councils to work for local development. It also recommends the creation of a national body to assist these councils. The national agency would encourage cooperation between metropolitan areas, undertake basic research to permit evaluation of their strengths and weaknesses, advise on the application of technology and strategies for development, and support initiatives such as import and export partnerships with sister cities in other countries.

21. The Science Council recommends that the mayors and chairpersons of cities or metropolitan regions consider the feasibility of establishing an advisory body to be called a Metropolitan Technology Council in their region. The council's mandate should be to elucidate through a participatory process a set of regional science and technology goals and to promote the cooperation of higher levels of government in working toward the achievement of those goals. Membership on a council should be voluntary and include elected representatives as well as representatives from business, labour and higher education, and other professionals and community leaders. Officials from federal and provincial governments should be invited to participate in an ex-officio capacity as resource people.

22. The Council further recommends the formation of a Canadian Metropolitan Agency, which should be jointly funded by federal, provincial and metropolitan governments. Its mandate should include:
    - undertaking primary research on Canada's metropolitan areas, particularly in response to the requirements identified by Metropolitan Technology Councils;
    - acting as a clearinghouse for information exchange, a data bank and a resource centre;
    - identifying opportunities for Canadian metropolitan areas to cooperate with foreign cities, establish twinning systems, undertake trade missions and increase technical assistance;
    - assisting with intermetropolitan initiatives in areas such as municipal procurement.