Report to the Ministry
of State for Science and Technology,
Secretary and Chief Science Advisor

on

Issues Related to Innovation and Increased Private Sector R&D

by

D.J. Doyle
Doyletech Corporation

DOYLETECH

T
174.3
.D69
1987

MINISTRY OF STATE
MINISTÈRE D'ÉTAT
BIBLIOTHÈQUE
MAR 2 1988
AGRE
LIBRARY
SCIENCE AND TECHNOLOGY
SCIENCES ET TECHNOLOGIE

T
174.3
.D69
1987

Condensed Executive Summary

1. The call for more R&D (and more industrial R&D in particular) will receive more support if it is made in the context of a strategic initiative to turn around Canada's high technology trade deficit.

2. The necessity for doing so is obvious; our trade surplus in resource related products is not growing and unless we become world class suppliers of technology as well as world class users of it, we will not receive our fair share of the benefits of the world technology revolution and our standard of living will drop significantly. Technology intensive products currently account for 12% of world trade and by 1995, they are expected to account for 25%. Canada currently supplies only 3% of that demand, and we had a trade deficit (using the new definition) of $6 billion in 1985, and it is now likely about $7.5 billion. We should be capable of supplying about 6% of the world demand, and this would balance our trade. While some may argue that we cannot expect to have a balance of trade in all sectors, especially when we have an overall trade surplus with our biggest trading partner, the United States, we clearly cannot afford to allow our high technology trade deficit to go on growing at over 10% per year.

3. The best way of addressing the R&D problem therefore, is to address the end result of the problem.

37985

4. The Government of Canada should send out a signal to our technology intensive companies (and to the rest of the world since most of them are foreign owned) that it is unacceptable for a country like Canada that represents one of the world's most lucrative and most open high technology markets in the world and that has one of the worst's most educated work forces, to have a high technology trade deficit.

5. It should state that the Government wants the high technology trade deficit growth **rate** brought to 0% within 5 years and the total **magnitude** of the deficit brought to zero within 10 years. This would result in the creation of almost 200,000 direct high technology jobs and almost $2 billion per year in R&D spending. The number of indirect jobs would be double that figure.

6. It should state that it expects the supply side of the industry to correct the problem on its own, but that it plans to implement certain policies on a sector-by-sector basis. Some of these are intended to encourage the creation of new technology-intensive companies in Canada, while others are designed to encourage more exports by the existing companies.

7. Of the eight major sectors which make up the high technology industry, the largest deficit is in office machinery ($2125 million in 1985), followed by scientific instruments ($1386 million). Both types of policy instruments are proposed to address those sectors, and in particular the strengthening of government procurement to encourage world product mandates or their equivalent.

Report to the Ministry
of State for Science and Technology,
Secretary and Chief Science Advisor

on

Issues Related to Innovation and Increased Private Sector R&D

by

D.J. Doyle
Doyletech Corporation

Table of Contents

	PAGE
1. Background	1
2. Executive Summary	3
3. Introduction	7
4. An Overview of Innovation in Canada	8
5. A Sector-by-Sector Analysis of the High Technology Industry	12
6. A Policy Map	21
7. Conclusion	23
Appendix I	
Appendix II	

1. Background

In March of 1987 the Ministry of State for Science and Technology issued a contract to Doyletech Corporation to provide services both to the Secretary and Chief Science Advisor and to the National Science and Technology Policy Sector. The statement of work for the Secretary and Chief Science Advisor was as follows:

a) Develop mechanisms which may be applicable to government in attracting more capital investment in Canadian technology-intensive ventures.

b) Examine and bring forward proposals for creation of new industrial ventures based on available exploitable technology.

c) Advise the Secretary on matters related to strategic planning and assessment of government science and technological activities.

d) Prepare and deliver a document that would recommend specific policies for bringing Canada's private sector GERD in line with other OECD countries on a sector by sector basis.

About three months elapsed from the first discussions with the Chief Science Advisor on the scope of the work and the finalization of the contract in March. During that period, there evolved a considerable amount of overlap between the above work statements and those covering the portion of the contract related to the work for the National Science and Technology Policy Sector. Because of the urgency of the latter assignment which was dictated by the requirements of the federal provincial working group on increasing Canada's private sector R&D, the latter work was proceded with first. Nearly all of the recommendations contained in that report are directly applicable to work statements a) and b) for the Secretary and Chief Science Advisor.

Therefore, this report will include the report to the National Science and Technology Policy Sector as an appendix and it will serve as a report against work statements a) and b). It is assumed that no report is necessary against work statement c). Therefore, the body of this report will contain specific recommendations and detailed discussions pertinent to work statement d).

The executive summary which follows next will encompass all of the work statements.

It should be pointed out that the definition of R&D as used in this report is similar to that used in the report to the National Science and Technology Policy Sector and adopted by the working group. It encompasses the overall innovative capacity of a country, including design, demonstration, marketing and managerial ability.

This approach is consistent with the overall aim of this study which is to optimize the economic benefits to Canada from its pool of science and technology, both the publicly and privately financed portions of it.

2. Executive Summary

In view of the current fiscal restraint, it is assumed that any government initiatives aimed at increasing the private sector component of Canada's GERD must be catalytic in nature and must "lever" the public sector component. Accordingly, it is recommended that the following policies be put in place to accelerate the creation of new technology based firms (NTBFs):

a) Improve the venture capital industry so that it can more actively exploit the results of our federally funded research. The resulting new ventures will become R&D performers on their own and will, over time, move much of the applied research out of the public sector into the private sector. Because of the number and the complexity of problems facing the venture capital industry, **it is recommended that a venture capital office be established within the Department of Finance.**

b) Replace (or upgrade) Canadian Patents and Development Ltd. with a **more proactive technology exploitation organization which deals more with business plans than with patents.**

c) **Give government and university scientists incentives for transferring technology.** Since business plans are the starting points in all new business ventures scientists should at least receive **the equivalent of a generous consulting fee for business plans that they help to turn into new ventures.**

d) **Implement a national technology marketing network (NTMN)** to upgrade the marketing skills of the various groups who become involved in the creation of new business ventures - groups such as economic development officers and boards of trades at the municipal level and even the national venture capital firms.

e) **Provide incentives to venture capital firms to develop better marketing and management support capabilities** so that they can provide more "value-added" to seed investments. Such incentives should take the form of a 30% "top-up" on qualified seed investments and the recipient firms would be required to meet strict requirements for such value-added capabilities on an annual basis.

In addition to the above **"NTBF policies,"** it is recommended that policies be put in place to encourage multinational entreprises (MNEs) to supply more goods and services (to both Canadian and foreign users) from their Canadian bases of operations. The following is a list of recommended **"MNE policies."**

a) **Encourage some initial Canadian ownership of the Canadian subsidiaries of MNEs** by tailoring tax policies to encourage the formation of more Canadian investment firms that will become involved in what is referred to in this report as "founding partnerships" with MNE firms. It is a relatively new phenomenon but one that warrants close attention by the federal government. It is explained in detail in Appendix 1.

b) **Streamline federal procurement policies so that the existing guidelines relating to the level of Canadian "rationalization" of MNEs can be more effectively applied.** MNE subsidiaries would be given the same access to government procurement as Canadian-owned and controlled firms only if:

i) they have a true world product mandate which results in exports which balance or exceed all imports, or,

ii) they have a Canadian "technology receptor" capability that accelerates the exploitation of the MNE's world wide pool of technology to the benefit of Canada

iii) they have a Canadian procurement capability whose charter it is to access Canadian sources of supply for world-wide needs

In addition to the above recommendations on NTBF and MNE policies, the following steps are recommended in response to work statement d):

d-1) The Government of Canada should issue a statement that it is not prepared to allow its high technology trade deficit to increase indefinitely.

d-2) It should challenge the industry and its trade associations to come forward with proposals that will bring the **growth rate** to zero within five years and that will bring the **absolute value** of the deficit to zero within ten years.

d-3) A small amount of money should be set aside from government procurements of leading edge technology to establish Canadian sources of supply.

d-4) In the meantime, a series of policies should be put in place which are tailored to each sector (e.g. aerospace, office machinery, etc.). These are spelled out in this report.

The rationale for each of the above recommendations is that if the trade deficit question is addressed aggressively, the R&D shortfall will disappear on its own - and of course the trade will return to a balanced situation.

Other studies (by ARA Consultants) have shown that aggressive policies of this nature could increase Canada's exports of high technology products from $25.4 billion (U.S.) to $42.6 billion (U.S.) in 1995 (they amounted to $12.4 billion Canadian in 1985). The $25.4 billion figure will occur if we maintain our present 3.2% of world exports, and the $42.6 billion figure will occur if we can increase that to 5.4%. This translates into more than 200,000 direct jobs that could be retained in this country instead of being "exported" elsewhere.

3. Introduction

As stated in the introduction to the report to the National Science and Technology Policy Sector which is attached as Appendix I, Canadians have been world class **users** of technology but not world class **suppliers** of it. There has been little need for domestic R&D in Canada, because when we needed to apply technology to our industries, suitable technology was always readily available elsewhere.

But we now have a very large technology deficit whose growth is no longer being balanced by our resource products trade surplus. This trend will result in a very serious deterioration in our overall balance of trade and our balance of payments over the next few years. Any attempts to increase our R&D efforts must focus on decreasing that trade defecit.

This paper breaks out the high technology trade deficit on a sector by sector basis and recommends actions for each. While some of these actions may seem far removed from R&D issues, they are all aimed at creating a stronger Canadian capability in each sector because R&D will not be sufficient on its own.

A prerequisite to any of these actions is a strong signal from the Government of Canada that it plans to restructure the country's industrial mix so as to take advantage of modern technologies, particularly those that are already being heavily used by our existing industries.

4. An Overview of Innovation in Canada

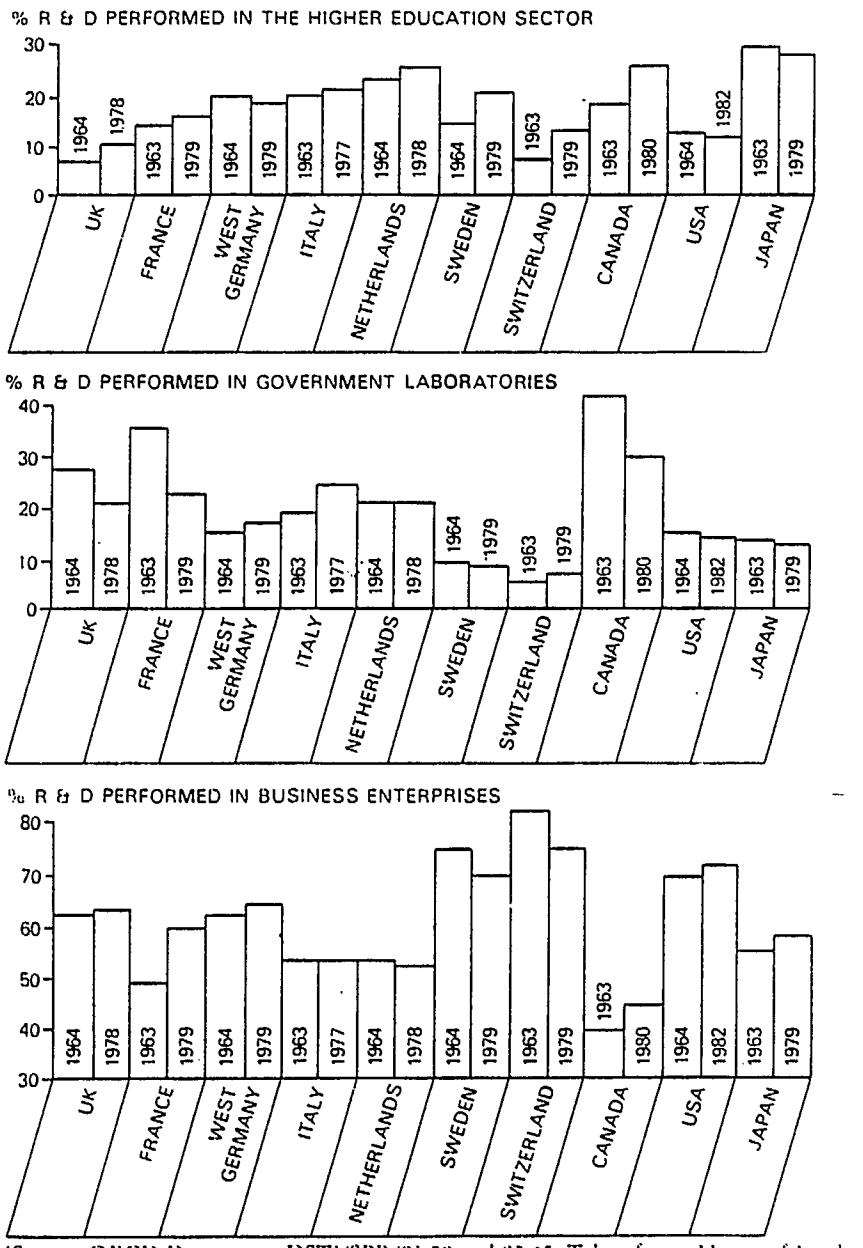
For innovation to occur in any given region, whether it be a municipality or a nation, that region must have two essential ingredients:

i) A "Technology Engine" that generates new ideas.

ii) An "Investment Engine" that finances them.

Canada's investment engine is one of the strongest is the world, but it is not geared towards risk taking in technology intensive ventures or to adding value to such investments so that the risks can be minimized. These issues are well addressed in the paper in Appendix I and will not be discussed further in the body of this report. But it should be noted that unless some fine tuning is done on the investment engine, the major overhaul that is being proposed for the technology engine will be a fruitless exercise. That fine tuning should be aimed at turning the venture capital industry into a strategic instrument for technology development.

The basic problem with the technology engine is that too much of it is in the public sector (government laboratories and universities) and not enough of it is in the private sector (industry laboratories, research consortia, etc.). That is not to suggest that the publicly funded portion should be cut back or shifted to the private sector, but unless it is complemented and supported by at least an equivalent amount in the private sector, Canada will never reap the economic benefits that other countries will from the same level of expenditures. (See figure 1 on next page and the data presented in Appendix I for a comparison of Canada's public/private R&D mix with that of other countries.)



(*Source*: OECD Documents DSTI/SPR/81.28 and 82.05. Taken from: House of Lords, 1983)

FIG. 1 - CANADA'S R&D MIX RELATIVE TO OTHER COUNTRIES

Since industrial R&D is usually carried out in an environment where marketing and commercialization capabilities exist, the chances of wealth creation through the early introduction of new products and services are greatly enhanced. Most government research is carried out to support a government mission or to solve a problem of national significance (the environment, agriculture, natural resource management, urea formaldehyde foam insulation etc.) and the scientists who work on such problems have little or no incentive to create products.

While there is a central facility (Canadian Patents and Development Ltd.) in place to ensure that any patents that result from such research are properly protected and licensing arrangements pursued, it is no longer effective as a technology exploitation instrument. The main reason for this is that patents no longer play a significant role in the creation of new business ventures. A modern version of CPDL would be staffed with more marketing people than lawyers and it would be proactively searching out technology exploitation opportunities in our publicly funded laboratories. The scientists would seek help from it in writing pro-forma business plans instead of (or in addition to) patent applications. CPDL would then broker those business plans to the investment community, and scientists would receive an up front consulting fee for any plans that resulted in seed investments.

While some fine tuning can be done to the publicly funded part of the country's technology engine, the greatest opportunities for wealth creation lie in the industrially funded part. Most of our technology intensive companies are foreign owned and operate primarily as sales subsidiaries. Many of them have R&D and manufacturing facilities attached to them, but they have been established mostly as a result of "moral suasion" from some level of government or by the Canadian management teams. But they typically do not report into the Canadian chief executive officer or contribute to the overall mission of the sales subsidiary. They

report directly into executives in the parent company. The result is a "truncated" subsidiary which lacks the essential ingredients for true innovation of the type that would be found in a more homogeneous Canadian-controlled company.

Senior employees who aspire to true profit and loss responsibility for a complete business unit must typically migrate to the company's head office. One of the most negative aspects of truncated companies, from a Canadian economic development point of view, is that they do not provide the same incubation capacity for new ventures as similar sized enterprises do elsewhere. This means that our venture capital companies tend to do most of their prospecting in the government and university laboratories. The would-be entrepreneurs who come from them require significantly more marketing and management assistance than their private sector counterparts. In fact, the people with the ideas are usually more interested in pursuing an R&D career, and so the venture capitalists typically have to build management teams "from scratch" to turn such ideas into business opportunities.

The recommendations pertaining to the venture capital industry which are contained in this report take those factors into consideration.

By the same token, the recommendations pertaining to the building of a stronger foreign owned sector are based on a more strategic approach than just the creation of jobs or short term exports.

5. A Sector-by-Sector Analysis of the High Technology Industry

The high technology industry, by OECD definition, is made up of the following sectors:

1. Aerospace - includes aircraft parts, etc.

2. Office Machines - computers, parts, peripherals, etc.

3. Electrical products
   - Telecommunications
   - Electronic equipment
   - Electrical machinery

   (Statistics are available for each of the above subgroups)

4. Scientific instruments
   - includes medical and surveying instruments, etc.

5. Other Machinery
   - turbines (water & steam)
   - nuclear reactors, etc.
6. Chemicals

Table 1 gives a more detailed breakdown of each sector in accordance with OECD definitions.

Figure 2 is a listing of imports, exports and the resulting trade balance for each of the above sectors, for 1985. It should be noted that the data in figure 2 are based on the new classifications adopted by Statistics Canada which reduce the total deficit from $12.5 billion to $5.8 billion. The major discrepancy in the two classification systems are shown in figure 3.

TABLE 1 - OECD LIST OF HIGH TECHNOLOGY PRODUCTS

Aerospace
Internal combustion engines for aircraft
Jet and gas turbines for aircraft
Aircraft hulls

Automatic Data Processing Machines and Units
Computers (analogue/digital data processing machines, central processing units)
Peripheral units

Electronic Equipment
Electronic apparatus for medical purposes
X-ray apparatus
Valves, tubes, transistors, semiconductors and other electronic components

Telecommunications Equipment
Electrical line telephone and telegraph equipment
Microphones, loudspeakers, amplifiers
Other telecommunications equipment including satellites

Drugs
Vitamins and provitamins
Penicillin, streptomycin and other antibiotics
Vegetable alkaloids, their salt and other derivatives
Hormones
Glycocides, sera, vaccines, etc.

Scientific Instruments
Electrical measuring and controlling instruments
Electron and proton accelerators
Binoculars, microscopes, telescopes
Photographic cameras and flashlight apparatus
Cinematographic cameras, projectors, sound recorders and sound reproducers
Photographic equipment, n.e.s.
Medical instruments (excluding electromedical)
Surveying instruments
Watches and clocks
Photocopying apparatus

Electrical Machinery
Electrical power machinery
Apparatus for electrical circuits
Electromagnetic appliances
Electric traffic control equipment
Electric sound or visual signalling apparatus, n.e.s.

Non-electrical Machinery
Steam engines and steam turbines
Internal combustion engines (not for aircraft)
Gas turbines other than for aircraft
Nuclear reactors
Water turbines and other water engines

Chemicals
Radioactive and associated materials
Synthetic organic dyestuffs and natural indigo
Insecticides, fungicides, disinfectants
Products of polymerization and copolymerization

SECTORS	EXPORTS	IMPORTS ($MILLIONS)	TRADE BALANCE
1. Aerospace	2471	2680	-209
2. Office Machines	1877	4002	-2125
3. Electrical Products			
• Telecommunications	1929	1488	+441
• Electronic Equipment	823	1541	-718
• Electrical Machinery	495	1074	-579
Total Electrical Products	3247	4103	-856
4. Scientific Instruments	832	2218	-1386
5. Other Machinery	2329	3284	-955
6. Chemicals	1304	1613	-309
TOTALS	12060	17900	-5840

FIG. 2 - IMPORTS & EXPORTS BY SECTOR

SECTOR	TRADE BALANCE ($MILLIONS)	
	OLD CLASSIFICATION	NEW CLASSIFICATION
1. Aerospace	-668	-209
2. Office Machinery	-2830	-2125
3. Electrical Products	-2885	-856
4. Scientific Instruments	-2683	-1386
5. Other Machinery	-3346	-955
6. Chemicals	-56	-309
TOTAL	-12468	-5841

FIG. 3 - OLD AND NEW CLASSIFICATIONS OF HIGH TECHNOLOGY TRADE STATISTICS

The following is a list of key observations to be made from the data presented in figures 2 and 3.

1. The largest trade deficit is in office machines. As will be seen later, this is also the fastest growing sector of the total world trade in technology, and it is predicted to grow even faster in the next ten years.

2. The next largest deficit is in scientific instruments. This is also a high growth industry, with only telecommunications, aerospace and office machines being higher.

3. Canada's only trade surplus is in telecommunications. This is a very high growth sector and therefore warrants special attention to ensure that this surplus is maintained. It is currently vulnerable because Canada is being accused of not making its domestic market open enough to foreign suppliers.

4. The major discrepancy between the two systems of classification was in the "Other Machinery," category and this was due to the fact that the total trade figure was overstated; some of it should have been classified under "Medium Technology" trade.

Before going on to make specific recommendations on how each of these deficits could be reduced (and thus the R&D increased) over time, it is useful to examine the world wide growth rates on a sector-by-sector basis. Figure 4 shows the past (1979-83) and forecasted (1985-95) growth rates along with the total world wide trade in 1983 and 1995 - $203.9 billion (U.S.) and $784.8 billion (U.S.) respectively. At the present time, Canada is only capturing about 3% of this business and it would require about 5% to balance its trade. (This latter figure is obtained by multiplying the 3% by the ratio of our imports to exports in 1985).

A report prepared by ARA consultants entitled: "Opportunities for Leveraging Canada's High Technology Trade" analyzes the impact of Canada achieving 5.4% of world trade in 1995 and this data is shown in fig. 5. It illustrates that the difference between 3.2% and 5.4% in 1995 would mean a dollar difference of $17.2 billion. This would translate into approximately 200,000 direct jobs, most of which would be in the "under 40" age category.

	1979-83	1985-95	1983	1995
	(% growth annually)		(U.S. $ bill)	
All trade (market economies)	2	5	1717	3073.4
High technology products:				
office machines, data processing	18	20	38.3	341.3
aerospace	11	12	20.7	80.6
telecommunications	14	18	20.4	148.7
controlling instruments	9	10	15.2	47.6
electrical equipment	5	5	13.3	23.8
medical, pharmaceutical	4	6	14.5	29.2
plastics, artifical resins	3	3	33.5	47.6
organic chemicals	2	3	32.6	46.5
inorganic chemicals	0	2	15.4	19.5
TOTAL			203.9	784.8

Source: 1979-83, GATT, International Trade, 1984/85
Forecasts for 1985-95, A.R.A. Consultants Ltd.

FIG. 4 - FORECASTS OF WORLD EXPORTS OF HIGH TECHNOLOGY PRODUCTS, 1995.

	1983 %	%	Scenario I $ U.S. bill	%	Scenario II $U.S. bill
High technology products:					
office machines, data processing	3.5	3.5	11	6	21
aerospace	1	1	0.9	4.5	4
telecommunications	7.4	7.4	11	9	13
controlling instruments	0.6	0.6	0.3	3	2
electrical equipment	0.2	0.2	0.1	1.5	0.4
medical, pharmaceutical	1.5	1.5	0.5	2	0.6
plastics, artifical resins	1	1	0.5	1	0.5
chemicals	2.3	2.3	1.1	2.3	1.1
Total-Canada			25.4		42.6
as % of total world trade in high technology products			3.2		5.4

Source: Canada's 1983 share of high technology exports is derived from data provided in GATT, International Trade, 1984/85; forecasts are prepared by A.R.A. Consultants

FIG. 5 - FORECASTS OF CANADA'S EXPORTS OF HIGH TECHNOLOGY PRODUCTS, 1995

To support $17 billion in additional exports annually, approximately $2 billion in additional R&D would be required.

So a concerted effort to achieve a high technology balance of trade is the ultimate solution to achieving a better balance between the publicly and privately funded portions of the country's GERD.

The next section will present a matrix (a policy map) showing how the various policy instruments described elsewhere in this report can be applied to each of these sectors to achieve this balance of trade.

The ARA report referred to above contains a number of recommendations which are either identical or complementary to those listed in the executive summary and described in detail in Appendix I. Two of them will be included in the "NTBF policies" shown in the policy map which follows, since they are "generic" to all NTBF activity. They were not discussed in this report, because it was felt that if the appropriate changes were made to the **financing** of technology in Canada, such strategic initiatives would follow automatically. The two to be included are:

1. Initiatives to encourage a more rapid **consolidation of NTBFs** into larger corporations so they could compete more effectively on the international scene.

2. Initiatives to encourage **the formation of world class trading houses capable of dealing in technology - intensive goods and services.**

The ARA report contains specific recommendations on the form that these initiatives might take.

6. A Policy Map

The policies to be discussed in this section are grouped under two broad categories:

a) NTBF policies - those aimed at the creation of new technology based firms.

b) MNE policies - those aimed at encouraging foreign owned technology-intensive companies to supply more goods and services from their Canadian bases of operation.

They are described in detail in the executive summary and in Appendix I, but they are repeated here in abbreviated form for easy reference to the "policy map" to be presented later.

a) NTBF Policies

- Improve the Venture Capital Climate
  - Establish an office in the Dept. of Finance
  - Encourage venture capital firms to acquire better marketing and management skills
  - Update the legislation
- Replace or upgrade CPDL
- Provide better incentives to government and university scientists for technology transfer
- Establish a National Technology Marketing Network
- Establish a source development fund for the emerging technologies
- Encourage consolidation of NTBFs
- Encourage trading houses

b) **MNE policies**

- Government strategy statement
- Encourage "founding partnerships"
- Encourage world product mandates
- Encourage 'technology receptor" capability in Canada
- Encourage Canadian procurement for world wide needs
- Provide tools to assist Canadian management teams to present strategic plans to parent companies

Figure 6 shows a "policy map" which illustrates how each of the above instruments might be applied to each of the sectors. Appendix II contains a "report card" on each sector which will help to explain the rationale for applying the various policy instruments in the manner proposed. Ideally, this data should form part of figure 6, but it would have made it overly complex and difficult to read. The two should be referenced simultaneously.

The number of stars (0,1, 2 or 3) in the intersections between the rows and columns is intended to indicate the extent to which each sector can be influenced by each policy. They reflect the opinion of the author based on experience in working with both the NTBF and MNE sectors of the industry and in discussions with government and industry officials (e.g. venture capital industry). The map may prove useful to the reader in arriving at his or her own individual assessments. However, what this approach does reveal is that **the sectors which have the greatest growth potential are also the most universally susceptible to the proposed policy instruments.**

7. Conclusion

A country should have a strategic purpose for choosing the proportion of its GNP that should be spent on R&D. Canada's strategic purpose should be **wealth creation through the restructuring of its economy.** Other countries with fewer natural resources than Canada have been quick to realize the potential of technology as a wealth creation instrument. Canada must now do the same because it has already "consumed" too many of the technology intensive products and services of those other countries in relation to the resource related goods and services it is now capable of supplying to the rest of the world.

More R&D on its own will not do that. The only output from R&D is knowledge, and unless that knowledge can be turned into economic benefits, governments will have difficulty in convincing taxpayers that it is a matter of national urgency.

This report has attempted to illustrate that the lack of a strategic approach to technology has already cost Canadians hundreds of thousands of jobs and could cause a significant decrease in their standard of living. It has offered prescriptions for how these losses can be curbed in the future. R&D is only one ingredient in that prescription. It recommends a major assault on the country's high technology trade deficit. This will not only bring the R&D spending in line, but will provide the strategic initiative for the required restructuring of the country's economy.

DOYLETECH

SECTOR	NTBF POLICIES - AIMED AT STRENGTHENING THE CANADIAN OWNED SECTOR							MNE POLICIES - AIMED AT ACHIEVING A BALANCE OF TRADE IN FOREIGN-OWNED SECTOR						
	Improve the Venture Capital Climate	Replace or Upgrade CPDL	Incentives to Scientists for Technology Transfer	Establish National Technology Marketing Network	Source Development Fund for Emerging Technologies	Encourage Consortia of NTBFs	Encourage Trading Houses	Government Strategy Statement	Founding Partnerships	World Product Mandate	Technology Receptor Capability	Canadian Procurement for World Needs	Strategic Planning Tools	Anticipated World Growth Rate 1985-1995 (%/YR)
AEROSPACE		*	*	*	**	***	***	*	*	*	*	***	*	12
OFFICE MACHINES	**	*	*	**	**	***	***	***	***	***	***	***	***	20
ELECTRICAL PRODUCTS — TELECOMMUNICATIONS	***	**	**	***	*	*	**		*		*	*	*	18
ELECTRICAL PRODUCTS — ELECTRONIC EQUIPMENT	***	***	***	***	**	***	***	***	**	***	***	***	***	10
ELECTRICAL PRODUCTS — ELECTRICAL MACHINERY	**		**	**	*	*	**	***	**	**		**	*	5
SCIENTIFIC INSTRUMENTS	***	***	***	***	***	**	***	***	***	***		***	***	6
OTHER MACHINERY	*	**	**	*	*	*	***	***	**	**		**	*	3
CHEMICALS	*	*	***		*	**	**	***	*	*		**		3

FIG. 6 - A Policy Map for Canada's High Technology Industry

Note: The number of stars in each intersection (0, 1, 2 or 3) indicates the response that each sector will have to each policy

Appendix I

Report Prepared for National Science
and Technology Policy Sector

(Please note that it includes Appendices A, B, and C on its own.)

Report to the Ministry
of State for Science and Technology,
National Science and Technology Policy Sector

on

Issues Related to Increasing Canada's R&D Effort

by

D.J. Doyle
Doyletech Corporation

June 1, 1987

Table of Contents

		Page
1.	Background	1
2.	Executive Summary	3
3.	Introduction	6
4.	The Current Situation	7
5.	Increasing the Investment in R&D in Canada by Foreign-Owned Enterprises	9
6.	The Establishment of a National Technology Marketing Network	15
7.	Proposed Changes to Venture Capital Legislation	22
8.	Other Issues	25
9.	Conclusion	26

1. **Background**

As a result of the First Minister's Conference in November of 1986 and a meeting of science and technology Ministers held in Montreal one month later, a federal/provincial working group was formed to explore ways of increasing Canada's R&D effort. Its membership is as follows:

- David Henderson, Chairman (Ministry of State for Science and Technology)
- Paul Dufour, Secretary (Ministry of State for Science and Technology)
- Thomas Nickerson (Nova Scotia Research Foundation Corporation)
- Philippe Eloy (Ministere du Commerce exterieur et du developpement technologique, Quebec)
- William Forward (Ministry of Industry, Trade and Technology, Ontario)
- Richard Letilley (Saskatchewan Science and Technology)

The terms of reference for the working group called for special attention to the potential for increasing R&D investment by the private sector. The group also agreed to treat the term R&D in its broadest context, which includes the overall innovative capacity of a country, including design, demonstration, marketing and managerial capabilities.

In its first report which was issued in March, 1987, the following issues were identified:

1. The industry R&D base in Canada is limited.
2. Many regions of the country lack the concentration of technologically-oriented firms that would facilitate the building of a diversified economic base.
3. A large number of firms in the primary and manufacturing sectors are foreign-owned or controlled, and do the major part of their R&D in the country where their parent firms are located.
4. Many of Canada's major companies are in sectors that are not particularly oriented to R&D.
5. Many small and medium-sized firms in Canada lack the technological expertise necessary to grow and evolve, or even to remain competitive over the longer term.

6. The lack of availability of risk capital acts as an impediment to the growth of technology-intensive industries.

7. The corporate attitude towards innovation would seem to be less advanced in this country than it is in a number of our trading competitors.

8. Fiscal restraint poses a major impediment to the government-financed R&D in Canada.

The Ministry of State for Science and Technology (MOSST) issued a contract for consulting services to Doyletech Corporation in March, 1987 to assist in clarifying and addressing these issues. The statement of work was as follows:

a) To explore the extent to which new or revised incentives are needed to encourage greater venture capital investment by individuals in early-stage technologically-oriented companies (start-ups); and to set out what, specifically, these incentives should be and how they should be structured. Are there any provincial incentive schemes that deal directly or indirectly with this matter (e.g. stock savings plans)?

b) To determine what other specific federal policy and program changes are required to increase the availability of venture capital to fund technologically-oriented private sector initiatives.

c) To develop an action plan for the establishment of a network (or set of networks) which provides technical, design, marketing, and financial information to the private sector, particularly small and medium-sized companies. It should clearly indicate how existing and planned mechanisms and organizations (e.g. TIS/NRC, CISTI, CPDL, FBDB, local incubation centres, and provincial research organizations) would fit into this scheme, and note how inter- and intra-regional linkages would be established.

d) To determine what additional measures might be put in place to increase the investment in R&D in Canada by foreign-owned enterprises.

The following table shows the relationship (or possible relationship) between the above work statements and the issues identified by the working group.

Work Statements		Issues
a, b)	Venture Capital	5, 6
c)	Networking	2, 5, 6
d)	R&D by foreign owned enterprises	3,7

This report describes the work that has been done and includes recommendations for actions and/or policies in each of the four areas.

2. Executive Summary

There is a close relationship between work statements a) b) and c) since they all deal with the issues related to the creation of new technology intensive business ventures. Those issues are very complex as is illustrated by the contradictions one hears when the subject of venture capital is discussed. Those seeking it say that it is too difficult to get, while those supplying it say that there are not enough "good deals." They are both right. And this situation will prevail until some third force is injected into the "deal-making" to make the deals better and to provide more competition for the deals. That third force must supply marketing and business expertise to the entrepreneurs, and networking is one way of doing this. The private sector will eventually address this need on its own, but the Government of Canada can act now to accelerate that process.

The following is a summary of the recommendations of this report.

a) & b) Venture Capital

- The recommendations contained in a Science Council report entitled: Pension Funds and Venture Capital: The Critical Links between Savings, Investment, Technology and Jobs - by Mary MacDonald and John Perry, September 1985 should be more fully implemented. It contains nine recommendations and while some of them have been acted upon or have become irrelevant due to other legislation, the following warrant attention:

  a) Tax treatment of capital gains of venture capital companies.

  b) Tax treatment of stock options for key employees.

  c) Training incentives for those working in the industry.

  d) The conditions under which an investee company can lose its status as a Canadian Private Controlled Corporation (CPCC) should be reviewed.

- The Department of Finance should establish what amounts to a "venture capital office" within its Economic Development Policy Branch to ensure that the special needs and concerns of the industry are taken into account when new finance policies are implemented.

- Incentives should be made available to venture capital firms to develop in-house expertise to assist would-be entrepreneurs in planning, launching and managing their enterprises. Firms that can clearly demonstrate that they can add significant value to their investment through better market research and better supervision of the entire incubation process should receive a "top-up" grant from the federal government equal to 30% of the initial seed investment. An annual ceiling of $20 million would be placed on the program.

- This same "top-up" funding would be available to the various provincial small business development corporations, but only if they can demonstrate the same ability to add value as a conventional venture capital company can. This would increase the probability of success for technology intensive investments made by individuals through these provincial vehicles.

c) Networking

There are individuals and institutions at the "grass roots" level in Canada that could contribute significantly to the creation of technology-intensive ventures if they had better tools, resources and information to work with. Specifically, they could assist would-be entrepreneurs in preparing business plans and accessing investment funds. The most valuable assistance that they could provide is marketing assistance - market research and planning, competitive data, product positioning, etc.

Therefore, it is recommended that the Government of Canada initiate a five year experiment which would involve the creation of a **technology marketing network** that would make it easier for entrepreneurs to work with such people as economic development officers and such institutions as Chambers of Commerce, The Entrepreneurship Institute of Canada and TIEM Canada to access marketing data for use in preparing business plans. Such a network would be operated by a private contractor reporting to MOSST. The contractor would be given a subsidy of $2.5 million per year for 5 years, after which time the network should finance its own operations through a "fee-for-service" and the sale of information to such parties as venture capital firms and economic development officers.

d) Increased R&D by Foreign-owned enterprises

- Encourage what is referred to in this report as "the founding partnership option" - this is an arrangement in which a Canadian investment/management firm establishes subsidiaries for foreign-owned enterprises. This encouragement would take the form of total tax forgiveness on the capital gains made by the Canadian investment firm when all or part of its equity is sold back to the foreign parent, such forgiveness being conditional upon the continuance of an R&D mission in the subsidiary for at least three years after the sale.

- Use existing DSS procurement policies to encourage foreign-owned firms to:

  a) Maintain Canadian R&D expenditures at their world wide levels, as a percentage of sales.

  b) Maintain Canadian employment at their world wide levels, also as a percentage of sales.

  c) Use Canadian sources of supply for their world wide needs by maintaining a full time procurement facility in their Canadian subsidiaries.

  d) Implement a "technology receptor" capability in their Canadian subsidiaries so that Canada obtains the maximum benefit from imported leading edge technology. Such a capability would require an applications team in Canada that could identify and exploit unique applications, either by using the resources of the subsidiary or value added resellers who use the subsidiary's products or services.

- MOSST should provide tools to both the subsidiaries and the parent corporations that will assist them in planning an R&D mission. One such tool would be a sector specific handbook that provides Canadian marketing information and guidelines for planning new ventures.

e) Other Issues

- Government scientists (or at least their managers), must be rewarded for transferring technology. A minimum reward would be an honorarium for assistance given in the preparation of business plans that result in new ventures. Such honoria would be paid by the investors.

- Canadian Patents and Development should be transformed into, or replaced by, a proactive technology exploitation organization that seeks out technology and "packages" it for review by prospective investors. It would act as a focal point for government scientists.

3. Introduction

As stated in a background paper prepared by the working group dated February 27, 1987, Canada's R&D "system" is strongly influenced by history, geography, economic structure, institutional make-up, and political jurisdiction. More specifically, Canadians have looked upon technology as a tool for industry and commerce as opposed to a strategic instrument for industrial and economic development. We have been world class **users** of technology but not world class **suppliers** of it. The result is an alarming growth in our high technology trade deficit relative to our gross domestic product and to the trade surplus in our resource-related sector.

So when one talks about increasing the private sector component of the country's R&D effort, one is really talking about changing the industrial structure of the country. We must continue to use technology for the extraction, processing and distribution of our raw materials and for the improvement of the country's commercial and socio-economic system, but we must also decide to supply some of that technology on our own. In fact, we must supply a higher percentage of the world's technology. Where possible, we must use Canadian applications as test beds.

A higher R&D effort will not cause this to happen overnight - or in fact at all, if the environment for further innovation is not suitable. But if Canada can strengthen its position as a **supplier** of technology, the R&D will follow because there will be a genuine demand for it and the process will become a regenerative one.

The catalysts that appear to be the most appropriate for starting this regenerative process are the following:

a) Industrial policies that will encourage the creation of new technology-intensive business ventures based on well defined needs in the marketplace.

b) Policies that will encourage foreign-owned enterprises that are now supplying us with our technology to supply more of it (and the products that flow from it) from a Canadian base.

Although the work statements for this consulting contract call for a focus on R&D effort, the recommendations contained in this report are more broadly based and are aimed at the above objectives. They take into account the current environment of fiscal restraint within the federal government and they are limited to actions in which significant leverage can be achieved from very small expenditures.

4. **The Current Situation**

In 1985, the Canadian expenditure on National Sciences and Engineering (NSE) was $5.8 billion, and it was comprised as follows:

	Funder	%	Performer	%
Federal Government	$2157M	37.2	$1419M	24.5
Provincial Governments	337M	3.8	188M	1.9
Business	2492M	43.0	3044M	52.5
Higher Education	382M	6.6	1074M	18.5
Private Non-Profit	159M	4.6	71M	1.2
Foreign	269M	4.6	-	-
	$5796M	100.0	$5796M	100.0

Although the business community was both the largest R&D funder (43%) and performer (53%), it still spends much less than its counterparts in most other OECD countries. The following table provides a comparison for the years 1975, 1981 and 1983 for the financed components, both public and private.

PERCENTAGE OF GERD FINANCED BY INDUSTRY AND BY PUBLIC SOURCES

	Industry			Public Sources		
	1975	1981	1983	1975	1981	1983
Switzerland	71.8	68.3	77.4	17.4	-	22.6
Japan	57.7	62.3	65.2	29.7	26.9	24.0
Sweden (NSE)	57.0	57.3	-	39.1	39.9	-
Germany	50.1	57.0	58.1	47.4	41.6	40.9
Finland	49.4	51.9	55.6	48.4	46.0	42.3
Austria	47.4	50.2	49.0	51.6	43.8	-
Italy	51.0	50.1	42.5	43.1	47.2	55.4
United States	43.1	48.8	49.0	54.8	49.2	49.1
Netherland	48.7	46.3	-	44.9	47.2	-
United Kingdom	40.7	41.3	42.1	51.9	49.0	50.2
France	39.0	40.8	42.0	54.2	52.8	54.8
Canada	29.8	40.4	37.7	61.9	51.5	53.5
Norway	37.1	40.1	-	59.1	57.2	-
Australia	-	21.0	-	-	75.8	-

Sources: "Science and Technology Indicators, GERD 1969-1982," OECD, March 1985 and Science and Technology Indicators, Recent Results," OECD, October 1985.

Similar comparisons for the 1986 number (43%) are not yet available, but it is at least encouraging to see that the Canadian percentage of industry funded R&D appears to be growing.

What the above table also shows is that although the publicly funded percentage has been dropping since 1975, it is still high in comparison with other OECD countries. Additional trend information is contained in the February 27th paper referred to earlier. (See appendix A.)

It is obvious that those elements of Canada's science and technology policy which are aimed at increasing the overall GERD must focus primarily on the private sector. This is not to suggest that the publicly funded sector should be cut back or directed at more applied research. What is of utmost urgency for governments at both levels is a more strategic approach to the exploitation of the existing GERD. This will automatically lead to more of it.

5. **Increasing the Investment in R&D in Canada by Foreign-Owned Enterprises**

The attached table, reproduced from the February 27th document clearly shows the extent of the "shortfall" in Canadian R&D activity by the foreign controlled firms. For example, in the **business machines** category alone, foreign controlled firms spent about 2% of sales on R&D in 1983 (of those firms performing R&D) whereas Canadian controlled firms spent about 11%. The latter figure is in line with the world wide average for the industry; most computer companies spend about 10% of world wide sales on R&D.

If these figures still apply in 1987 (and there is no reason to indicate why they should not), then the shortfall in terms of dollars spent is now a very large number. The foreign controlled firms in this sector will have total Canadian sales in excess of $6 billion in 1987. Applying the 9% shortfall to that sales figure gives an R&D dollar shortfall of more than $500 million/yr. That translates into more than 5000 scientists and engineers - just in this one sector alone.

Of the R&D activity that is performed by the foreign-owned enterprises, nearly all of it has come about as a result of what is usually referred to as "moral suasion." While most of this came from either the federal or provincial governments, some of it also came from the management teams of the Canadian subsidiaries of such firms. Typically, when governments applied the suasion process they used government procurement, grants or tax breaks as suasion tools. On the other hand, when the Canadian management teams applied it, they were arguing for more challenging careers, better acceptance in the Canadian marketplace, and a Canadian corporate entity that could be more easily identified and measured in the overall corporate infrastructure.

It would appear that with the exception of very large procurement programs, the tools available to governments are getting fewer and fewer. For most mature technology-intensive companies, government business is not as important as it was (in a relative sense) even a decade ago. In the business machines industry for example, governments were practically the only users in the early days of the industry when each machine sold for a million dollars or more. But as prices dropped and the machines became smaller and more "user friendly", several other markets (e.g. the single user market, the small office market etc.) became far more important than the government markets.

As technology permeates our society to lower and lower levels, governments will find that their existing "suasion tools" will become less and less effective and will eventually have to be replaced with something else. That is not to say that the government markets are not still important to these firms, but we must understand that they tend to be more important to the emerging firms - particularly those based on emerging technologies.

One of the tools that the federal government has used with limited success over the years is a system of classifying potential suppliers in accordance with the degree of their "Canadian presence" which is sometimes confused with "Canadian content" in the products supplied. The Department of Supply and Services (DSS) has described this system in a Policy Memorandum entitled "Selecting Potential Suppliers," a copy of which is attached as Appendix B. It assigns potential suppliers into four groups, with Group One being applicable to Canadian-owned firms or their equivalent. It provides DSS with considerable flexibility in using government procurement to influence corporate behavior - at least in those cases where the government market is still significant.

However, it appears to be losing effectiveness, because a number of foreign-owned firms are claiming that they warrant a Group One rating because their Canadian operations are "rationalized." This is a term that has become quite common in technology intensive companies and industries and it seems to be related to the concept of "Canadian content" because that is what is actually called for in individual DSS contracts. They claim that it is unreasonable for the Canadian government to expect a high degree of Canadian content in any particular procurement, but so long as the company is putting **some** Canadian content into a wide range of procurements, both Canadian and export procurements, then the company is "rationalized" and it should be treated just like a Canadian controlled company that is able to claim 100% (or almost) content in all sales to the government.

The problem is that DSS has not been successful in clearly identifying what a "rationalized" company is and who they are. As a result, rationalization is not being used to the same extent as in the past and it is losing favour as an instrument of procurement.

Rather than abandoning it, it is recommended that more precise criteria be used for measuring the degree of rationalization. Using the guidelines outlined below, only a firm with a 75% rating would qualify as a Category One supplier. The following rules are proposed:

1. The degree to which a company is rationalized will be determined by a combination of the **R&D expenditures** and the **employment levels.** (Other factors might be just as important such as the level of taxes paid in Canada which can be easily manipulated in a technology-intensive company through transfer pricing and management fees, but if R&D and employment are in line, other factors will usually follow suit) The following is a formula that might be used to measure a company's degree of rationalization.

   Rationalization factor = 0.5 x R&D factor + 0.5 x Employment factor
   where
   R&D factor = R&D expenditure in Canada as a percentage of Canadian sales divided by the world wide R&D expenditures as a percentage of sales.

   Employment factor = number of employees in Canada as a percentage of Canadian sales divided by the world wide numbers - as above.

2. A world product mandate will also qualify a company for some degree of rationalization. A company will be 100% rationalized if it has a world product mandate to **design** and supply a product or service **with full profit and loss responsibility** and the sales from that product or service **offset all other imports.** (The same criteria for transfer pricing must be used in for imports as for exports, of course.) Please note that a manufacturing or R&D mandate on its own would not qualify under these rules, but those in #1 would apply.

3. As an alternative to the "rationalization" approach, the government should also encourage a "technology receptor" capability inside the Canadian subsidiary as follows:

   a) the subsidiary will have a group of technical and marketing experts who are capable of identifying and exploiting opportunities in Canada (and elsewhere) for the company's products and technologies. The objective is to ensure that the company's world wide pool of technology can be quickly and easily transferred into Canada for the benefit of Canadian users and value added resellers. The existence of such a group will make the subsidiary a more entrepreneurial unit and will result in the creation of entrepreneurial units within the end user customer base or third parties who add value on the way to the end user. It will also be of great assistance to value added resellers - frims that use the company's products or services to address world wide markets.

   As an alternative, or in addition to a), it would give credit for a situation where:

   b) the subsidiary will have a full time procurement staff that is committed to accessing Canadian sources of supply for the company's world wide needs.

   The subsidiary would qualify for 100% rationalization when the sum total of the above two activities can be translated into Canadian economic benefits that would be equal in value to its imports. (This would obviously have to be done by means of a memorandum of understanding.)

To avoid the conflict that often arises between DSS and government user departments when a potential supplier is rated on anything other than the merits of its products, DSS should have a system of "taxing" all procurements, at least in those sectors where its buying power is still significant. Such proceeds would then go into an **emerging technology source development fund** that would be used to encourage Canadian-based sources of supply for such technology and products. For example, in the artificial intelligence (AI) field, DSS would be given a pool of funds equal to 1 or 2 percent of all AI purchases to either encourage rationalization by MNEs or to develop alternative sources of supply in Canada. It is beyond the scope of this study to explore all of the details of such an arrangement, but it is mentioned here to address one of the major impediments to using DSS procurement for industrial development, namely the question of user preference. It is not reasonable to expect a scientist in a government laboratory to use what he or she considers to be inferior equipment only because it is supplied by a manufacturer that DSS considers to be "rationalized." This is a particular problem in the emerging technologies - the very field in which procurement can be effective.

4. In addition to the above recommendations which are basically aimed at refurbishing the procurement tools, there are two others which are not related to procurement and they will be referred to as the "founding partnership option" and the "MNE handbook." The following are descriptions of those two ideas:

   a) **The founding partnership option.** This is a relatively new phenomenon in which a well-financed Canadian company approaches a foreign company at an early stage in its development and offers to set up its Canadian subsidiary for it. The Canadian company puts up the money and provides an operating vehicle and a management team in return for a significant portion of the equity in the new enterprise. It is done on the understanding that the foreign company will be allowed to buy back all or most of the Canadian equity at some later date - such as when the foreign company goes public or raises additional cash through second or third round financing.

      A firm in Ottawa by the name of Nexa Corporation has done this with a number of firms in the information sciences field. It owns 80% of Symbolics Canada, 70% of Inference Canada, 70% of Interleaf Canada, and so on. This concept should be encouraged in other fields such as robotics, biotechnology and speech recognition. The advantages to Canada are obvious. Firstly, it increases the chances of some residual Canadain ownership down the road. Secondly, the subsidiary is more

likely to operate as a true corporate entity and not just as a sales office. Thirdly, the buyout price down the road is usally based on a multiple of sales or earnings and the figure can be very high - much higher than the investment that most MNEs make in their Canadian subsidiaries when they set them up on their own. Fourthly, Canada benefits from the early application of emerging technology. (Most of NEXA's holdings are companies in the newer technologies such as AI.)

There are many ways of encouraging this approach and capitalizing on it -- maybe help the NEXAs of the world raise the money through special tax treatment on the promise that the government will share in the "windfall" down the road. Such firms automatically have a management and marketing capability in place and so they would qualify for any "top-up" funds that would be made available if changes were made to the venture capital legislaton as suggested earlier.

Another approach would be to give the capital gain on the sale of the company a zero tax treatment so long as the "transferred" company has achieved a meaningful R&D mission and so long as this mission continues for some time afterward. The gain would be taxed (as a capital gain) at the time of the sale, but if the transferred company maintained a level of R&D in Canada equal to the parent company's world wide figure (both as a percentage of sales as discussed earlier) for each of the next three years, the tax would be refunded in three equal payments. This would cause the two parties to enter into a commitment between themselves and it would probably encourage a continued working relationship. At least it would encourage three years of R&D at a formative stage in the company's development.

b) **MNE handbook.** It is recommended that MOSST publish a handbook that would assist both the Canadian management teams and their corporate superiors in planning a Canadian mission that would include an R&D mission. To avoid the reaction "What can the government tell us about planning?" it should be a book that contains a wealth of information about Canada and Canadian technology and would be used as "The Canadian Handbook" in the foreign boardrooms and executive offices. Such information is already available in MOSST and is exactly the kind of data that such people would cherish. It would be sprinkled with the "whys" and the "hows" of strategic planning for technology-intensive ventures. Specifically, it would include a number of arguments that would illustrate how a meaningful Canadian presence can mean extra profits for the entire corporation. It would emphasize the quality of the Canadian education system and it would point out that since Canadians prefer to work for companies that offer a broad

spectrum of career opportunities, a more meaningful Canadian presence would make their recruiting job easier. It would refer to the DSS guidelines (the strengthened ones) and the ability to react to unique Canadian market needs. Finally, it might even include an outline for a long range plan for the Canadian subsidiary. Imbedded in that plan would be a plan for a world product mandate and an analysis of its possible long term impact on the revenues of the Canadian subsidiary.

In addition to the market-oriented data available in MOSST, there are publications available from DRIE, External Affairs and Investment Canada which would facilitate such a project. It is at least worthy of further investigation.

6. **The Establishment of a National Technology Marketing Network (NTMN)**

There is a well recognized need for a stronger "marketing culture" within all sectors of the technology venturing community in Canada - by those who do develop the technology, those who find it, those who write new ventures business plans, those who finance the new ventures and those who manage them. It seems that the people who have the strongest desire to see new technology intensive ventures created in the first place are the very people who have been the least exposed to a marketing culture. Examples of such people are economic development officers (EDOs) at the municipal level, private investors, Chamber of Commerce officials and even the people who are involved in one way or another with the various incubator malls and enterprise centres that are to be found across the country. Even commercial development officers at universities are often lacking in this kind of experience and training.

Unfortunately, such people are often confused about what constitutes the most urgent and most real needs of the would-be entrepreneurs. Some think they need a "dating service" that links entrepreneurs with investors, others think they need a one-stop shopping place for access to information on government grants and others think they need real estate. The fact of the matter is that while all of the above are important, none of them compare to the need for marketing data and marketing know how.

The major "show-stopper" in launching any new enterprise is the market research that must go into the business plan. Unfortunately, a would-be entrepreneur in Penticton or North Bay cannot afford to hire a marketing consulting firm from Vancouver or Toronto. Even if they could, it may not be the best thing to do. What would make more sense would be to put the appropriate tools into the hands of the would-be entrepreneur to allow him to do more of it on his own.

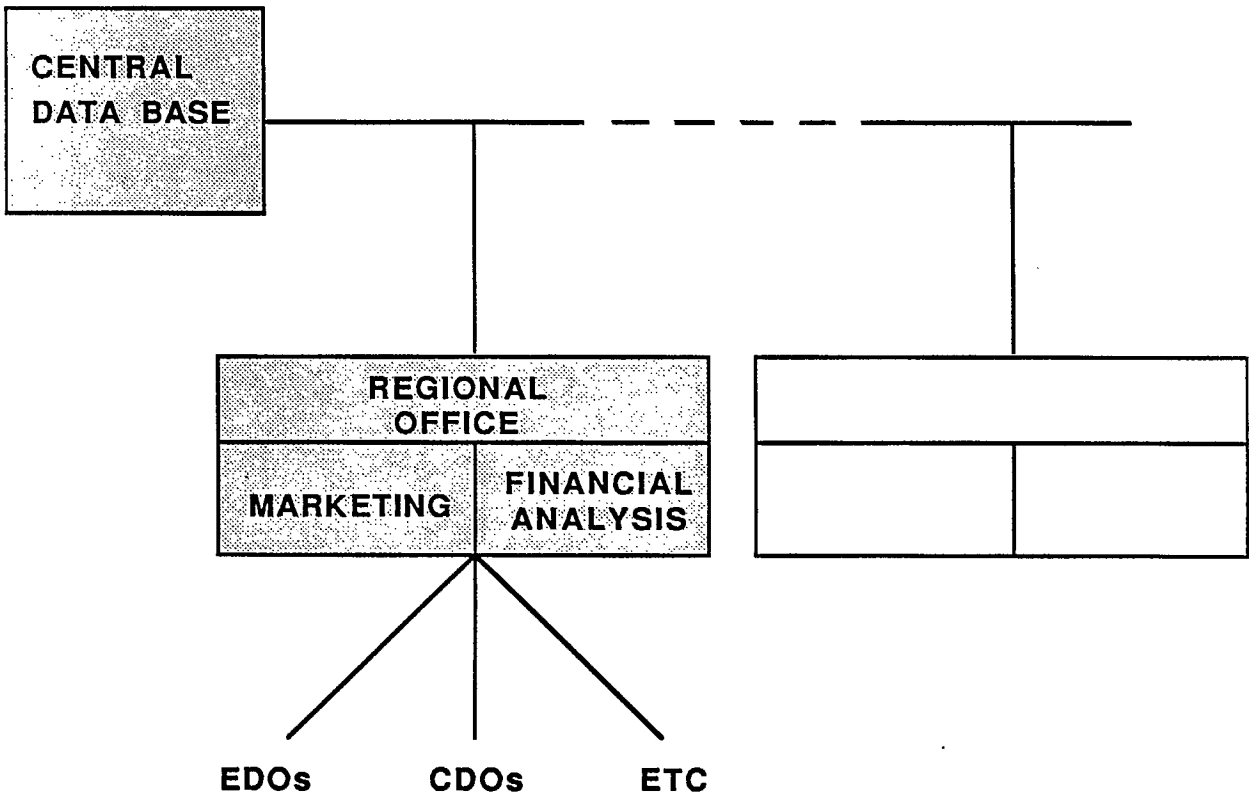
Since EDOs and such people want these firms to happen in their locality, it seems reasonable to set them up as a focal point in the interchange that must go on between the entrepreneur and the investor - and all the sources of marketing data that both will probably use before a deal is struck. One way of doing this is to equip them with a data gathering and local counselling capability which in turn is driven from a central facility. That central facility would consist of a small group of people who would be the equivalent of a **market data centre** in a typical large technology-intensive corporation. They would have access to commercial electronic services such as DIALOG and INFOGLOBE as well as to data bases offered by CISTI (NRC) and Statscan. This is an ideal scenario, and one that is not likely to happen unless the concept (and its benefits) can be demonstrated for

some period of time by people with more expertise in such work. Therefore, it is suggested that MOSST put in place (through a contractor) approximately ten offices across the country, each equipped with a director, a market research expert and a financial analyst. They would act as a resource to the EDOs and local people who are in frequent contact with would-be entrepreneurs. Eventually, they may become dispensable as the local people acquire the appropriate skills, but for purposes of this discussion it will be assumed that there are ten local offices communicating with a central market data base.

The entire facility would act as a disseminator of information as well as a "how-to" shop. It could play this role very efficiently to a large number of clients (EDOs and the like) if it set strict rules as to what services it would and would not provide - for example, it would not write business plans. For purposes of this discussion, this interconnection between the central agency and the local offices will be referred to as a National Technology Marketing Network (NTMN) - even though it is not a network in the definition used by the communications industry (see diagram). The primary target of the NTMN is the incubation stage of technology development; inventors, entrepreneurs and early-stage companies with a need for market-related information for use in evaluating product development proposals and the potential success of new product launches.

Two main types of services would be offered: information access services, and market research services. The former would involve access to a range of generic market information extracted from network databases, including those developed by the network itself. The major advantage of such services to potential users is the provision, through one responsible national agency, of improved access to currently or potentially available databases. The second service area would involve adding value to the process of collecting market-related information and directly assisting inventors, entrepreneurs and companies throughout the technology development process. Embodied within the market research services are broker services which would assist users with technology transfer, access to potential investors, commercialization, marketing and obtaining financial and other support. Training would be focussed, in the first instance, on ensuring that these services can be delivered as effectively as possible.

It is recommended that MOSST take the unusual step of directly managing this project through an outside contractor. MOSST is the only department that has the kind of technical and marketing data that would form the nucleus of the data base. It also has the appropriate connections with IRAP and CISTI.



NATIONAL TECHNOLOGY MARKETING NETWORK

The following is a proposed action plan:

1. MOSST would hire an outside contractor to do the work. It would use this description as the basis of the contract.

2. The contractor would hire 3 outside consultants who would establish the central office - two with expertise in marketing and one with expertise in financial analysis. (Cost - $400,000/yr.)

3. MOSST would assign one or two of its own staff to assist the contractor in building a pool of generic marketing data - mostly by tailoring Statscan and CISTI data to be more "user friendly" by EDOs and entrepreneurs. The object is to be able to provide quick and easy answers to questions like "How many farms are there in Saskatchewan?" or "How many acres of hardwood forests are there in Ontario?" or "How many robots are in use in Canada - by industry sector, by size of installation, by country of supplier, etc.?"

4. The above people would either be located in MOSST or in CISTI. They would outline in clear and simple terms to their potential clients what kind of services and information they would provide. For example, they would not lobby for government grants and they would not write business plans. They would act as central clearing houses for marketing and business information as requested by the remote offices and they would even provide in depth training programs at the local level.

5. As experience is gained, the functions of the local MOSST office would be disseminated down to another level as a result of the EDOs (or whoever) deciding that they can do it on their own. However, the requirements for becoming a node in the network would be strict. The EDO (or whoever) would need the capability of accessing a public network (DATAPAC) and of maintaining a market data base pertaining to local business opportunities. Examples of marketing questions that the entrepreneur should be able to get answered at the local level are: "Who is the process control expert at the local university?" and "Who are the major local users of technology-intensive goods and services? Who are the suppliers? Who are their local agents, etc?" An astute EDO would even keep track of local university graduates, particularly those holding senior positions in large corporations. Such people make good candidates for starting local businesses, particularly if they feel that the EDO can help in the financing process. A node that is not prepared to build such a data base and share it with the local offices and the central facility (within the limits of client confidentiality) would not be allowed to participate.

6. A memorandum of understanding would be required with the NRC Industrial Development Office so that the NTMN and the IRAP offices would act in harmony. The IRAP offices represent the country's only true network for access to the government's scientific resources. The NTMN would represent a new and complementary **marketing** resource and the two would have to cooperate closely. A flow chart should be drawn up showing how a typical enquiry would be handled and when an NTMN node calls in an IRAP office and vice versa.

7. There would be no incentive (and no charge) for an EDO (or whoever) becoming a node.

8. The total cost of the NTMN per year is estimated as follows:

   a) Central office

• Contractors + 3 consultants	-	$400,000
• Computer facilities	-	100,000
• Subscriptions to commercial data bases (DIALOG, etc.)	-	100,000
• Communications	-	100,000
• Travel	-	80,000
• Supplies	-	20,000
	-	$800,000/yr

   b) Ten nodes

• 3 specialists per node	-	$300,000
• Facilities	-	50,000
• Miscellaneous	-	50,000
		$400,000
X10 nodes		$4,000,000/yr
Total		$4,800,000/yr

This is a worst case scenario and is unlikely to occur because it would be impossible to set up the entire network immediately, and by the time it was operational the contractor would already be in the process of privatizing it. So the total cost of a 5 year experimental program would not simply be 5 x $5 million but it would be more like one half of this amount. Therefore, a total budget of approximately $12 million should be sufficient. The exact amount could only be determined after detailed discussions with one or more potential contractors because it is their ability to recruit the appropriate personnel that would determine the implementation and therefore the cost. Also, the incentives for privatization would have to be fully discussed.

The following is a scenario of how a new venture might evolve with the aid of the NTMN.

1. A would-be entrepreneur approaches a local EDO with a new method of drying lumber.

2. The EDO gives him a guide for preparing a business plan (there are many available) and he may make one or two preliminary enquiries about the state of the art - possibly by contacting the local MOSST facility, the local IRAP office or a research laboratory working in the field. The EDO may have a group of advisors, one or more of whom may be able to provide additional information. (The role of such a group is outlined in a MOSST publication entitled: Technology Venturing in Canada.)

3. One week later, the entrepreneur returns to the EDO with a business plan, but the marketing section is weak. (This will nearly always be the case.) The EDO ensures that at least the "generic" data is correct - the number of drying kilns in use in North America, the state of the art in new kiln technology, etc.

4. A second pass is made on the business plan.

5. It is reviewed by the EDO's advisory body - subject to the consent of the would-be entrepreneur.

6. A potential test site for the first system is identified.

7. The financial section of the business plan is completed.

8. The business plan is sent on to a venture capital company (one or more) and to some local investors.

9. A small amount of seed money is put up by some local investors to put the system into a test site.

10. An IRAP grant for $35,000 is obtained, and possibly some marketing funding, likely from one of the various provincial programs.

11. A board of directors is put together by the investors and a monthly status report and sales forecast is provided by the entrepreneur.

12. The first installation is successful and new orders are received.

13. A major venture capital company then invests in the company.

14. When it comes time to present the board with the first annual long range plan (about nine months after start-up) the entrepreneur may want to access more in depth marketing data through the services of the NTMN. The central facility could provide this by accessing one or more of the data services to which it subscribes.

7. Proposed Changes to Venture Capital Legislation

Venture capital is a term used to identify high risk investments in new business ventures in return for equity. There are approximately sixty companies in Canada that call themselves venture capital companies and they are represented by a trade association known as the Association of Canadian Venture Capital Companies (ACVCC). And of course there are literally thousands of private investors who could also be described as venture capitalists. They are the wealthy individuals who invest in new ventures that have little or no collateral to offer, and so their investment must take the form of equity, or at least an option to obtain equity if sufficient assets do not materialize in the company to provide collateral.

Attached as Appendix C is a discussion paper on the industry prepared for MOSST in 1986. With minor exceptions, most of the descriptions and issues are still relevant one year later. (Some apologies are in order, however, for the editorial license exercised by the author.)

As implied in that paper, the legislation pertaining to the venture capital industry (and its interpretation) do not reflect a strategic approach to the use of venture capital for the exploitation of technology in Canada. In fact, very few of the people who propose and draft such legislation seem to understand the industry well. There appears to be an attitude that "What is good for small business or the pension funds must automatically be good for the venture capitalists." As a result, the Small Business Investment Corporation (SBIC) legislation which was part of the April 1985 budget and which was supposed to address most of the problems raised by the industry in the years proceeding it, has fallen far short of the mark. What is worse, there is now a sense of futility on both sides - the Department of Finance seems to think that the industry expects too much and the industry is convinced that the Department does not care about it or understand it.

This leads to the first recommendation:

The Department of Finance should establish a "venture capital office" within its Economic Development Policy Branch. Such an office would review the potential impact of all new finance legislation on this very important sector to ensure that it is not prevented from exploiting new industrial opportunities to their fullest - particularly the technology-intensive opportunities. To be effective, such an office must be in a position to advise the industry on how Revenue Canada will interpret its legislation - from stock options to key employees to the tax treatment of capital gains on liquidation of investments, to the conditions under which a company is considered to be publicly or privately controlled.

The industry has a long list of irritants which it feels are preventing it from operating efficiently. By far the biggest is the uncertainty about the tax treatment they will receive when they liquidate their investments. This is the subject of recommendation number 8 in the Science Council report entitled "Pension Funds and Venture Capital - the Critical Links between Savings, Investment, Technology and Jobs." That report is referred to in the executive summary and Appendix C of this report. **It is essential that that recommendation be acted upon, because it is unreasonable to expect venture capital firms to assume the additional risks involved in start ups unless they know what the tax treatment is going to be on eventual liquidation.**

Another irritant that seems to be generic in nature concerns the conditions under which an investee company may lose its status as a Canadian Controlled Private Corporation (CCPC). For example, most pension funds use a public trustee to hold their equity in a new venture (all of their investments in fact). As a result, pension fund control of a Venture Capital company is often interpreted as public control simply because its trustee is "public." This in turn makes the venture fund "public." If one or more venture funds control an investment, the investee then becomes "public" and loses its CCPC status.

The loss of CPCC can have devastating impacts on the company and its investors because:

a) Stock options to key employees receive more favourable tax treatment if the company is a CCPC than if it is a public company. For a CCPC, the stock option benefit is taxed as capital gains, whereas for a public company a taxable income is deemed to be received at the time the option is exercised and is lumped in with ordinary income. Since the key employees of such companies usually have to be lured away from secure jobs with good stock options and fringe benefits, they will not be attracted to a company where stock options are effectively "taxed away."

b) Investment tax credits of 35% are available to 100% of the R&D expenditures of a CCPC whereas for a public company, only 20% of such expenditures are eligible.

While this is the kind of issue that would be automatically dealt with by a venture capital office inside the Department of Finance, it is typical of a broad range of issues which, taken individually, do not appear to be serious, but when layered on top of each other, can be very discouraging to the industry.

Even the innocuous budget of February 17, 1987 had a surprise for the industry. In the share for share exchange provisions of the Income Tax Act, which are widely used in corporate takeovers and share acquisitions, the purchaser is now deemed to acquire the shares at their fair market value for future capital gains purposes. This applies even if the selling shareholder defers his capital gain by "rolling over" the cost base of the shares into the new shares. This is going to have a very negative impact on the venture capital industry because the cost of this extra taxation will have to be borne in the transaction. That cost can be very large in relation to the new funds invested. It is beyond the scope of this paper to list all of those irritants because there are so many of them and because most of them are quite technical. It would be somewhat like trying to describe every weed in the lawn instead of recommending that fertilizer be applied from time to time, that the grass get cut and that a gardener get hired.

This working group should recommend that:

a) A venture capital office be established in the Department of Finance.

b) The Science Council report referred to above should be revisited.

c) The conditions under which a CCPC can be thrown "offside" must be drastically reduced.

d) A system to encourage a market research capability inside venture capital firms should be considered so that they will more quickly build up the resources necessary to do more intelligent seed funding. It would take the form of a 30% "top-up" by the federal government on individual start up investments by firms that can demonstrate that they have marketing and management "added-value" to bring to the investee firm.

e) A comprehensive review of all provincial programs (the SBDCs, the VCCs, etc.) should be done with a view to applying the same marketing capability at this level as well. While these programs do act as useful vehicles for pooling funds by private investors and channelling them into high risk investments, none of them encourage the kind of marketing and management discipline that is so necessary to make seed financing for technology-intensive ventures more successful.

   Any "top-up" schemes would require an annual limit in much the same way that applies to the IRAP program and strict criteria would be enforced on any SBDCs, VCCs or venture capital companies that apply - they would have to demonstrate a capability to add significant value to their investments in tax revenue. Less than $20 million per year would have to be forgone.

8. **Other Issues**

The working group should consider the following issues which do not fall directly under any of the above headings:

a) Some thought should be given to ways of building a stronger "innovation consulting" industry. Innovation consultants are widely used in West Germany where government assistance is available to entrepreneurs through collaboration with the Chamber of Commerce. The NTMN might act as an impetus to the creation of a stronger industry in Canada. NRC (IDO) proposed such a strengthening program about two years ago (Dr. Molozzi).

b) The Government of Canada should direct more of its attention to the **consequences** of a low GERD as opposed to the **size** of the GERD itself. Specifically, it should not set goals for the GERD but it should state that the present rate of growth in the country's high technology trade deficit must be reduced from 10% per year (or whatever it is) to half this figure within 5 years and to zero within 10 years. If it did this at the same time that it sent out signals about encouraging a stronger marketing culture, about "fixing" the venture capital industry and about using government procurement to influence MNE behaviour, the various sectors of the industry would rally to the call and come forward with proposals to achieve the desired results.

c) Government and university scientists who will inevitably be called upon to assist in this process should be rewarded for their efforts. Such rewards should take the form of honoraria which would be paid whenever a business plan actually attracts an investment. They should be sizeable enough to at least cover the equivalent of a consulting fee which an outside innovation consultant might charge - in the range from $5000 to $25,000. Such honoraria would be paid by the venture capital firm that invests in the operation. **It is therefore recommended that the managers of all publicly funded research activity implement a system to encourage such work and to track the time spent on it, so that the appropriate honoria can be claimed when a business plan is acted upon.**

d) Canadian Patents and Development Ltd. should be transformed into a proactive technology exploitation organization. Instead of being staffed with lawyers, it should be staffed with people who can identify early opportunities in publicly funded laboratories and arrange to have them "packaged" so that the investment community can review them. The legal services can be obtained outside as needed. One of its new roles, should be to act as a "point of enquiry" when a scientist thinks he or she has the makings of a business plan.

9. Conclusion

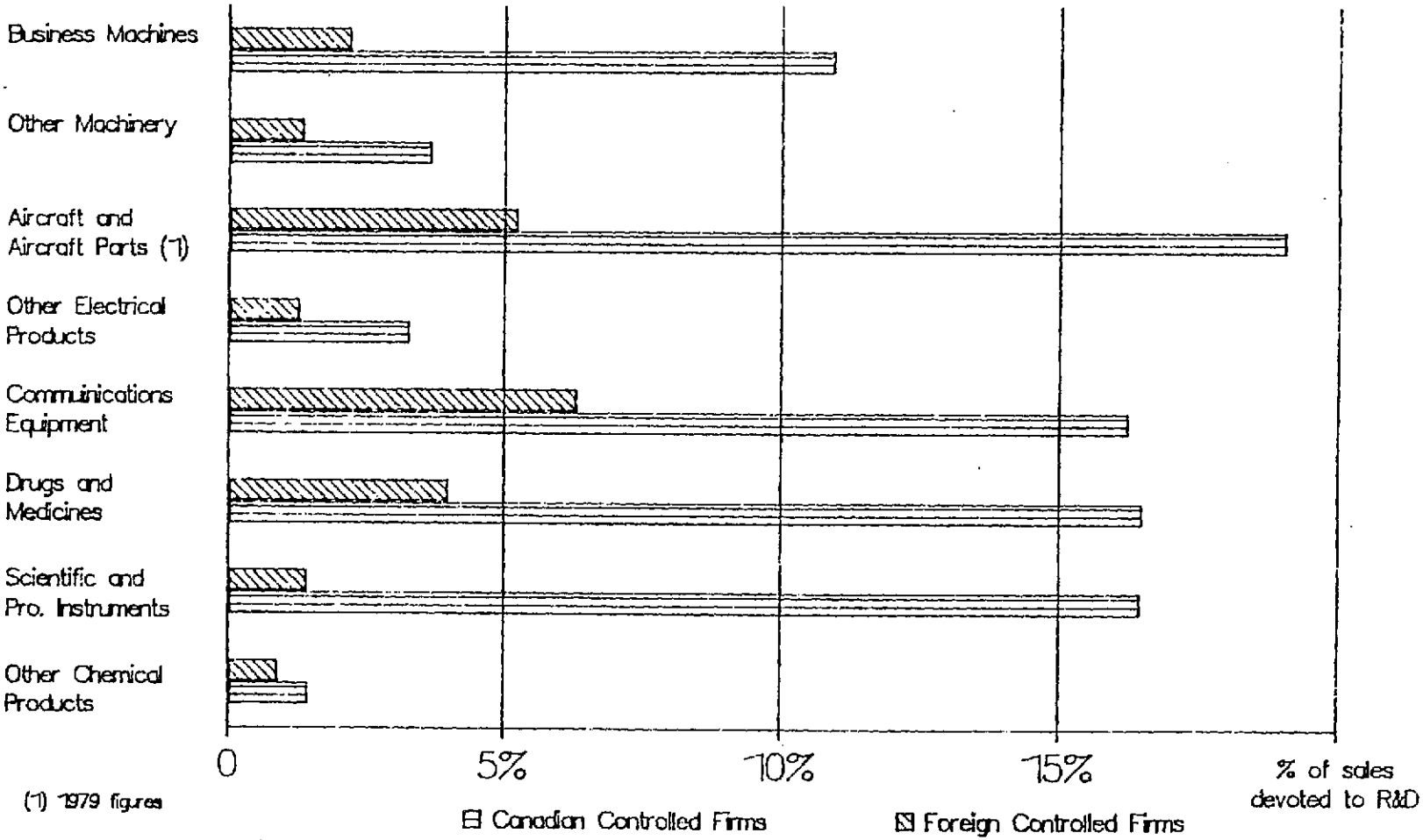
The wide array of options and issues discussed in this paper illustrates that the working group is justified in adopting the broader interpretation of R&D in addressing its mandate. While there is no single move that will cause an immediate sudden increase in private sector R&D, there are obviously a number of "catalytic" initiatives which will not only increase it (even though slowly) but will also increase the wealth creation process from the existing base. Most of those initiatives will have a strong marketing component to them .

If no incremental funding is available for them, then funds should actually be diverted from the various programs (at both the federal and provincial level) that subsidize R&D. In the MOSST report entitled: "Technology Diffusion in Canada: Myths and Realities" published in September 1986, it was pointed out more than once that our existing grant programs are quite generous for R&D activity but are conspicuously short on marketing (not selling but marketing) support. It may seem contradictory for a group whose mandate is to recommend ways of increasing R&D to actually suggest that the public component be reduced. However, it is just such strategic thinking that has enabled other countries to not only increase their total R&D activity in the long run, but to exploit it far more efficiently than Canada has ever been able to do in the short run.

Appendix A
Canadian R&D Statistics

TABLE 5

PERCENTAGE OF SALES DEVOTED TO R&D IN CANADA'S MOST R&D INTENSIVE INDUSTRIES, BY INDUSTRY AND CONTROL, 1983



(1) 1979 figures

Source: Statistics Canada, RDC: Survey, July 1985.

Appendix B - DSS

Policy on Selecting

Potential Suppliers

PURPOSE

1. This directive sets out the policies and guidelines for selecting potential suppliers for both competitive and non-competitive bid solicitations. Special sourcing procedures for printing products and standard vehicles are set out in Directive 3050.

2. For commodities that fall within its scope, the sourcing requirements of the GATT Agreement on Government Procurement override the sourcing policies set out herein and in all other international agreements or arrangements. Where the GATT Agreement does not apply, the sourcing policies in this directive may be overridden to meet the needs of other government programs and objectives (e.g., Canada/US Defence Production Sharing Program, Auto Pact, CIDA, individual product area strategies).

SOURCING POLICIES

Order of Priority of Suppliers

3. The order of priority for selecting suppliers from source lists shall be by Group as shown below and in accordance with the accompanying policies and guidelines. All suppliers listed in a particular Group have the same priority. The selection of potential sources will be restricted to firms within Group 1 if there is competition in the form of three or more sources. The list of bidders may be limited to fewer than three Group 1 sources when the provisions of the Guidelines are met or where there are no sources available from Groups 2, 3, or 4.

Priority Groups

4. GROUP 1

   a) Canadian-based manufacturers manufacturing or processing the particular commodity.

   b) Canadian-based manufacturers who do not manufacture the particular commodity in Canada, but are treated for sourcing purposes as if it were made in Canada, pursuant to an agreement between DSS and the firm, which accords such treatment on the basis of, and commensurate with, the economic benefits to Canada resulting from the firm's rationalized operations in Canada (reference Directive 3051, paragraph 5.b).

   c) Canadian-based companies acting as bona fide agents of Canadian manufacturers if such manufacturers do not sell directly to the government or other customers as part of their normal marketing policy, provided such companies offer suitable aftersales services.

   d) With respect to requirements for services, Canadian-based companies providing the particular service.

5. GROUP 2

   Canadian-based companies acting as bona fide agents of Canadian or foreign manufacturers, when such companies offer suitable aftersales services.

6. GROUP 3

   Other Canadian-based companies acting as bona fide agents or distributors of Canadian or foreign manufacturers.

7. GROUP 4

   a) Foreign-based manufacturers or service companies;

   b) Foreign-based agents;

   c) Foreign governments or selling agencies of foreign governments.

Selecting Public Organizations

8. Government departments, agencies, Crown corporations or companies owned by them in whole or in part, whether federal, provincial or municipal, may be sourced:

   a) if such public body is the sole source for the product or service, or

   b) if such public body has established itself as competing with private industry in the normal course of business.

9. With respect to paragraph 8.b) above, Crown corporations will be allowed to compete with private industry only after they have proved, to the satisfaction of DSS, that they are indeed competing with private industry in the normal course of business and that they are not given unfair competitive advantage either through subsidization by any level of government or through the absence of any liability to pay corporate income taxes.

10. In accordance with Treasury Board policy, contracts or arrangements with Crown corporations are subject to Treasury Board approval if their value is in excess of GCR limitations.

Government Rehabilitation Institutions

11. Government rehabilitation institutions (e.g., Correctional Service of Canada) shall be sourced in accordance with directives issued by DSS. (See Directive 3053).

Selecting Universities and Non-Profit Organizations

12. Universities and non-profit research organizations may be sourced for knowledge-oriented requirements where private industry is not able or willing to undertake the work, or the university or research organization is a recognized center of excellence in the particular field involved. In sourcing from universities or non-profit research organizations, competition among such institutions may be used whenever practical.

Appendix C

VENTURE CAPITAL
AND THE COMMERCIALIZATION OF
RESEARCH AND DEVELOPMENT

A DISCUSSION PAPER

BY

D.J. DOYLE

PREPARED FOR

MINISTRY OF STATE FOR SCIENCE AND TECHNOLOGY

The views expressed in this paper are those of the author and do not necessarily correspond to the views or policies of the Ministry of State for Science and Technology.

DENZIL J. DOYLE, the author is an innovation consultant on contract to the Ministry to provide advice on the commercialization of publicly funded research.

INTRODUCTION

The difficulties encountered in attracting professionally managed venture capital to high technology start-ups constitute a serious drawback to the commercialization of Canada's publicly funded research. They warrant the attention of the Ministry of State for Science and Technology and all government departments involved in the technology diffusion process. Unless more private sector funding can be brought to bear on this end of the innovation process, the demands on government sponsored programs will continue to escalate to unmanageable levels.

Any significant increase in the publicly funded component or our gross expenditures on research and development (GERD) will require a corresponding increase in funding unless the private sector can be persuaded to do more funding at the front end of the innovation process. When the technology transfer results in the formation of a new business venture, the only source of such funds is the venture capital community. At present that community is not pursuing such opportunities to anything like the degree that its counterpart in the U.S. does.

This paper will discuss the reasons for this and will provide the reader with background information on the venture capital industry in general. It will also recommend solutions to the problem.

WHAT IS VENTURE CAPITAL?

There are sixty or so companies in Canada that call themselves venture capital companies and they specialize in financing high risk technology intensive ventures. Generally speaking, such financing takes the form of equity rather than debt because the ventures have no assets that can be used as collateral for a loan. In fact it is the venture investor's money (along with retained earnings) that eventually builds up an asset base which in turn can be used for debt financing.

Obviously, they are in the high risk investment business. The greatest risk is in start-up companies. However, every technology intensive company is risky right up until the time it can be traded on a public stock market. (In fact the risk does not disappear then either, but at least it is shared by several hundred shareholders, by the banks and even by the vendors at that stage).

Such venture capital companies manage pools of money that might range from a few million dollars to a hundred million or more. The largest in Canada is Vencap in Alberta with assets of over $200 million. It got its original financing from the Alberta government. The others get their

money from pension funds, mutual funds, private individuals and the banks. In fact many of them are partially owned by the banks.

HOW BIG IS THE INDUSTRY?

A report prepared for the Science Council of Canada in September 1985 gives an excellent overview of the venture capital industry. It is entitled "Pension Funds and Venture Capital: The Critical Links Between Savings, Investment, Technology and Jobs" and was prepared by Mary MacDonald of Venture Economics Ltd., a Toronto based consulting firm, and John Perry, a partner in B.I.O.S. Inc.

The following are some key numbers in that report:

1. The entire pool of Canadian pension fund assets in Canada in 1983 was approximately $85 billion (It is now over $100 billion).

2. The entire pool of venture capital assets in the same year amounted to $1.2 billion. (These are the assets of these 60 odd companies).

3. The total of all investments by these firms in 1983 was only slightly more than $100 million.

4. Of this amount, about 38% was outside of Canada leaving only $62 million for Canadian ventures.

5. Of this $62 million, the venture capitalists would claim to have put $23 million into start-ups. However, their definition of a start-up includes firms that are already in existence and are now getting around to shipping their first product. From our point of view, a start-up is a company that has just been formed to do product development - the kind of company that emanates from an NRC or university laboratory.

6. The Science Council report estimates that only about $10 million in true start-up money came from these venture capital companies. So in 1983 we had a pool of pension fund money in this country of over $100 billion, or 25% of our GNP and less than $10 million of that finds its way into start-ups! ! ! That is less than 50 cents for every man, woman and child in this country. If one traces the same stream of investment in the U.S., everything follows the traditional ten-to-one ratio that exists between the two countries until we arrive at this start-up figure. In the U.S. start-up investments by the professional venture capital companies amount to more that $5.00 for every man, woman and child, as compared to our 50 cents. While the situation may have begun to improve in 1985, these figures should be a red flag to us. While it is true that we do not have the same level of military spending and the same "incubation" capability that large companies like IBM and ITT represent, it is difficult to believe that we only have one-tenth the technology per capita to exploit.

Appendix A is a listing of the recommendations in the Macdonald report. It should be noted that they do not refer to the Small Business Investment Corporation (SBIC) legislation which was introduced in the May 1985 budget and published in November 1985. As mentioned later in this paper, industry reaction to that legislation has been very negative.

THE START-UP PROBLEM

The problem in its simplest terms is that we have not found a way of getting these sixty or so venture capital companies to invest in technology. I think they are essential to the commercialization of research and development and unless this happens more aggressively in the publicly funded sector, additional funding may be put into question.

I say "industry-oriented" R&D because obviously some of our publicly-funded research goes to support Department missions, or is basic research, or is diagnostic in nature, etc. Nevertheless, I believe we are justified in expecting technology diffusion from nearly all of the science and technology activites of the Canadian government today. Certainly, we should expect a very high level from research funded by such agencies as the Natural Sciences and Engineering Research Council (NSERC).

As a taxpayer, I do not object to paying civil servants to do research, both pure and applied research, but until we can find ways to turn the results of that research into more new business ventures, I do not believe we should

increase such spending - and specifically the spending on industry-oriented research. This applies even in Agriculture and Fisheries and Energy, Mines and Resources. In addition to solving the problems of their respective industries, their research efforts should be orientated to the creation of new business ventures.

The biggest "showstopper" is the tax treatment the venture capital companies receive on the capital gains they make when they sell such enterprises. The fact is that they don't get capital gains treatment like private individuals do. The situation at this time is that if a venture capital firm and a dozen private individuals invest in the launching of a Mitel Corporation and they all sell their holdings when the firm goes public some years later, the venture capital company's gain could be taxed as straight income, while that of the individuals is taxed as capital gains. In effect, we tend to reward the amateurs and to penalize the professionals. (And bear in mind that the amateurs are being given a $500,000 lifetime deduction as well).

Revenue Canada will argue that there is a provision whereby the venture capital companies can elect to receive capital gains treatment, but it is not being taken up by the venture capital companies. The reason is that they are not allowed to write off their expenses in full. This is unfair because a well-managed venture capital company incurs significant expenses in market research to assess each investment and to provide hands-on management afterwards. Unfortunately, the pay-offs come at

unpredicted intervals and in unpredicted amounts, and such companies bear no resemblance to an investment company that buys and sells securities for a living. The same tax rules should not apply.

THE NEED FOR PROFESSIONALISM IN THE START-UP PROCESS

Starting a high technology company bears no similarity to starting a hardware store or a tourist lodge. It requires a unique combination of skills on the part of the investor group, and these skills are usually beyond the capability of a private investor. In the United States, the average venture capital company has a sophisticated in-house market research capability and it is able to draw on the skills of hundreds of technical and business consultants who service the industry. Generally speaking, venture investments in the high technology industry are not for individuals. We must find ways of bringing the professional firms into the act and allowing them to become even more professional at it.

Another aspect of high technology start-ups is that the people who have the technical ideas and the knowledge to implement them are very young and have no assets of their own. While it may be tempting to dismiss this issue of the lack of start-up funding by suggesting that the best test of a new venture is the amount of money the founder is willing to invest, these founders do not have a home to mortgage or even a car to sell. And they should not go to a rich relative because that person likely does not know how to evaluate the opportunity or enforce the necessary management

discipline to protect the investment. The most fortunate thing that could happen to both parties is for a venture capital company to take a major position in the venture. It would put together a board of directors and implement a planning and reporting system that would give the young founders the key ingredient to their success, namely discipline. If one of the rich relatives want to take part in the venture as well, they should be allowed to do so, but not as the lead investor. In fact they might make excellent members of the board of directors, because those who know very little about the technology are likely to ask "dumb" questions in board meetings, and thus provide a stabilizing influence.

I believe we should set a goal for ourselves to have at least $4 per Canadian citizen ($100M) going into start-ups from the venture capital community by 1988 - that is the sort of the message the Minister of State for Science and Technology might want to deliver.

THE NEED FOR A NEW VENTURE STRATEGY

This whole situtation would not be so discouraging if the need for a new venture strategy were not so obvious. The only way that Canada is going to turn around the spiralling trade deficit in technology-intensive goods and services is to create more new busines ventures of its own. It is not strictly related to a level of research and development, because we could bring more companies like IBM and Digital and Burroughs to the country and ask them to do more and more R&D. Yet it is those very companies that

are contributing most to our trade deficit. We simply have to create more Canadian-owned technology-intensive companies.

While it is unreasonable to expect all publicly-funded research to lead to new ventures, the emphasis should be in that direction. The U.S. experience has shown that the technology can be exploited faster and with greater innovation in a small company than in a large one. All too often our government laboratories rely on the larger companies as a technology transfer vehicle with little or no concern about the ownership of the company or the level of its innovation ability. I would like to see a better choice of such vehicles, particularly at the small end.

WHAT ABOUT IRAP, PILP and IRDP AND OTHER GOVERNMENT INDUSTRY SUPPORT PROGRAMS?

The numbers I quoted at the beginning of this paper should help to illustrate the futility of attempting to use the Industrial Research Assistance Program (IRAP) and the Program for Industrial Laboratory Projects (PILP) to transfer all of our technology out of the labs. I find it ironic to see us quibbling over whether IRAP and PILP should be funded at $75M or $100M or $150M when in fact there is over $1 billion of venture capital money which is basically on strike in the country. As a taxpayer, I have no objection to the current levels of IRAP and PILP funding, but when we are spending ten times as much on such funding as we are able to entice out of the venture capital companies in start-ups, then I know there is something wrong.

There is a misconception that IRAP and PILP money can be used to start new ventues or new product lines in existing companies. The fact is that they cannot. In the case of a new venture, the IRAP rules require that an appropriate corporate entity already exists and that there are some assets in place either in the form of debt or equity before funding is given. That is why it is sometimes easier to give such grants to the larger companies than to the smaller ones. Granting officers feel they are on safer ground financially, even though they know such companies are less innovative.

Even if IRAP and PILP monies could be used to start new ventures, the people who manage them do not have the full spectrum of capabilities referred to above. They have excellent capabilities in assessing the technology and in implementing a reporting system to ensure that the research is properly done, but they usually do not have the other skills that are necesary to make a new company successful. The major difference between venture capital and IRAP and PILP funding is that the venture capital funds go to finance not only the research, but the marketing, the selling, the financial management, the inventory and the accounts receivable. In fact, R&D expenditures are often the least significant of all.

The above discussion does not mean to suggest that the IRAP and PILP programs should be scrapped. On the contrary, I believe they should be strengthened and expanded. As pointed out in the Wright Report of 1984 on Science and Technology, they have proven to be effective over the years and I believe they provide a reasonable Canadian equivalent to the

development money that is available through various military programs in the United States. Another very large granting program is the Defence Industry Productivity Program (DIPP) but it is not as directly focussed at the front end of the innovation chain. In fact, most of the money goes to large multi-national corporations. (In 1983/84 General Motors received $17.6M in DIPP funding.)

WHAT ABOUT THE MAY 1985 FEDERAL BUDGET?

The federal budget of May 1985 brought about new legislation which was intended to encourage pension funds to invest more money in venture capital and into small businesses generally. It is known as the Small Business Investment Corporation (SBIC) legislation. It does not appear as if it is going to address the problems I refer to in this paper for the following reasons:

1. It is extremely complex and most venture capitalists could not live within the various contraints that are written into the legislation - Finance seems to be overly cautious because of the abuse of the Scientific Research Tax Credit (SRTC).

2. It presupposes investment vehicles other than the established venture capital companies, and unless these other vehicles are put in place very quickly the problem will go unsolved for some time to come.

3. It does not address the fundamental "showstopping" issue of taxation. (The report to the Science Council places top priority on this issue).

The industry has made several suggestions to Finance and it is encouraging to note that some of the more constructive ones have now been adapted. For example, a venture capital company operating under these rules will now be able to own more than 30% of the shares in a company - usually an essential in the case of a start-up. Also, in the past, limited partnerships, vehicles commonly used in start-ups, were classified as foreign property. This meant that pension funds tended to avoid them because they must limit their total foreign investments to 10% of their portfolios. Given the choice of investing in IBM or a Canadian high technology start-up the choice is obvious unless the start-up looks awfully good. This "classification" problem has apparently now been solved. However, it is important that in drafting any such legislation in the future, the unique problems of high technology start-ups are taken into account.

In the U.S. some of the state pension funds are forced to invest a certain percent of their assets in venture capital. With such a pro-active approach there, and with Canadian legislation that has favoured an IBM investment over a Canadian start-up, it is little wonder that our start-up investment ratio is only one tenth on a per capita basis.

In addition to recognizing the special needs of high technology, it is important that Finance act to create the fiscal environment needed to stimulate the start-up of new firms.

WHAT TO DO?

I believe the Ministry of State for Science and Technology should call a meeting of senior people from MOSST, DRIE, NRC, Finance, Revenue Canada, the Pension Funds and the Venture Capital community to achieve the following:

1. A consensus on the rules of the venture capital game.

2. The establishment of a goal for the amount of money flowing into start-ups from the venture capital community - I suggest at least $100 million per year.

3. Address the recommendations of the Macdonald report to the Science Council (See Appendix)

In order to encourage greater participation by government departments in actively sponsoring the creation of start-up companies, consideration should be given to rewarding the departments through a mechanism to supplement their R&D budgets by an incremental amount for each new start-up resulting from technology transfer.

WHAT WOULD THIS COST?

Obviously the tax revenue being generated from the venture capital community is very small because, as mentioned above, the community is basically on strike. With only $62 million going into Canadian investments per year, I would estimate there is only a working taxable part of about $300 million in place today. If one assumes that it has a rate of return of 20%, that amounts to only $60 million per year in taxable income. The difference between capital gains treatment and income treatment would only amount to 25% of that, or $15 million. When one considers that total federal expenditures for Science and Technology are in excess of $4 billion, it does not seem logical to hang onto $15 million so tenaciously. Even if the flow of venture capital should increase by a factor of ten, it would still be a small price to pay for the leverage which I think it would achieve. The bottom line is that the supposed loss would in fact result in a net gain in tax revenue since the resulting increase in investment would generate considerable more revenue both in the short and long term.

SUMMARY

We have a situation in Canada whereby we are highly dependent on publicly funded research because there is a relatively low level in the private sector. Even though that publicly funded research should be available for public exploitation, we do not have the vehicles in place to do it. The

intricacies of high technology investment are such that it is not a game for amateurs. It will be necessary to get the professionals into it before Canadians can claim the kind of leverage that we deserve from our publicly funded research. Unfortunately, the professional players are on strike and we must find a way to get them back onto the playing field. I believe that the Minister of State for Science and Technology can and should draw attention to the issue because he is in a position to assist the others in resolving the problem. Also he has ultimate responsibility for the IRAP and PILP programs and they are being called upon to fulfill a task which is beyond their mandate.

APPENDIX A

RECOMMENDATIONS FROM MARY MACDONALD REPORT

REGULATIONS:

RECOMMENDATION 1: Eliminate the designation of limited partnerships as foreign assets.

RECOMMENDATION 2: Permit a proportion of public-sector funds to be set aside for venture capital.

RECOMMENDATION 3: Expand the basket clause to allow the investment of up to 15 per cent of assets under this provision.

EXPERIENCED VENTURE CAPITALISTS

RECOMMENDATION 4: Institute an apprenticeship program to train venture capitalists.

LIQUIDITY

RECOMMENDATION 5: Develop policy initiatives to strengthen the over-the-counter market in Canada.

RECOMMENDATION 6: Ensure speedy and efficient review mechanisms under Investment Canada for foreign acquisitions of small Canadian technology firms.

TAXATION

RECOMMENDATION 7: Eliminate capital gains tax for shares purchased in the initial public offerings of junior companies and held for a minimum of three years.

RECOMMENDATION 8: Clarify tax policies concerning the income of venture capital firms.

RECOMMENDATION 9: Review tax policies on stock options with a view to simplifying the policies and providing more favourable treatment of stock options.

Appendix II

Situation Analysis of Individual High Technology Sectors

1) **Office Machinery**

a) Vital Statistics

- domestic market of about $4.6 B growing at 50 per cent per year
- employment is approximately 15,000 people
- exports of about $1.8 B growing at 20 per cent per year
- trade deficit of about $3 B

b) Situation Analysis

- Sector is dominated by subsidiaries of multinationals comprising close to 85 per cent of the market (mostly "truncated")
- Canadian-owned firms are small and niche-oriented (e.g. software, microcomputers, etc.)

c) Suggested Actions

- use government procurement as leverage to extract WPM from MNEs
- use a 3% set-aside on technology-intensive purchases to provide R&D assistance to Canadian industry
- set in place a mechanism that provides timely information on upcoming technology-intensive procurements

d) Results to be Expected

- import substitution; attenuation of trade deficit
- maintenance (improvement?) of market share of world trade

2) Telecommunications

a) Vital Statistics

- domestic market of about $3.4 B growing at 9 per cent per year (serviced mostly by domestic suppliers)
- employment is approximately 45,000 people
- exports of about $1.8 B in 1984
- trade balance: + 441 M (1985)

b) Situation Analysis

- Sector is dominated by Northern Telecom
- other 400 odd firms are small and supply a narrow range of niche products
- industry is primarily Canadian-owned (i.e. Microtel is the exception) and a major performer of R&D in Canada

c) Suggested Actions

- keep a stable and supportive R&D tax regime in tax reform
- enhance export support programs, particularly the support of consortia

d) Results to be Expected

- penetration of new export markets
- maintenance of technological leadership
- increasing market share of world exports

3) **Controlling Instruments**

a) Vital Statistics

- domestic market of about $1.6 B growing at 8 per cent per year
- employment of 19,000 people
- trade deficit of approximately $600 M (1984)

b) Situation Analysis

- Sector is dominated by subsidiaries of U.S. corporations
- also some 250 small companies supplying niche markets

c) Suggested Actions

- encourage creation of niche-oriented firms

d) Results to be Expected

- there are several applications in the resource industries in which the Canadian market is big enough to be used as a test bed.

4) **Aerospace**

a) Vital Statistics (1984)

- shipments $2.9 B
- exports as % of shipments - 77%
- employment approximately 40,000
- trade deficit:

b) Situation Analysis

- industry has four segments:

Segment	Dominant Firms
• airframe (35-40%)	Canadair, De Havilland, McDonnell-Douglas
• propulsion (30-35%)	Pratt & Whitney
• aeronics (10-20%)	Litton
• space (5-10%)	Spar

- favourable competitive position
- strong government support (DIPP, DPSA)
- focus more on components and sub-systems than on complete systems

c) Suggested Actions

- adopt a strategic approach in implementing Canada's new space program (involve the investment community)

d) Results to be Expected

- balance of trade within 5 years
- robotics capability for Canadian industry (particularly resource sector)

5) **Electrical Products**

a) Vital Statistics

- shipments $4.2 B
- employment 55,000
- trade deficit almost $1 B

b) Situation Analysis

- dominated by U.S. subsidiaries
- 50 firms account for 70% of employment and 80% of revenues out of a total of 550 firms
- slow growth in North America; focus shifting to developing countries; firms lack "turnkey" capabilities and international experience

6) **Medical/pharmaceutical**

a) Vital Statistics (1984)

- shipments $ 2 B
- exports as % of shipments - 7.2%
- trade deficit $389 million

b) Situation Analysis

- branch plant structure dominates the 130 odd manufacturing operations
- small Canadian-owned generic and biological subsectors
- biotechnological advances have begun to restructure the industry

c) Suggested Actions

- new ventures strategy
- WPM strategy would apply

d) Results to be Expected

- with Canada's aging population, the Canadian market will serve as a significant test bed