MINISTERE DES AFFAIRES EXTERIEURES

DEPARTMENT OF EXTERNAL AFFAIRS

REPORT

ON

THE ACQUISITION OF FOREIGN TECHNOLOGY

ETUDE

SUR

L'ACQUISITION DE TECHNOLOGIES ETRANGERES

A. Couvrette

A. Watanabe

OTTAWA
NOV. 1984

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ANNEXES

THE ACQUISITION OF FOREIGN TECHNOLOGY

TERMS OF REFERENCE

Ever since the Government announced its strategy on this subject in 1982, the scientific community in Ottawa has been concerned with the importation of advanced technologies that could be used by Canadian industry. The many sectors involved include government departments, the Science Council, the NRC, universities, provinces and the industrial sector. The needs are recognized and the sources of supply abroad are often known. However, the same cannot be said for the information-gathering and delivery networks or systems.

OBJECTIVES

- Consideration should be given to the Department's role in the acquisition and marketing process, and decisions are required respecting the resources it should allocate to these matters:

  1. Clarify the role of EA in the search for foreign technology.

  2. Link EA's role with existing networks in Canada to ensure that information gathered abroad is transmitted rapidly and in a useful manner.

  3. Clarify what resources are required (p-y; budget).

WORK PLAN

a) Consultation (already undertaken) with the Canadian organizations involved (NRC, SCC, DRIE) in order to identify their interests and their capacity to cooperate with EA and embassies abroad.

b) Comparative study of the networks and methods of operation of foreign countries in this field. Identify which methods would be applicable to our system. Possible visits to some countries.

c) Recommendations and proposals:

  1. On the network to be established abroad.

  2. On the home-base and liaison services required in Ottawa to support this system;

3. On the resources required:
   - person-years
   - funding

TIMETABLE

- Consultations: April-May
- Initial proposals: end of May
- Studies and consultations in Canada (users, provinces): June
- Draft report to the ICISTR: July
- Formation of teams and visits abroad: early September
- Final report: end of September

RECOMMENDATIONS

1. That the XC of DEA declare S&T/Industrial Development to be a priority field and orient the action of the elements accordingly, by drafting a circular document defining its terms of reference and establishing the priority;

2. That the appropriate divisions in the Department be re-grouped to ensure that the necessary attention is given to this function and that a plan for reorganizing the personnel be drawn up (the work to be given to a special group within the Department);

3. That the newly created unit act as a focal point for policy development for the acquisition, distribution and marketing of technological developments and new technologies;

4. That the newly created unit assist the geographical bureaux responsible for the management of this activity by targeting this activity in liaison with domestic networks and be tasked:

    a. to provide support for the technological offices abroad in concert with geographical bureaux;

    b. to promote the use of the network by small and medium-sized Canadian companies through a selective "marketing" programme;

    c. to identify, through the use of an advisory committee, the key areas for which technological information will be required from abroad;

    d. to assess information received from abroad, to distribute this information making use of existing domestic channels, and to maintain an institutional memory, through the use of a computer data base, of these reports and follow-up activities based on them;

    e. to manage the use of the funds set aside to support foreign technology acquisition activities by the private sector;

5. That the Catalytic Seed Fund be augmented through the creation of a separate category (CSF-B) in order to encourage small and medium-sized Canadian companies to undertake technology investigation and acquisition visits abroad;

6. That Industrial Technology Fellowships be created and used to encourage highly qualified Canadian scientific and engineering students recently graduated from top foreign Universities to seek careers with Canadian industrial organizations and thereby play a linking role in the acquisition of foreign technology;

7. That the staff abroad in certain embassies (hereinafter called "Office of Science and Technology - Service de Science et Technologie" under the direction of a Counsellor (S&T) be increased (see Table I):

   (a) by adding two new counsellors (in Northern Europe and Central Europe);

   (b) by recruiting officers in the new and old posts, by secondment or locally, at a level (engineer) equivalent to that of the Commercial Officers (CO), those new officers to be responsible for following the development of industrial techniques and preparing technology transfers and acquisitions; by recruiting locally the necessary support personnel;

   (c) by installing equipment, linked to that of the home base and the trade offices, that will provide rapid access to and dissemination of S&T information;

   (d) by making available in designated Embassies and consulates office space for officers of the Departments and specialized agencies, or from industrial associations, so that in-depth sectoral studies can be prepared or special industrial co-operation projects implemented;

8. That the resources listed in Table II be approved for the implementation of the recommendations listed above.

TABLE I

Augmentation of the Science and Technology Network Abroad

(a) FY 85/86

Country	Canada-based	LES Officer	LES Support
USA	0	4	4
F.R.G.	0	3	3
U.K.	0	1	1
France	0	1	0
Benelux	0	1	0
Northern Europe	1	1	1
Central Europe	1	1	1
Japan	0	1	1
TOTAL	2	13	12

(b) FY 86/87

Country	Canada-based	LES Officer	LES Support
U.S.A.	0	4	4
Japan	1	1	1
TOTAL	1	5	5

TABLE II

(a) Summary of Resources Required in FY 85/86

Abroad	
PY (Canada-based)	2
Salaries*, allowances, operating budget and capital costs	$2,050,000
Home Base (Part of Operation Readiness)	
PY	8
Operating budget and capital costs	$ 115,000
Other	
Augmentation of the Catalytic Seed Fund	$1,250,000
Empty Office**	$ 100,000
Industrial Technology Fellowships	$ 175,000
TOTAL	$3,690,000

(b) Additional Resources Required in FY 86/87

Abroad	
PY (Canada-based)	1
Salaries, allowances, operating budget and capital costs	$850,000

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* Includes salaries for locally engaged staff and FSD allowances and removal costs for Canada-based staff

** Cost of modifying and furnishing space in existing quarters in 10 to 12 locations in order to accommodate short and medium-term technological experts from Canada.

INTRODUCTION

The technological innovation process

In order to acquire foreign technology, it must be understood:

a. to what sectors it applies
b. in which countries it is to be found;
c. who are the producers/proprietors;
d. who are the Canadian clients.

2. It is already known that:

a. The OECD has drawn attention to the rapid evolution of the following high technology sectors:

Bio-technology and genetics;
Mico-electronics, communications and robotics;
Space, aeronautics and transportation;
Chemistry and plastics, ceramics and new materials.

The OECD has identified the following characteristics:

- heavy dependence on a sound technical base and R&D efforts;
- strategic importance for governments;
- long delay between R&D and industrial applications, short delay for marketing, rapid obsolescence as a result of fierce competition for new products and processes;
- high risks and costs;
- high level of international R&D cooperation and competition for production and marketing.

b. Technological innovation is today found in the advanced countries of the OECD (approximately half):

- Those in which we already have a foreign mission with S&T resources: USA, Japan, Benelux, Great Britain, FRG, France.

- Those in which our diplomatic mission does not yet have a S&T capacity: Northern Europe: Scandinavia-Netherlands Central Europe: Switzerland - Austria - Northern Italy.

- Parts of the United States outside Washington: the Eastern Seaboard ("Massachussetts Turnpike") - the Mid-West - Texas - the Pacific Coast ("Silicon Valley").

c. Inventors still tend to be individuals rather than groups. Virtually all multinational manufacturing companies were formed on the basis of a particular discovery, and their original founder was almost always an engineer who had discovered a product or process: Edison, Bell, Ford, etc. However, as unresolved problems become more complex, they increasingly require collective research facilities beyond the resources of individuals; there is a tendency to measure opportunities for technical development in proportion to the assistance allocated to research and development, and it is then that government enters the race. In addition, industrial, scientific and technical communities place great importance on the monitoring of patents and publications that describe new products and techniques; however, outside these milieux, industrial and commercial firms rush to acquire innovations in order to exploit them as rapidly as possible. Even though inventors are often isolated individuals, the ultimate proprietor will always be in one of the following three categories:

   - Government (defence - space - infrastructure)

   - Conglomerates or multinationals (MNCs)

   - National corporations (usually SMEs)

   (In order to make a distinction between SMEs and MNCs, the latter are large corporations equipped with an international trade network, considerable financial assets and the capacity to manufacture products in a number of countries).

d. Similarly, Canadian clients will belong to either the public or the private sector:

Federal government + provinces;

Industries (conglomerates - subsidiaries - SMEs).

3. The provinces are even more directly linked with industry, especially with SMEs (with less than 200 employees) that create, according to the Department of Consumer and Corporate Affairs, over 44.6% of new jobs in manufacturing industries. Some sources state that innovation and the creation of new jobs by the SMEs amount to 70% (CRIQ).

4. In Canada, it has been observed that innovation is often "lost" in the commercial sense because inventors fail to recognize the need and benefits of patents. Thus, at trade fairs, Canadian corporations often display unpatented products which foreigners are free to appropriate without any form of compensation. Similarly, as a result of such carelessness, our trade delegations often lose opportunities to negotiate Canadian innovations and to obtain access to a market or an exchange value. While the sole function of the Canadian Patents Office has always been to provide protection, such offices in other countries often conduct research, provide comparative trade data and forecasts and may even give invaluable encouragement to innovations. The cost of patents (and future renewals) could be used to nurture an active policy of motivation and promotion. This need has finally been understood and a new policy based on promotion, though more heavily on protection, is now being proposed.

5. The Patents Office constitutes a unique data bank on new technology. Serious analyses of these data provide information on the principal sources of innovation throughout the world, the sectors which are affected, those which are neglected (unfilled gaps in which inroads can often be made), trends in innovation and their commercial potential. Furthermore, they reveal where the ownership of the inventions reside and, consequently, the best means of acquiring them.

The technology acquisition process

- Bearing in mind that 95% or more of the technology used in Canada comes from foreign sources, we are obliged to acquire it or fall irretrievably behind in our industrial and commercial development. The conditions in which

scientific and technical knowledge are transferred form the very basis of technological exchange, and must be studied.

- A common and effective means of acquisition often used by MNCs as well as countries like Canada is simply to attract the inventor to settle in the country. This practice, which requires the cooperation of immigration services, is systematically used by Bell-Northern, for example. We also know that the founders of MITEL and GANDALF were British.

- We must then study how to acquire foreign technology. This can be done in several ways:

  - by buying the product;
  - by buying a license;
  - by obtaining world product mandates;
  - by attracting investment by a foreign company;
  - by buying a foreign company;
  - by participating in a joint venture.

6. This immediately brings us to the problems of importations and investments.

- In Canada, approximately 50% of high technology enters via the internal transfer of information between American MNCs and their Canadian subsidiaries: there is no precise record or evaluation of this vast system of product and process transfer.

- The purchase of licenses and the subsequent payment of royalties has a negative effect on the balance of payments, whether compensated or not by the export earnings of products for which there are world mandates.

- World product mandates can be entirely profitable if they concern an invention by a Canadian subsidiary. This sector is small but growing. It is also fragile; in cases where the technology belongs to a foreign conglomerate, the threat of pull-outs is great in times of recession. Furthermore, in cases of large-scale exploitation beyond the means of the subsidiary, the parent company loses no time in laying claim to the world market and profits made from it.

7. Foreign investment depends on government policy. For companies, the key issues are as follows:

   a. the legal and regulatory framework

   b. the socio-economic situation

   c. the financial situation:

      a. tax legislation, tax breaks, subsidies (federal, provincial and municipal); legislation governing competition, monopolies and patents; regulations governing employment, production, domestic trade (banking, corporate and trade legislation) and international trade (bilateral or multilateral agreements) which either open or close the Canadian or foreign market;

      b. local infrastructure facilities (empty shells, industrial parks, etc.); conditions governing employment and property (obligations to hire local employees and appoint Canadian directors, zoning, etc.); and the location (amenities, cultural structure: universities and research centres, cultural and sports activity centres, regional and demographic characteristics, language of work, etc.);

      c. lastly, the means available for reducing costs, one of the characteristics elements of high technology industries according to the OECD, given its high costs and risks. From the investor's perspective, these means are relative to those available in his own country: exchange rate, interest rates, labour, etc.

8. Cost and risk-sharing modalities: joint ventures, procurement and barter are double-edged swords; they require case-by-case solutions, but also an overall examination.

   - Each method of acquisition has both positive and negative aspects and it is instructive, for each case, to compare their respective effects: thus,

   - investment by multinationals can be discouraged by insisting on job creation and participation in the world market; with every investment, it is

much easier to appropriate products than to attract a new influx of capital and adapt and perfect new techniques.

- a "nationalistic" policy (i.e. protectionism) often works to the detriment of consumers and industrial development by producing isolation and long and short-term delays, even if it may appear more immediately attractive to political (sovereignty) and union (jobs) circles and advantageous to less competitive domestic industries (protectionism).

The process of world-wide transfer of technology

- Acquisition should be considered in the same light as importation. However, technological transfers works in both directions as soon as the technique (product or process) is integrated with the production of goods for export. Few Canadian businesses are interested in investing in high technology without immediately thinking of the world market. And few have the means to do so without direct or indirect government assistance.

9. The second phase of commercialization is essential in the new world of high technology; it consists of selling products the world over, since in this field production lines are short, costly and quickly obsolete; they must therefore be amortized quickly and on large-scale. The market is world-wide and some believe half of it will soon be controlled by 300 of the large multinationals ("Canada Tomorrow", Commissioned Papers, p. 4). If this forecast proves true, it would probably be better to think twice before establishing a national policy as outlined in the previous paragraph. But, above all, we must prepare ourselves to participate in this great world-scope challenge; otherwise all the regulations, liberal in intent and restrictive in their application ("honoured mostly in the breach") of GATT, UNCTAD, and even the OECD, will be powerless in the face of the economic dynamism of strong commercial interests ("If you cannot beat them, join them?").

10. How can we participate in the world trade for high technology products? Many Canadians corporations are already the subsidiaries of foreign conglomerates. However, these subsidiaires rarely have world product mandates and most often are forbidden to participate

in foreign trade. Even more serious is the fact that they have neither the right nor the means to invest abroad in order to expand and thereby exploit foreign markets. Thus, we must consider forming Canadian international trade corporation:

- either by the spontaneous growth of private companies;
- or by joint ventures between Canadian companies;
- or by cooperation with foreign companies;
- or, finally, through their deliberate creation by government.

With respect to the means of creating corporations, it should be noted that:

- in our history, spontaneous growth has created very few multinationals: apart from the Bell/Northern Telecom conglomerate and its "derivative", Mitel, most are corporations whose base of operation is natural resouces: INCO, ALCAN, NORANDA, COMINCO (Canadian Pacific), not to mention the purely financial trusts (Seagram's, Power, Argus).
- Canadian corporations are not usually disposed to mergers for industrial and commercial purposes, and when they are, they receive little encouragement from the banking system. In other countries (Japan, Germany, Sweden), this conglomeration process usually takes place under the aegis of banks. However, our banks do not seem to take on this responsibility. Perhaps the current legislation discourages them from this practice. Certainly, their recent experiences in extending credit to Brazil and Dome Petroleum are discouraging factors.
- Joint ventures are a promising solution; however, they involve problems of ownership (patents) and balanced market distribution. Currently Canada consists of 25 million people and has an $85 billion total import market. The market for high technology imports is much more limited: $4 million for computers, for example. Countries offering (1) a market of comparable size and that possess (2) advanced technology and (3) an international trade network are few in number.

As with world product mandates, joint ventures will be rare, at least in relation to the major trading currents that require only a general effort to buy and sell. Complicated formula are more advantageous but also require more time, something the high technology market does not have.

Financing transfers - Government's role

11. Government controls several conglomerates or large corporations in various fields: at the federal level, Petro-Canada, CN, AECL, Air Canada among many others; and at the provincial level, Hydro-Quebec, Ontario Hydro, and Saskatchewan Potash, for example. More important, however, it can be instrumental in the formation of new corporations -- MITEL being only one such example -- by offering the necessary assistance for survival, including procurement, subsidies and protection. Furthermore, in major sectors, notably defence and space, the state is the only body with the capacity to shoulder and carry the financial burden as a last resort. Government also possesses the means of favouring consortia by providing them with a good legislative framework (federal legislation expressly exempts export companies from anti-trust suits) and, more positively, by encouraging the injection of venture capital through its tax policies, as through certain agencies such as the CCC, the FBDB or the EDC. Business circles maintain there is a very large quantity of floating capital in Canada seeking investment in promising ventures. Why, then, does investment always go to the United States?

12. The other source of domestic capital besides government and banks is found in pension and retirement funds and other public financial institutions. In addition to the Federal Business Development Bank (under the aegis of DRIE), there are provincial corporations (SODEQ, IDEA/Ontario), private venture capital corporations (grouped in the ACVCC), bank subsidiaries, insurance and investment corporations such as ROYNAT and large stock brokers (Wood Gundy, Pitfield, etc.). However, the apparent historical attitude of our banking system - fiduciary (financial) monetary conservatism - is possibly even more marked in these institutions which, first and foremost, must preserve and stenghten their financial capacity for the future, given the social and

demographic trends that darken their prospects. Their governing legislation is very restrictive in that regard.

13. The crux of the problem is possibly of an historic and cultural nature. The profoundly segmented and competitive social and political system in which Canadian business operates - every corporation, even a bank, is everyone else's adversary - will require a long period of adjustment before attitudes change and a policy of concerted and cooperative national effort is adopted. Let us hope that our experience in the meanwhile is not too harsh.

14. While high technology activities usually follow socio-economic criteria (costs/benefits, R&D investment, proximity of universities, material and financial infrastructures, local amenities), every Canadian policy suffers from interregional competition. Each province has its incentive program for industry (including procurement), for the distribution of funds to universities and research institutes, and for distribution among municipal "poles". Our federal tax system is deemed comparable, in equity and generosity to those of other countries. Nonetheless, overlapping federal, provincial and municipal jurisdictions are major obstacles to investment. ("Canada Tomorrow", op. cit., p. 10). Surrounded by this confusion, the federal government hesitates and refuses to decide between regions: its ability to act is limited by domestic constraints.

The role of the Department of External Affairs

15. These constraints weigh heavily on DRIE, whose responsibilities for industrial development can come in conflict with its mandate to ensure balanced interregional industrial activity. In consequence, the foreign service must be able to work directly with its customers, including the provinces and industry. Furthermore, the work of Trade Services could not be effective if barriers were erected between our foreign missions and their clients. One can easily imagine the discouragement of an industrialist having to battle his way through the successive levels of authority (municipal, provincial, DRIE, EA) to finally make contact with a foreign trade official, especially if, after completing this obstacle course, he has to run through it in reverse order.

16. At the same time, the now dormant idea of establishing Trading Houses is one worth reconsidering. Ever since the reorganization of duties between DRIE and EA, this responsibility had fallen directly to our Department. In June, 1981, a Special Parliamentary Committee recommended the establishment of a National Trade Corporation. However, opposition from the business community was so strong that in 1982 the Minister, Mr. Ed. Lumley, announced at an Ottawa conference on this theme that the Government had decided to shelve its plans: "The challenge is now in the hands of the private sector". Since that time a task force, in which our Department participates, has been working on the matter. According to the Canadian Exporters Association, an analysis of 640 of some 1000 Canadian trade corporations reveals that they account for an export volume of $11 billion, representing one-eighth of our total volume of exports.

17. Our Department must also see to the implementation of recommendations of the Hatch Report, which proposed a certain concentration of trade arrangements in order to increase the effectiveness and facilitate the work of SMEs. These recommendations may be interpreted as inciting our Trade Commissioner Service to maintain direct communications with any company interested in international trade.

18. There is certainly no question of creating a corporation run or even organized by the Government (besides, one already exists: the CCC). But neither can we ask small, private import-export business to occupy world markets in the complex and specialized fields of high technology, in which so many sectors are directly or indirectly controlled by governments. Will we therefore allow foreign-based MNCs an unchallenged sway in this field? Here, it is necessary to outline a strategy to weigh options in:

- supporting the organization of Consortia formed by (a combined effort on the part of) high tech to enable them to produce for an international market;

- promoting the organization of trading houses capable of developing world trade networks;

- encouraging the expansion of Canadian MNCs

- mobilizing available private capital for high-risk ventures.

These problems should, of course, be studied in conjunction with DRIE, which has prime responsibility for industrial development.

19. This new role involves a major reorientation of trade service activities, whereby they will be more closely integrated than has been the case with scientific and technical services, which are too often seen as far removed from the concerns of heads of posts, as of those responsible for trade services at headquarters.

20. In the field of science and technology, particularly transfers of technology, this role consists in aligning trade activity with that of private and public bodies responsible for domestic policies in:

a) innovation and production:

- MOSST policy development and strategies;
- NRC and DRIE networks linking federal activities with those of the provinces and of private industry;
- incentive and sectoral policies of other science-based departments and of private agencies;

b) trade:

- DRIE innovation and investment strategies;
- a policy of promotion (not discouragement or delay) at FIRA;
- a Patents innovation promotion policy;
- tax, competition and security policies;
- encouragement - to Canadian consortia
  - to joint ventures
  - to the formation of Canadian trade corporations.

c) funding/resources:

- PEMD and CSF strategies;

- (few additional direct EA resources: act through secondments and local recruitment);
- ties with the CCC, CIDC and EDC;
- direct ties with
  - the provinces
  - private industry (industry associations)
  - science-based government departments and agencies
- special ties with the DSS and DND

21. Multilateral aspects - Numerous services (at least 12 divisions) in the Department are involved in the preparation of our negotiating postures in international organizations that deal with the multilateral trade context for S&T products and processes:

- GATT and UNCTAD, which define international codes of conduct;
- the OECD, a forum in which industrial nations try to agree on trade and its economic consequences;
- NATO, where security restrictions on transfers are debated;
- the Economic Summit and the Group of Six European nations), which try to compare analyses and formulate international cooperative projects;

22. Trade promotion services relate to high technology from a military standpoint (joint defence production with the United States; bilateral agreements with 7 European nations) as well as from a civilian standpoint (technology and trade and investment development divisions), in both functional and geographic terms (particularly with the United States). Other services deal with methods of promotion (e.g. trading houses and trade services) and problems relating to trade in high technology products (bilateral agreements and investment).

23. For its part, the scientific community develops bilateral scientific agreements or multilateral ("Big Science") development and cooperative projects. It conducts long-term forecasts of developments and, through its colloquia, meetings, publications, missions and visits, attempts to define a research

framework that will serve as a basis for future developments. Although these activities are outside the scope of this study, the scientific community's contribution to decisions on development and trade should be borne in mind when the services in question are being reorganized. It would thus be appropriate:

- to have representatives of the economic, legal and scientific services meet periodically in committee to help identify major medium-term trends and to prepare our international negotiating postures;

- to use these meetings to meet with the scientific community, as represented by members of ICISTR, to give briefings, finalize preparations, and hear the points of view of other departments and agencies involved in these issues.

24. Any initiative or new direction, no matter how emphatic in written or verbal form, often meets with a cool reception unless accompanied by a suitable allocation of resources. However, we know that government resources -- in particular personnel resources -- are limited at the present time. Initially, then, we should channel existing resources into this program by broadening their current objectives and tasks:

- the financial resources which today serve to promote exports, the PEMD, should henceforth also be assigned to the importation of technology; the activities such funds support whether for export or import purposes are essentially of the same type (missions, delegations, groups, etc.) and equally suited to the promotion of exchanges.

25. Joint management (S&T/Trade) of the heavy action program outlined in the preceding pages will demand a concentration of human resources who are competent not only in matters of technology but also in investment, licensing, transfers, market forecasts, all this in a fast-moving environment. The Department does have people with these dual qualifications, whether in engineering or similar professions. It does not, however, have an over-abundance of them and it must therefore bring together those who fit these requirements. This is the only means of ensuring <u>continuity</u> both in competence and interest, as demanded of us by both the scientific and the industrial communities. It is

the only way to make the Department a valid participant in this work with vastly different and demanding clienteles, domestic and foreign, and to deal with opportunities and problems attending rapid scientific development in the current technological revolution.

Part I - External and Internal Network - Resources

In developing new functions in the Central Unit and abroad, the two aspects of technology transfer must be distinguished:

a. acquisition of foreign technology;
b. marketing of Canadian technologies.

Those two aspects give rise to two distinct activities. Both require the same degree of competence to ensure a knowledge of the products and processes, hence an understanding of the technical know-how expressed by those products and processes. However, the modus operandi requires a different type of staff, seeking out a different clientele and using different methods.

A. Acquisition

To search out and acquire new techniques, we must start with an enormous and constantly evolving technical data base. This type of knowledge cannot be stored in files: we must have a computer program so that a huge memory can be accumulated and - this is of even more practical importance - so that it can be immediately accessible to both the private and public sectors. That base exists at CISTI (the Canada Institute for Scientific and Technical Information), which is part of the National Research Council. CISTI has the third largest data bank of its type in the world - comparable to that at the Smithsonian Institute in Washington. CISTI serves as a base for the industrial development activity of NRC's 120- 150 ITAs (Industrial Technology Advisors), who are distributed throughout Canada and divided between the Provincial Research Organizations (PROs) and private industry, as well as the research institutes and universities. These officers are generally at engineer level, and - in closer and closer exchange with the private sector consultants - are in direct contact with over 8,000 firms. To keep up to date on the extremely rapid development of technologies, they are continually refreshing their knowledge through their access to and analyses of CISTI. One of the recent research projects of this system made it possible to set up a sectoral matrix, pointing out the needs of the various sectors of Canada's manufacturing industry and the corresponding sources of new technology, here and abroad.

That network for transmitting knowledge will be directly linked to the external network proposed in this report:

a. CISTI must serve as a base for technical/industrial data;

b. The matrix must indicate needs for new technologies;

c. The ITAs must specify in which firms the specific needs exist and what innovations are involved;

d. The foreign sources are identified using the data base and also that for Patents, which must be linked to CISTI.

It is the ITAs - or equivalents - who must do the in-depth research work on a sector in a country over a given time period, unless (and this will apply in most cases in which individual needs of the firms are identified) the firm in question itself has the expert required for doing this research abroad.

In this context of liaison with industry, the function of our posts abroad will be to:

a. Make a workplace available to the experts designated by the Canadian network.

Our contacts in NRC considered it very important to provide a properly equipped office (with computer and secretarial staff), the understanding being that the organization (NRC or the firm) will cover the salary and living costs for these experts.

b. Provide financial incentives for the travel required by using CSF funds.

Since this participation requires that CSF funds be made available to the private sector, and we can expect that the demand will grow very quickly, that budget must be increased substantially.

c. Open doors and provide necessary contacts in the country being explored.

Some contacts with institutions (research directors of institutes or state corporations) are more readily made if the person doing the introduction has diplomatic status (S&T or Trade counsellor). That is in fact the normal work of diplomatic officers, broadened to include this area in a more frequent and continuing manner. Thus it is important to have greater knowledge of the S&T environment in the "source country", and also of high-technology firms in that country. That need must be met by recruiting officers (locally for the most part) with engineer-level ability, along with local support personnel.

d. Keep in memory the knowledge acquired for subsequent use and transmission to the data bank.

The projects for which experts in industrial techniques are sent to our posts will not be short-term ones, like visits of sales agents, but will have practical, technical, legal and commercial sequels (negotiations on the transfer of licences or conclusion of joint ventures and joint research agreements, adaptation and improvement of imported technologies) that cannot be started from scratch on each occasion and which will often require several months before they mature. That is why these posts must be given people with a high degree of general technical knowledge (experts from Canada would do the specialized work on the projects), equipped to ensure continuity in the co-operation between the Canadian networks and the post. What the post can contribute in a number of countries is the knowledge of the local sources of technology and an understanding of the language of the country. Hence it would be useful to add to our S&T and commercial sections an officer recruited locally who knows the scientific vocabulary well enough to serve as an interpreter in highly technical discussions and exchanges of documents.

B. Marketing

What the Canadian high-technology firms want to know in penetrating a foreign market are the following:

a. the legal, regulatory and fiscal context, the industrial structures (the size of the local firms and what equipment they have), the style or attitudes of the local contacts and the quality of public-private sector relations in the industry;

b. the attractiveness of their product or new process, its uniqueness and its chances on the local market;

c. the level and nature of competition in the market in question.

The type of market study required in this very rapidly developing sector of high technology requires a high level of product knowledge, in other words a technical ability to judge a product's originality accurately (point b), distinguishing it clearly from products that might seem to be competitors but are actually in another related niche. High technology is in fact characterized by the large number of narrow, very specialized niches in the market.

It is also necessary to bring general knowledge of the preferred methods (joint ventures in R&D or production, in the distribution of markets, or in licensing practices, etc.) in the target country. That expertise comes naturally to our Trade Service, and thus the marketing work does not create new requirements in our posts. The only difference is that concluding licensing and joint venture agreements is much slower and more laborious than simply setting up contacts. And we must not rule out the possibility, given that Canadian firms in general are smaller than their foreign counterparts (in such countries as Germany, Sweden, and even Italy and Switzerland), that they will need much more assistance than in the case of general trade activities. Thus marketing in the area of high technology is a much longer-term activity: this is not one-shot action, but contacts and negotiations over a long period. Here again our posts must be equipped with sizeable memory tools that are more reliable and can be more quickly accessed than files, to guarantee continuity in service to the client.

Finally, seeking out and concluding transactions requires much travel between Canada and the country in question. It is therefore important to provide simple, quick cost-sharing formulas. Here again the use of the CSF should be available, particularly to the small and medium-sized firms for which success in exporting is a matter of life and death, especially in the initial phase of their activity. It has been stated that in its initial phase (fewer than 50 employees and $1 million in sales), a high-technology firm must export 80% to 90% of its product. It is during this time of scarce funds and extreme fragility that basic commercial assistance (travel costs) is most needed and appreciated. Once a firm grows to become medium-sized and its survival is assured (200-300 employees and $5 million in export sales), it generally also possesses the resources to follow the PEMD route, with its auditing requirements and delays. At that point it also has a basic clientele and is beginning to establish and develop its own network of international contacts.

Resources required:

Based on inputs received from the geographic Branches concerned it is estimated that 2 additional Canada-based officers, 13 locally engaged technology acquisition officers (TAO) and 12 locally engaged support staff would be required for the proposed technology acquisition program during FY 85/87, with an additional Canada-based officer, 5 TAO's and 5 support staff in FY 86/87. The proposed geographic is distribution of these additional resources is given in Table I. Extracts from the inputs received are given below.

a. United States

"For the U.S.A., we would suggest dedicated personnel at four locations whose only program responsibility would be the search for and dissemination to Canadian industry (via some Canadian focal points(s) not yet identified) of specified new technologies. Each of these officers (who might be called Technology Acquisition Officers - TA0) could have a mandate, on a national basis, for one or two closely-related fields of technology. The officer should be located at or near the principal recognized knowledge centre for his/her specialty. The TAO would need to travel widely to other centres where significant research or product development activity is taking place, as well as to attend meetings of research societies, industrial association, etc."

"We recommend that the program be undertaken on an experimental basis for a specified initial period of time, say two years, and that we utilize locally-engaged personnel, retained on a term basis. University graduates with a background in applied research would seem the most likely candidates. Americans rather than Canadians are recommended, as this may decrease the learning time in the particular technological sector, although this may not always be the case in an integrated North American industry. Also, locally-engaged status is recommended over Canada-based to add flexibility in candidate selection and to reduce overheads (both direct costs and administrative support) at posts."

b. Western Europe

"The choice of countries in which the services of a technical attache will be recommended is based on a sectoral approach (biotechnology, microelectronics, robotics/manufacturing products, offshore aeronautics/space). The conclusions we draw from previous successful experiences of success are that we should choose sectors according to the strengths of each of the countries and concentrate our efforts in those sectors by choosing a technical attache who is an expert in that sector. This list distinguishes between the posts that already have scientific counsellors and where we have a better idea of what the country can offer us, and the others where the technical attaches will have a more exploratory mission and should be there only on an experimental basis."

"The Canadian-local employee formula. We would prefer to send a Canadian who knows the needs of the Canadian industries and who by virtue of his title would have access to the industries in the host country, especially in the case of a "generalist" technical attache. On the other hand, in cases where a specialist can be assigned, a local employee might be better able to meet our objectives because of his knowledge of his country's industry and his language knowledge."

c. Japan

"This subject is of particular relevance in our relations with Japan and our scientific counsellor in Tokyo spends by far the greater proportion of his time in acquiring Japanese technology. In fact this constitutes the first component of the role of the office of science and technology at the Embassy which is to identify, promote and manage the development of collaborative activities in science and technology yielding benefits envisaged to be mutually advantageous for both Canada and Japan.

We are in full agreement with the first recommendation of your report to make sandt and its application to industrial development a priority of the department. Japan is now in fact Canada's second most important sandt relationship in terms of trade in technology."

"Our conclusion is that serious thought should be given to the allocation of additional resources such as an Les Sandt analyst devoted to technology acquisition and a microcomputer system to enable the sandt office to manage the myriad of data it must collect more efficiently."

TABLE I

Augmentation of the Science and Technology Network Abroad

(a) FY 85/86

Country	Canada-based	LES Officer	LES Support
USA	0	4	4
F.R.G.	0	3	3
U.K.	0	1	1
France	0	1	0
Benelux	0	1	0
Northern Europe	1	1	1
Central Europe	1	1	1
Japan	0	1	1
TOTAL	2	13	12

(b) FY 86/87

Country	Canada-based	LES Officer	LES Support
U.S.A.	0	4	4
Japan	1	1	1
TOTAL	1	5	5

C. New Services in the Central Unit

When marketing goes beyond prototypes and develops a permanent clientele there arise problems of a different nature: the need for a trading firm, negotiations for joint R&D projects, joint venture agreements, etc., which require more general service but less particular attention. These problems will arise more in the home base in Ottawa, and they will be for the new division in charge of investment and transfers to deal with.

It has already been agreed to group the scientific and technology marketing divisions in Ottawa and to set up a division tasked with dealing with investment problems. Now we must specify the duties of each.

(a) S&T Division

The present division in charge of scientific exchanges is almost entirely taken up with science policy tasks. It takes part in the recruitment and training of S&T Counsellors. It is up to the geographic bureaux - and not the S&T Division - to manage the work of these counsellors abroad. For its part, the division is primarily interested in the international scientific activities of the government and its science-based departments: space, data transfer (TBDF), Communications, Economic Summit initiatives, the Commonwealth Science Council, ACTC, OECD, NATO, IIASA, Task Force on Biotechnology, Data Processing and other interdepartmental international activities, including the federal- provincial aspects. In short, this division deals mainly with multilateral activities.

This work must be continued, as it plays an essential part in the context of the new priorities given to technology transfer.

However, work related directly to private-sector industrial and trade development is done elsewhere. The link between the external network and the domestic industrial development networks must be located elsewhere.

(b) Technology Division

This division is responsible for marketing high-technology products of Canadian industry. Its work is growing rapidly, and it is this division in particular that provides the liaison with the corresponding offices in DRIE. It already has an extensive network of contacts with Canadian high-technology firms. It will remain responsible for communicating the demand from that sector to our posts.

As has already been pointed out, acquisition and marketing are often simultaneous, and to that extent this division will develop its trade promotion activity linked to industrial development, particularly in the electronics sector.

(c) Transfers and Investment

A new division, which would be responsible for questions related to investment, will inevitably be led to act directly in questions of technology transfer. It is a condition of foreign investment that it bring something new to Canadian industry, whether it be products, processes, capital or managers. It is from this division - and the geographic branches - that liaison will best be set up between the foreign network and the domestic networks. Thus this division must be responsible for direct liaison with the national agency dealing with investment, and also with the NRC's Industry Development Offices, since that is where investments that bring foreign technology will be dealt with.

It would be useful for this division to have personnel who are very knowledgeable in the area of licenses, joint ventures, world product mandates and transfers of risk capital. Finally, this division should deal directly with the creation and encouragement of Canadian trading houses to sell Canadian high-technology products abroad. That responsibility would be held jointly with the Technology Division.

In accordance with the recommendations of the Schroeder-Gudehus report, the Bureau thus formed should be able to rely on the support of a public-private advisory committee, consisting of clients for technology transfer from industry and from government agencies, together with officers from our home base and from geographic divisions responsible for administering the S&T offices abroad. Such a body would help to provide continuity in the links with the domestic clientele, to pinpoint the demand for acquisition and marketing of technology, and to administer a CSF that would be greatly increased to respond to a stronger demand.

D. The Home Base and its Connection to the Clientele

Recent government reorganizations have centralized within the Department the international aspects of science and technology, which can be categorized as follows:

a. development of policy for and promoting bilateral and multilateral activities that include scientific and technological factors and that have the potential for significant downstream scientific and/or economic benefit to Canada;

b. development of markets for technology-based goods and services.

c. monitoring of significant foreign development in technology and in science and technology policy and serving as an early warning system for the benefit of Canadian planners and decision makers in government and industry.

d. assistance to Canadian industry, particularly small and medium-sized companies, in the process of importing technological information and know-how;

The capability to discharge these functions is provided abroad by the science counsellors together with the trade commissioners. A crucial element of the network is the "home base" - the connection between the resources abroad and the domestic clientele.

These functions are quite different in nature, their clientele are different and thus will require handling in rather different ways. The first category has been one of the main preoccupations of Canadian science counsellors to date. The clientele is primarily the federal government, and occasionally, provincial bodies, with the private sector brought into the planning and discussion phases as appropriate when potential downstream industrial benefits have been identified. The management of this activity is centred in the ETS division and the geographic Branches, with policy guidance provided by ICISTR (Interdepartmental Committee on International Science and Technology Relations) through the ETS Division of External Affairs. In this case ETS along with the geographic Branches collectively constitute a sort of home base. Although no systematic (computerized) data base exists, the various bilateral relations are all formalized

to some degree or other, and the institutional memory has been good to date.

The second function is carried out by the Trade Commissioners Service. The TIS Division along with the geographic Branches constitute the home base for this operation. The clientele is the private sector, and direct contact with the posts is the accepted method of operation.

The activities of the third category are no doubt the most difficult to manage, and also about which there are many questions about their utility. The monitoring of both leading-edge and best-practice technologies is already being carried out through existing mechanisms such as personal contact, conferences, scientific and trade journals, trade shows, etc. and it is argued that reports prepared by non-experts in the field cannot add anything of significance. The experience of countries, such as Sweden and the Netherlands, who have industry-oriented technical attaché systems in place, would suggest the contrary. What is clear, however, is that for such reporting to have value, the science and technology counsellors must have clear directions from the user groups. What is lacking at present are a method of determining the detailed requirements of the client group, as well as an effective method of disseminating the reporting output of the posts.

One method of providing such direction would be through the creation of an advisory body reporting to the head of the home base unit, with membership from industry associations, federal and provincial governments, and universities, to prepare a clear and concise annual statement identifying sectors of importance, and delineating those aspects where timely reporting would be of value. It is equally important to establish effective information dissemination mechanisms. The general feeling is that the creation of a newsletter for this purpose would be futile. Also it is impractical to send all Embassy reports directly to all potential clients. What is required in the home base is the ability to critically assess the information and to shape it to meet the needs of the gatekeepers of the existing domestic information channels.

It is clear that, no matter what methods are used for the dissemination and distribution of technological information from abroad, information handling experts would be required in the home base.

Although client-originated specific reporting activities have been undertaken by science counsellors on occasion, the fourth function is essentially a new one. For handling client-originated requests, the best mode of operation would appear to be direct contact between the client and the Embassy. Direct contact would ensure good understanding of the clients' needs and speedy response and, furthermore, would help assure prospective clients that proprietary information would be protected. The home base need not play any active part in the process. One of its major roles would be the "marketing" of the services - to give science and technology counsellors a higher profile domestically. Surveys of potential industrial users clearly indicate that what is lacking principally is the knowledge, by the potential client, of the very existence of the science counsellor network. From these surveys it is also reasonably clear that, once industrial users become more aware of what the network could do in helping them to satisfy their specific information needs, the demand could sorely tax our meagre resources at our posts abroad, particularly in the United States and Japan.

The home base would work very closely with existing domestic networks in the technological infrastructure, such as NRC's Industrial Technology Advisors, DRIE, industry associations, federal and provincial research organizations, etc. The home base could also assist clients in making contact with the appropriate post or posts, and also in tapping mechanisms such as the Catalytic Seed Fund to fund the visits of experts for on site investigations, to follow-up their initial information requests. The home base would also provide an institutional memory of the contacts made through this process. Most important, it would monitor the work load on each science and technology office and ensure that adequate resources are provided.

Resources required

It is important that the home based be staffed with the kind of people that would have credibility in the eyes of the clientele. The qualifications required would be similar to those for NRC's Industrial Technology Advisors: "A university degree in engineering or science with a minimum of 8 years of relevant industrial experience, good organizational abilities and a good knowledge of Canadian industry". Some of these technological experts could be recruited on secondment from industry or from other government departments and agencies. In order to achieve good institutional memory, however, some degree of permanence in the staff would be

desirable. At least one of the technical personnel should be a former science and technology counsellor.

A data base development officer would catalogue information received from abroad in a large microcomputer (or a small mini computer). Users would access the data base through terminals placed in this Department and in other organization, such as CISTI. Outside users could access the data base either via a telephone coupler and an auto-answer modem or by personal contact with the personnel of the home base.

The home base should also possess the capability of handling certain other post-originated activities, such as foreign technologies available for licensing, investment inquiries, etc. These items should be directed by the home base to existing domestic networks, such as DRIE's Regional Offices and provincial governments, and are not expected to constitute a large fraction of the workload of the home base.

It is estimated that a staff of eight would be required to provide the level of service attributed to the home base. These qualifications would be distributed as follows:

a. 4 technology experts;
b. 1 information cataloguing expert;
c. 1 licensing and investment expert;
d. 2 support staff.

For the operation of the home base a budget of $115,000 would be required to be used as follows:

Computing Facilities	$40,000
Printing and Distribution	$15,000
Promotion Activities and Travel by the Home Base	$20,000
Travel to Canada by Science and Technology Counsellors and Technology Acquisition Officers	$40,000
TOTAL	$115,000

The travel funds for the science and technology counsellors and technology acquisition officers would be used to bring some of them back to Canada each year to participate in suitable gathering of industry groups and to visit organizations in Canada in order to increase contact between the personnel abroad and potential clients in Canada.

Summary

The tasks of the home base are

a. to provide support for the science and technology offices abroad in concert with the geographic bureaux;

b. to prepare, through the use of an advisory committee, an annual prioritized "shopping list" of our technological information needs from abroad;

c. to assess information received from abroad, to distribute this information making use of existing domestic channels and to maintain an institutional memory, through the use of a computer data base, of these reports and follow-up activities based on them;

d. to promote the use of the network by small and medium-sized Canadian companies through a selective "marketing" programme;

e. to manage the use of the funds set aside to support foreign technology acquisition activities by the private sector (see following section).

E. Funds to Support Foreign Technology Acquisition Activities

The recently released Report of the Standing Senate Committee on National Finance entitled "Federal Government Support for Technology Advancement: An Overview" stated that "grant and contribution programs to support research, development and innovations should be responsive to the needs of industry and the market place", and also that "Diffusion of technology is the most important element of any technology strategy. The government should increase its efforts, in co-operation with universities and the private sector to strengthen mechanisms for collecting information on foreign technological developments and for disseminating it within Canada." One of the factors that inhibits the activities of small Canadian companies is the shortage of uncommitted risk capital. A useful government mechanism to promote the access of these companies to up-to-date foreign technologies would therefore appear to a readily accessible source of funds to encourage them to undertake technology scouting trips abroad.

DRIE is considering the extension of its Program for Export Market Development (PEMD) to support activities to explore technological applications, major product process innovations and organizational and managerial innovations, which could enhance their productivity and competitiveness. It would appear, however, that an extension of the Catalytic Seed Fund (CSF) would be more appropriate. The CSF was established to stimulate international collaboration in science and technology, and supports a range of activities for this purpose, including "missions by individual experts to collect information an emerging technological opportunities of interest to Canada". Extension of the coverage to include missions to investige and/or acquire "best-practice technologies" and relaxation of the existing constraint regarding sponsorship by a federal department or agency should make the extended CSF a useful source of funds for small Canadian companies.

Small Canadian companies generally complain about "the slowness of evaluation, processing and payment procedures of government programs". The CSF has minimized the evaluation process by using as a basic criterion the degree of commitment of the organization to the proposed activity. It normally reimburses only the travel costs, with the participating organization paying for living expenses.

Structure of an extended CSF

One question that needs to be examined in more detail is whether or not a separate category of the CSF should be created for direct utilization by the private sector (CSF-B), with the present CSF continuing to support government-industry initiatives which require sponsorship by a federal department or agency (CSF-A). To date the CSF has proven to be a useful vehicle for encouraging government-industry cooperation in international collaboration, and perhaps should continue to be used for that purpose, as well as for purely governmental purposes. The creation of a second category of the CSF would not only ensure that a portion of the funds would remain available for the original purposes, but would also highlight the private sector orientation for the bulk of the funds.

Resources required

It is estimated that a fund of $1.25 million would be adequate, to be utilized as follows:

10	major missions (approximately 10 members) average cost $25,000	$250,000
500	individual visits and minor missions average costs $2,000	$1,000,000
	TOTAL	$1,250,000

During the first year, it may not be necessary to have this total amount. Past experiences show that there is a gradual increase in the use of such funds as the number of satisfied clients grows.

F. Industrial Technology Fellowship

One of the more effective methods of technology transfer is through the movement of people. In top rank U.S. technologically oriented universities there are always a significant number of Canadian students. A systematic program of attracting a number of these students into Canadian industry upon graduation would be one method of promoting the flow of U.S. technology back to Canada, not only in the form of the know-how possessed by the students themselves, but also indirectly in the form of the contacts established by these students.

It is therefore proposed to offer, on a trial basis, a handful of industrial technology fellowships that would allow these students to act essentially as industrial technology advisors in training in the National Research Council system. Working out of offices located in appropriate Consulates in the United States, they would establish contact with potential industrial clients in Canada and provide assistance to them in acquiring U.S. technologies in their own areas or expertise. Fellowships would be tenable for one year, a period of time that would be sufficient for the recipients of the fellowships to find suitable employment in Canada, where they could continue their linking role.

Resources required

It may be possible to use an existing program for the fellowships, namely, NSERC's Industrial Research Fellowships, which was created "to encourage highly qualified scientists and engineers to seek careers with industrial organizations in Canada". If it proves to be possible to use this source, the only additional resources required would be the provision and furnishing of offices and support infrastructure and a budget for travel. Total estimated cost for five fellows would be in the neighbourhood of $50,000. If, on the other hand, the amount of the Fellowships themselves must also be provided, then an additional $125,000 would be required.

Part II - Foreign Policy Considerations

A. Technology transfers and East-West relations

East Block countries have little to offer us in the way of technological and industrial innovation. Because they lag behind the West economically, they tend instead to be eager customers for our innovations. This presents problems in relation to:

- competition among western nations to sell their technologies to these countries;

- the requirements of allied security which, particularly because of the potential military applications of certain products and processes developed in the West, could be threatened by a massive, blind transfer of new technologies.

The debate over these problems has troubled the American administration for some time and has affected its relations with its allies to the extent that, on several occasions, foreign participants have been excluded from seminars and symposiums held in the United States - even in the universities - on subjects considered sensitive. Needless to say, such restrictions give American firms an edge in areas where they have exclusive knowledge.

As early as 1950, a paper prepared for NAMRAD mentioned the commercial restrictions on joint ventures in the military field.

> "Firms of all countries are reluctant to release detailed information to firms of other countries unless some commercial agreement is arranged. How patent and proprietary rights are to be protected in the context of full collaboration is a serious problem. Unless there is a complete link on a firm-to-firm level for each weapon* considered for cooperative action, and a readiness to make available expertise which is in the possession of industry, the opportunity for valuable work will be sterilized."
>
> * ("Weapon" could be replaced by "product/process.")

The Corson Report was commissioned by the Academy of Sciences and the US Department of Defense in 1982 to clarify circumstances in which such restrictions would be justified - and to which they would be limited. As expected, in so changeable a field, directives can be issued in only the vaguest of terms, thereby satisfying no

one. Nevertheless, their interpretation must be carefully monitored to have an accurate idea of the commercial impact of the acquisition and marketing of products and processes incorporating American technologies.

Even indigenous Canadian technologies that mark Canada as a world leader can be affected by security considerations.

> "Canada has significant indigenous high technology production capabilities and research establishments. For certain branches of industry: communications, remote sensing, submersibles, avionics and aviation, Canada is considered to be among the world leaders. A host of relationships and inter-connections between Canadian and US scientists and technicians, stemming from the HYDE PARK 1941 Arrangements, allows for the two-ways flow of otherwise controlled goods and techniques without the need for export licences. Furthermore, special bilateral trade relationships like the Defense Productions Sharing Agreement and the widespread parent-subsidiary relationship of US corporations and their Canadian subsidiaries have given rise to a large cross-border flow of high technology."

Obviously, this cross-border flow would be affected if our neighbours suspected us of laxity. It is important to note here that the restrictions apply not only to bilateral trade but to multilateral trade involving third-party countries. The transfer of technologies to an eastern country, whether made directly or indirectly (as through a neutral country or a non-member of COCOM) has the same impact on security.

> In the recommended new internal system for handling technology transfers, it will be important to establish contact with the services in charge of implementing the directives approved by COCOM. These directives were revised this summer after two years of intense inter-allied discussions. Like the recommendations of the American Corson Report, they are open to interpretations which will have effects on inter-allied exports and competition in eastern markets, and on political relations between the United States and its allies. We must have the capability to interpret these directives and put them in practice in our own best test political and economic interests.

B. Technology transfers and North-South relations

Here again, we would be well advised to state our objectives clearly because of the very real opposition between productivity and employment: the more technology we export to Third World countries, particularly NICs, the more jobs we will be exporting for the mass production of new products using new processes. At present, Canada is content with her exports to relatively solvent markets; however, these markets may well substitute domestic production at a lower cost, once they have mastered the technological knowledge they are importing.

The IDRC is the major agency of technology transfers to the Third World, but a significant contribution is also made by Canadian engineering firms working in the Third World on their own or on behalf of CIDA. Together with the CCC, these companies are responsible for an ongoing transfer of knowledge, not without considerable profits. However, while industrial development programs in the Third World yield immediate benefits to many Canadian firms, we must accept that any medium-term job creation will take place in the the Third World rather than here. Whereas, in the long term, we neither need nor want to create or maintain the sort of low-paying jobs that do not meet our domestic requirements.

Exporters can profit immediately by disseminating in the Third World technologies that, while no longer considered advanced for us, will create jobs in the less industrialized nations, with the immense needs of their growing populations. Unfortunately, a lack of Canadian trading houses forces our manufacturers to deal through foreign houses (Plessey, Marubeni, Phillips), so that once the products derived from these technologies are in great demand in populous consumer nations, the export profits will no longer revert to Canada but go to the country of origin of the trading house. The result will be not only the loss of sales, but loss of jobs in the medium-term to those countries where mass production for mass sales will take place.

This underscores the need:

a. to encourage Canadian firms acting as transfer agents through their work in the Third World to broaden their activities for the benefit of other innovative firms;

b. to promote the establishment of truly Canadian trading houses so that the profits from marketing and eventually from the jobs

created by the long-term use of Canadian innovations will be kept in Canada.

C. The importance of the American market

Although in recent decades, the Japanese have marketed innovation more successfully and rapidly than the Americans and productivity has declined relatively more quickly in the United States than in any other western nation, two or three important points must be kept in mind:

(a) Invention is still mainly American, even though innovation (the manufacture of new products or the use of new processes) is less so.

(b) There is a very high propensity to import in this sector. Our official statistics show that 90% of firms that have imported a process or product from another country will continue to do business with that country.

(c) Since Canada, along with Australia, is the only country without an open market of 100 million inhabitants, it is becoming increasingly dependent on its neighbour to the south to buy its products, while the European market becomes more continentally centred and Japan invades the Asian markets.

Private industry is well aware of this situation. A CATA survey reveals that 96% of the organization's member firms consider the United States to be the important market and that 46% of these companies make over half of their sales to the Americans. It comes as no surprise that 88% of these firms are in favour of the idea of a free trade zone in their sector. Two thirds (62%) recommend such a zone. They see it as a means of gaining access to a vast market and also as an opportunity to import advanced technologies as soon as they come on the market. The most striking figure is that virtually all (96%) of these high technology firms import hardware, components (chips) and computers from the United States. (We would note in passing that half of these companies consider the Canadian government to be as protectionist as Congress!)

It is difficult to fight such realities. A policy of barriers, substitution or redeployments could well be ineffective, at least in its efforts to prevent such a continued, massive transborder flow. What is more,

the fear of reprisals would be such that some Canadian companies could be expected to become Americanized rather than comply with such a policy.

Diversification - seen as an extension rather than a substitution - is not easy. Europe uses strong measures to protect itself against the importation of foreign technologies and blocks joint ventures with Canadian sources. It is extremely difficult to negotiate with the Europeans, particularly the French, without having the division of benefits turn into a one-sided arrangement where the Europeans reserve jobs, production and marketing for themselves. Their system of protection goes beyond GATT provisions, no longer consisting of tariff barriers or even non-tariff barriers (such as the policies applied brutally on occasion by the French), but simply of what one Canadian businessman and exporter has termed "chauvinism." "If it was not invented here, it is no good," or "We will buy the prototype, but only to discover the secret."

Meanwhile, despite the hundreds of protectionist bills passed by Congress, the American market remains open. Still better, the Americans are willing to sell foreign products to themselves and a number of specialized agents are prepared to support Canadian exports in the various regions.

This absence of political and cultural barriers and our common language still make the American market irresistible, particularly for small Canadian companies. Consequently, the problem will remain to take a serious look at:

- the possibility of a free trade zone;
- bilateral deregulation to give our firms continued access to both investment and imports and exports.

At the same time, the lack of qualified administrators and especially market-oriented managers greatly increases the demand for American managers trained by the large multinationals.

> "Although no quantitative evidence ... is possible, what scanty evidence there is appears to confirm the common belief that most h.t. entrepreneurs get their start as spinoffs from established h.t. companies."

and

> "Whichever way one looks at it, a world of freer trade favours multinational or global enterprises."

As soon as a Canadian company sets about making innovations or decides to modernize and improve its competitive ability, there is a very strong tendency to recruit American managers. There are claims that the obstacles which our immigration services place in the way of "importing" these managers hinder the modernization of Canadian companies, particularly from a commercial standpoint.

It is important therefore:

- to continue examining investment policies (especially the tax incentives) that can attract American risk capital; and

- to study ways of attracting to our companies managers who can gear production to the search for new markets.

Our penetration of the American market is still limited in large measure to the Northern Tier and the remaining two thirds of the country are the wealthiest. The American market is therefore the most important to our industrial development, but it is also unique. Certainly, it is not surprising that the recommendations for extending our technology acquisition system to the United States differ from those for obtaining access to the European high technology market. The conditions for investigating and for marketing new technologies are different.

When it shall consider the numerous Reports on these questions, for instance, that of the Senate Standing Committee on National Finance of August 1984 - on Government support for technological advancement, the Government might well consider how rapidly the demand for technology acquisition services has risen, particularly on this continent. So the present recommendations for new resources should therefore be considered as just a starting point and those for material and financial support should be taken as designed to compensate for the very modest request for human resources.

ANNEX A: CONSULTATIONS

I. Public Sector (not including consultations within External Affairs)

Association of Provincial Research Organizations
G. Bertrand, President

B.C. Ministry of Industry
G.A. Smallenberg, Executive Director, Trade and Industry

B.C. Ministry of Universities, Sciences and Communications
Dr. P. McGeer, Minister

B.C. Research
T.E. Howard, Executive Director
Dr. M. Smith, Head, Division of Physical Technology

Canadian Commercial Corporation
R.E. Pedersen, Vice President, Planning

Centre de Recherche industrielle du Québec
G. Bertrand, Président et directeur général
G. Handfield

Department of Communications
D. Kelly, exchange officer from Autralian Department of Communications

Department of Consumer and Corporate Affairs
R. Gagnon, ADM, Corporate Affairs
M. Leesti, Deputy DG, Intellectual Property
L.A.W. Hunter, ADM, Competition Policy
M. Andrieux, Director, Economic Analysis and Policy Evaluation
D. McCracken, A/DG, Policy Research

Department of Energy, Mines and Resources,
Dr. J.E. Harrison, Senior Science Advisor, Earth Sciences

Department of Finance
Honourable Roy MacLaren, ex-Minister of State
F.W. Gorbet, ADM, Fiscal Policy and Economic Analysis
L. Farber, Assistant Director, Tax Policy and Legislation
A. Brossard, Director, Compliance and Administration, Office of the Inspector General of Banks
D. Gélinas, International Economic Relations

Department of National Defence
Dr. G.L. Nelms, Deputy Chief, Research and Development (Laboratories)
D. Knowles

Department of Regional Industrial Expansion
J.C. Oliver, ADM, Policy
D. Haggarty, Trade Focal Point
D. De Melto, DG, Office of Industrial Innovation
T. Stone, Director, Technology Assessment
E. Payne, Director, Policy and Program Development
Dr. R.H. Bower, DG, Policy, Planning and Analysis
L. O'Toole, Federal Coordinator, Ontario
J. Blackwood, Regional Executive Director, Ontario
R.M. Dodson, Regional Executive Director, B.C.
J.P. Campbell

Discovery Foundation
H.E. Kelsey, Vice-President

Embassy of Denmark
H.E. Hetting, Counsellor

Embassy of Japan
K. Omori, First Secretary

Federal Business Development Bank
B. Lavigueur, President

FIRA
G. Dewhirst, DG, Policy, Research and Communications
A. Abonyi

IDEA Corporation
Dr. B.E. St. John, President
L. Robinson, Vice-President, Technology Transfer and Licensing
R. Perry, Director, Policy Analysis

International Development Research Centre
J. Mullin, Vice-President, Collaborative Program

JETRO
Y. Teramoto, Director
R. Ulmer

Ministry of State for Science and Technology
Dr. L. Berlinguet, Secretary
J. MacDowall, Senior Science Advisor, International Affairs and Trade
R.A. Gillis, Director, Assessment
Dr. D.W. Henderson, Director, Strategic Analysis
Dr. R. Reenstra-Bryant
A. Millington

National Research Council
K. Glegg, Vice-President (Industry)
Dr. W.M. Coderre, Executive Manager, Industrial Development Office
Dr. S.S. Grimley, Industry Policy Analysis
Dr. B. Gingras, Vice-President (External Relations)
P. Beaulieu, Director, International Relations

Ontario Ministry and Trade
P. Barnes, ADM, Innovation and Technology Division
A.H. Williamson, Manager, Product Development Section, Industry Division
H.R. Nellis, Product Development Consultant

Ontario Research Foundation
T.E. Kingry, Manager, Corporate Communication

Royal Netherlands Embassy (Washington)
J.W. Vasbinder, Attaché for Science and Technology
H. De Hullu, Assistant Scientific Attaché

Science Council of Canada
Dr. S. Smith, Chairman
Dr. D. Read, Science Advisor
T. Lee
S. Mills

Statistics Canada
R.B. Hoffman, Director, Science and Technology Statistics Division
H. Stead, Chief
B. Mercereau, Financial Flows and Multinational Enterprise Division

Visual Information System Development Association
Dr. M. Kawahata, Managing Director and Chief Engineer

Countries studied under contract with U. de Montréal:
Finland, France, FRG, the Netherlands, Sweden, UK.

Canadian Science Counsellors

Current: Dr. B.K. Bhaneja (FRG)
W. Cockburn (USA)
P. Eggleton (Japan)
J.M. Ghent (European Space Agency)

Former: P. Beaulieu (Belgium)
Dr. L. Berlinguet (France)
Dr. R.H. Bower (Japan)
V. Caron (France)
W. Greenwood (USA, UK)
Dr. J.E. Harrison (USA)
J. MacDowall (USA, Japan)
Dr. A. Watanabe (Japan)

II. Private Sector

Association of Canadian Venture Capital Companies
M. Kostuch, Vice-President

Bell Canada
J. de Grandpré, President

Canada Wire and Cable Ltd.
B. Ness, Chairman and Chief Executive Officer

Canadian Advanced Technology Association
R.S. Long, Executive Director

Canadian Exporters Association
F. Petrie
Task Force on Trading House
T. Burns, M. Reshitnyk, D. Goldfield

Canadian Industrial Innovation Centre
G. Cummer

Canadian Manufacturers' Association
G. Hughes
G. Lloyd

Carleton University
Prof. L. Mytelka, Dept. of Political Science

M. Coté, avocat, représentant des sociétés
montréalaises: Alcan, Bombardier, etc.

Dyname
L. Fournier, President

Gelda Scientific and Industrial Development, Inc.
Dr. C. Sen Gelda, President

Glenayre Electronics
Dr. K. Deering, President

Leigh Instruments
J. Shepherd, Chairman

KBS
B. Henderson, President

Lomar
L. Eckerbrecht, President

MacDonald, Dettwiler and Associates, Ltd.
Dr. J.S. MacDonald, Chairman
W. Dettwiler, Principal Engineer
M.N. Prentice, Sales Manager

Mobile Data International, Inc.
F. Rasul, Vice-President, Marketing

MPB Technologies
A. Waksberg

Microtel
M. Franklin, President
J.F. Martin, Vice-President, Canadian and Offshore Sales

Miller Communications
A. Miller, President

NEI (Canada) Ltd.
B. Hercus, President and Chief Executive Officer

Noranda
A. Zimmerman, President

Optotek Ltd.
Dr. D.I. Kennedy, President
P.G. Wareberg, Vice-President, Operations

Hon. Maurice Sauvé, ancien Ministre, directeur-
Barclay's Bank consultant, ex-Power Corp,
Bathurst, Nesbitt-Thompson

Sharwood and Company
G. Sharwood, President

Stargate Consultants, Ltd.
T. Clarke

Ultra Lasertech Inc.
Dr. R.A. Crane, President

Université de Montréal
Prof. G. Schroeder-Gudehus, Institut d'histoire et de sociopolitique des sciences
S. Mills
J. Fortier

University of Toronto
Prof. A.E. Safarian, Dept. of Economics

Ventures West Technologies
M.J. Brown, President

Waterloo University
Dr. D. Wright, President
A. Headlam, Director of Research Services,
Waterloo Research Institute
E.B. Cross, Executive Director,
Waterloo Centre for Process Development

Wilfred Laurier University
Prof. Overgaard

ZZ International
Z. Zeman, President

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ANNEX C: TASK FORCE PRELIMINARY REPORT

(May 30, 1984)

Canada Canada

ETD/A.Watanabe/6-1068

TO/À •DMT

FROM/DE •
CCBX

REFERENCE/RÉFÉRENCE •Termes de Référence ETS-0613 April 18, 1984

SUBJECT/SUJET •System for the Acquisition of Foreign Technology

Security/Sécurité	
Accession/Référence	
File/Dossier	
Date	May 30, 1984
Number/Numéro	ETD-087

ENCLOSURES
ANNEXES

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The purpose of this memorandum is to bring you up to date on the activities of the Department's Working Group on the Technology Inflow Study, since its commencement on April 16, 1984, to summarize the issues involved and to indicate to you where we appear to be heading.

BACKGROUND POINTS

2. Canada's science and technology policy recognizes as one of its primary objectives the strengthening of the Canadian economy through the development of new technologies for producing goods and services and the widespread adoption of new and existing technologies. Recent government reorganizations have placed squarely on our Department the responsibility for carrying out the external relations to enhance domestic economic development; the systematic and effective acquisition of foreign technology is one aspect of this broad area.

3. The Cabinet Decision 388-82RD(C) of July 28, 1982 encouraged the more vigorous use of carefully chosen international collaboration in science and technology (S&T) as a means of enhancing the achievement of Canada's economic development goals and established the Catalytic Seed Fund to support the process of identifying and initiating collaborative international S&T activities undertaken primarily to meet Canadian economic development needs. After a year of operation the Fund is proving to be a useful tool and to-date has been used primarily to underwrite the costs of bringing together Canadian experts from industry, the universities, and provincial and federal governments, as well as the costs of sending exploratory missions by small groups of experts in selected technical areas to selected target countries (e.g. a biotechnology mission to Japan).

EXT 407

4. Last November the Science Council of Canada and the Department jointly hosted a workshop to examine, and to consider new approaches to the operation, of Canada's existing Science Counsellor system. It was noted that approximately 95% of manufacturing technologies are diffused to Canada from abroad, so that it is most important that our intelligence on foreign technology is complete and up to date. Canada's existing science counsellor system plays a role in this process of gathering intelligence on foreign technology; to date, however, the clientele has come primary from the federal governmental sector. The Science Council has undertaken a review of the system; its report is expected to be completed this fall.

5. The National Research Council's Industry Development Office has approacned this Department with a draft proposal of its own system for the acquisition of foreign technology for use by Canadian industry. NRC already has programs in place to assist industry with new technology, and proposes to use these programs as the delivery system to industry. NRC industry proposes to post some of its Industrial Technology Advisors abroad to act as facilitators in the technology acquisition process. The Department of Regional Industrial Expansion also has an interest in this subject, insofar as it is susceptible of industrial applications, as well as the Ministry of State for Science and Technology, in its role of providing advice on scientific and technological policy matters to Cabinet.

Factors

6. In other countries, we have: a) science counsellors; b) trade officers. The former have numerous responsibilities that do not allow them to concentrate on the acquisition of advanced technologies, while the latter's activities are geared to exportation, although in practice acquisition involves importation.

1. A system of technology attachés should meet two needs:

a) facilitate contacts between Canadian firms and foreign innovators;

b) point to developments of value to Canadian industry in these fields.

2. The information gathered through this system should be kept and used in our posts and at headquarters.

a) In our posts abroad, the technology attaché must obviously work with the trade services, which are responsible for facilitating contacts between Canadian enterprises and firms in the country of accreditation and making use of those contacts. (Note that we are referring here to importation rather than exportation, although the parties involved are sometimes the same.)

b) The network must be backed by a base in Ottawa. Setting up a base involves not only our Department, but DRIE, MOSST and NRC, whose task it will be to disseminate information and put Canadian companies in contact with foreign sources. (We intend to contract out this particular study.)

3. At home, the sometimes very active role of the provinces in industrial development of research must be taken into account. We intend to alert the provincial services that provide support for research and innovation (centres of strength) and to establish links with them through the "home base."

Consultations

7. The Working Group has consulted informally at the working level with officials of NRC, DRIE, MOSST, and the Science Council, as well as with two of the private contractors that carried out the surveys of users for the Science Council study. We have also launched discussions with TFB and EFB on the links between this new service to be provided for Canadian industry and the trade services; these discussions will be pursued further. It is intended to consult in the near future with other interested

federal departments, with provincial research organizations, and, through contracts, with a cross section of the industrial community, particularly with the small and medium-sized companies that are expected to be the major users of the proposed service. Selected foreign embassies in Ottawa and Washington will also be queried as to the existing practices of their respective countries.

Preliminary Recommendations

8. Based on consultations to date the Working Group makes the following preliminary recommendations:

(a) The acquisition system

(i) that the science counsellors and their staff be specifically tasked to act as agents abroad in the process of acquiring foreign technology for use by Canadian industry, with the intelligence and information gathered by them followed up by visits of technical experts, as necessary, and that the designation Counsellor (Science and Technology) be adopted to reflect this emphasis.

(ii) that a number of new science counsellor posts be established and the existing (6) offices be expanded, through the addition of qualified locally engaged technology officers or Canada-based technology attachés. The latter is much more difficult to obtain (person years are scarce), more costly and the former has the advantages of language knowledge (important e.g. in Japan, Germany, Sweden) and knowledge of the local markets.

(iii) that, at the same time, the technology analysts be linked to the Economic and Commercial Divisions of our Embassies, who could provide knowledge of Canadian industry and its needs, explore joint venture possibilities and insure continuity in the contacts.

(b) The delivery system

(i) that existing domestic networks, such as those of NRC, DRIE and line departments,

and provincial research organizations be used for marketing the services of the science counsellors to industrial users and for the targetted delivery of the intelligence and information obtained by them.

(c) the central unit

(i) that a central unit be created to act as the focal point for international S&T matters and policy development, to manage the science counsellor system and to coordinate, in consultation with geographic bureaux, the demands on the science counsellors' services in the technology acquisition process.

(ii) that the central unit be staffed by technically qualified staff from the Department, from other federal government departments and from industry.

(iii) that adequate consideration be given to the career development of technically qualified staff in the central unit and in our Embassies abroad, including the possibility of using the central unit as a pool of former and future science and technology counsellors and attachés. Some of these could eventually come from the TCS, especially where export considerations (e.g. in NIC's) apply.

BRIEFING NOTE - TECHNOLOGY INFLOW

1. The Importance of Technology Inflow

- The critical importance of technology to economic growth and the increasing rate of technological change are now widely recognized at the political level. Governments now show considerable interest in technology diffusion, both in Canada and abroad (see Annex I).

- Technology diffusion into Canada and within Canada appears to occur more slowly than in most other developed countries. There is increasing preoccupation with its mechanisms and concern about the adequacy of laws and regulations of the knowledge-intensive industries.

- In studying the problem it is necessary to take into account mechanisms for the identification of new technologies (personal contact, trade journals and shows, patent searches, etc.) and for the diffusion of technology across international boundaries (the activity of multinational corporations, international trade, joint ventures, licensing arrangements, etc.).

- Factors that can influence the rate of technology diffusion include the ownership of the firm (domestic or multinational), the investment climate, and the concentration of industry. Trade associations, particularly in the service sector, should normally play a key role in collecting and disseminating information on new ideas and best-practice technology.

- More than 95% of the technology used for domestic economic development in Canada is of foreign origin, and of this amount approximately half is imported from the USA, with multinational enterprises (parent-subsidiary) accounting for 80% of the total flow, investment being the primary mode. However, the vehicle -the MNE- may be more important as a factor, good or bad.

- To many of our interlocutors, this transborder flow of technology is so fast and massive that it appears daunting: they declare it "impossible to monitor". One must wonder whether an informed government policy can evolve from this attitude.

2. The Role of Government in the Technology Inflow Process

- The principal barriers to the development of high technology in Canada are self-imposed. They appear to result in large measure from an excessively fissiparous and adversarial system. It is said that in Canada government laws and regulations are both excessive and conflicting and contribute a barrier to a well-focussed government policy on the subject.

- The federal and provincial governments could enhance the flow of technology into Canada by creating a more favourable investment climate (for example, complementary and concerted policies toward R & D, new foreign investment and joint ventures).

- The action in the field could well start with a more accurate picture of the flows. It is possible to monitor flows in various sectors (for example, it is done in defence sharing agreements). As 67% of industrial value added is in manufacturing industries, they could be addressed one by one, on a sector basis.

- The federal government can also play a role in identifying and diffusing new ideas, processes and products on a timely and efficient basis. Moreover, some sectors cannot progress without its intervention (infrastructure, defence, for example).

- A modest increase in our representation abroad (in the form of technology attachés), provided that it is coupled with a reorientation and retasking of some of the existing services, can play a catalytic role in the process of identifying and transferring technology from foreign sources. This reorientation may prove difficult and should be started on an experimental basis to allow for evaluation "en cours de route".

- Some of the existing domestic mechanisms for the support of technology development (see Annex II) can then be used for the delivery of this new service to the target clientele: the small and medium-sized companies, where more than 70% of job creation is recorded to happen.

ANNEX I: INTEREST IN TECHNOLOGY DIFFUSION

1. Within the Federal Government

The following partial list of studies currently underway within the federal government indicates the wide scope of interest in this and related subjects.

(a) Science Council of Canada - Review of the Science Counsellor Network.
- Preliminary reported expected by July and final report this fall.

(b) Science Council of Canada - seminar on Foreign Direct Investment and Industrial Development, scheduled for October 15.

(c) MOSST - Technology Diffusion
- Study of the various ways in which technology diffusion occurs to within and between sectors in Canada, and into Canada from abroad.
- One aspect that is now being addressed is an industry survey to determine the mechanisms used by firms to access technology and the extent to which these mechanisms meet their needs.

(d) MOSST - Task Force on Federal Policies and Programs for Technology Development (Wright Commission)
- To review and recommend improvements to federal policies and programs related to technology development.
- Report expected by the end of June.

(e) FIRA - Review of the 1972 Gray Report on foreign investment in Canada

(f) DRIE - Strategy papers on innovation and on investment policy

(g) External Affairs - Review of the PEMD Information System
- Series of studies on the GATT work program and negotiations, including trade in services.

(h) External Affairs - Evaluation of the effectiveness of current foreign investment activities at posts abroad.

(i) Statistics Canada - Science and Technology Indicators
- This year's version of the Indicators, due to be released in November, will contain more detailed information on technology flows than was contained in previous issues.

2. International Studies

(a) OECD Study on International Flow of Technologies
- An examination of the ways in which the international flow of technologies could be facilitated by, inter alia, joint ventures, acquisitions and licensing, what obstacles to such flows may exist and whether existing international arrangements are adequate to deal with the problems that may arise.

(b) Six Countries Programme on Government Policies towards Technological Innovation in Industry
- Study on technological information from abroad; scientific attachés and other public institutions discussed at the Six Countries Workshop, December 1983.
- Spring 1985 Workshop will focus on the international flow of technology.

ANNEX II: GOVERNMENT PROGRAMS FOR THE SUPPORT OF TECHNOLOGY DEVELOPMENT

The Federal Government provides support for technology development through a variety of mechanisms, such as grants, loans, contracts for goods and services, and tax incentives. The principal Agencies involved are DRIE, NRC and DSS.

(a) Industrial and Regional Development Program (IRDP)
Responsible Agency - DRIE

Objective - to stimulate investment to enhance the productivity and international competitiveness of Canadian industry

Mechanisms (partial list)
- dissemination of scientific or technical information
- the creation of non-profit centres and industrial research organizations
- studies on technology transfer, market research, project feasibility
- development of new technically risky projects
- modernization and expansion of existing processes and services
- industrial adaptation of microelectronics and electronics technology

Total Budget - 1984/85 - $110 million

(b) Industrial Research Assistance Program (IRAP)
Responsible agency - NRC

Objective - to support Canadian companies in their efforts to expand through new product development and to encourage applied research in Canadian industry

Mechanisms (partial list)
(i) Field Advisory Service - provides information and guidance on industrial engineering methods and techniques.
(ii) Technical Information Service - helps clients solve their technical problems and helps small and medium-sized companies keep up-to-date on new information
(iii) Contributions to projects

Total Budget - $48 million

(c) Defence Industry Productivity Program (DIPP)
Responsible Agency - DRIE

Objective - to enhance the technological competence of the Canadian defence industry in its export activities

Mechanisms - financial assistance for selected projects

Total Budget - $130 million

(d) Procurement
Responsible Agency - DSS

Objective - to promote the development of Canadian industrial R&D capability through the use of procurement

Mechanisms - Contracting-out Policy
- Unsolicited Proposals
- Source Development Fund

Total Budget (estimated) - $335 million

(e) Departmental Programs

- programs designed to assist technology development in specific industries, e.g. in energy, forestry, agriculture
- estimated expenditures $50 to $100 million

(f) University/Industry Cooperative Programs
Responsible Agency - NSERC

Objective - to promote greater co-operation between university researchers and industry

Mechanisms - research manpower awards
- research grants

Total Budget - $32 million

(g) Tax Incentives

Responsible Agency - Dept of Finance

Mechanisms
(i) Investment tax credit - Credits for R&D may be used to offset federal taxes otherwise payable
(ii) Scientific research tax credit - allows firms to transfer their tax benefits for scientific research expenditures to other firms or individuals.

Estimate total amount of tax support in 1983/84 - $900 million

ANNEX D: RECOMMENDATIONS OF SCIENCE COUNCIL OF CANADA STUDY ON THE CANADIAN SCIENCE COUNSELLORS (Final draft, October 22, 1984)

1. The Science Council recommends that, in order to respond to Canada's growing need to acquire foreign S&T information and to interact with other countries on S&T activities and issues, the Department of External Affairs increase its emphasis on S&T, further strengthen the science counsellor system and maintain that system as the principal focus for government-organized international S&T activities.

2. The Science Council recommends that the functions of a science counsellor should be to:

   a) gather and analyse information on foreign government S&T policy and program initiatives;

   b) gather and analyse information on industrial S&T activities;

   c) inform representatives of the host country about Canadian S&T activities;

   d) develop contacts and arrange visits;

   e) assist in negotiating S&T agreements, implement and administer associated bilateral activities, and facilitate cooperative activities;

   f) act as the local agent for the Canadian S&T community;

   g) provide S&T background advice to the head of post and other officials, as well as assist in negotiations related to diplomatic issues having S&T components; and

   h) assist public relations staff to project an image of Canada as a technically advanced country.

3. The Science Council recommends that, as an initial measure, the number of science counsellor unit staff be increased to a minimum of three positions per post and to four at London, Washington, Tokyo, and Bonn.

4. The Science Council recommends that the Department of External Affairs extend the science counsellor system to provide additional representation in the United States, Northern and Southern Europe, and East Asia, and that consideration be given to coverage of Australia and New Zealand.

5. The Science Council recommends that science counsellors become more deeply involved in the acquisition of both emerging and existing technologies from foreign sources by:

   a) where appropriate, coordinating their activities with those of the trade commissioners; and

   b) including on their staff and working closely with science and technology officers assigned by science-based departments and agencies to specific posts abroad to handle topics unique to their requirements.

6. The Science Council recommends that External Affairs continue to be the home base of the science counsellor system. However, in order to become an effective central unit, the External Affairs group should assume a number of functions in addition to those it now performs, including greater responsibility for expediting the flow -- in both directions -- of the S & T information that the counsellor must handle.

7. The Science Council recommends the development of a multiyear strategic plan designed to enhance the effectiveness of the science counsellor system.

8. The Science Council recommends that the principal function of the central unit be to provide for the distribution and dissemination of S&T information acquired from foreign sources.

9. The Science Council recommends that the central unit establish a public awareness program to promote the visibility of the science counsellor system within the federal government and in nongovernment sectors.

10. The Science Council recommends that the counsellors' title be changed to counsellor (science and technology) so as to reflect more accurately the range of interests and activities of these officers.

11. The Science Council recommends that the Department of External Affairs, in order to give greater emphasis to S&T, increase the level of its central S&T unit to, preferably, that of a bureau.

12. The Science Council recommends that the S&T counsellor plus staff should be identified as a separate unit and, as such, report to the deputy head of post.

13. The Science Council recommends that the current practice of departmental or agency nominations to the candidate selection process be immediately replaced by open competitions within the public service. The Council further recommends that the Department of External Affairs examine how these competitions might be broadened in accordance with the conditions identified in the Public Service Staff Employment Act to include as soon as possible candidates from industry or other nongovernmental sectors.

14. The Science Council recommends that candidates spend at least six months meeting clients, learning how information is acquired and handled, and developing a good mastery of the diplomatic process before starting their assignment.

15. The Science Council recommends that overlap at the post between incoming and outgoing counsellors be a minimum of one month in addition to the time required to make the necessary arrangements for the tour of duty.

16. The Science Council recommends that the S&T counsellor's tour of duty be for a total of three to seven years (to allow for one or two renewals of the original two-year term) and that such a period be the basis of the secondment agreement with the candidate's home department or agency.

17. The Science Council recommends that the Department of External Affairs and home departments and agencies give greater consideration to overcoming the problems of reintegrating S&T counsellors returning from assignment and to evaluating how to make fuller use of their experience.

ANNEX E: TECHNOLOGICAL INNOVATION: GOVERNMENT/ INDUSTRY COOPERATION

Excerpts from the proceedings of an International Conference held at The Hague, Netherlands, July 1978.

1. "The main influence on technological innovations is the general economic climate rather than specific government measures. While it is true that certain specific measures might result in some technological innovations, by far the overriding influence on technological innovation is the general state of the economy.

The government's essential task in providing incentives and disincentives for technological innovation is to create an environment conducive to innovation, rather than to attempt to influence innovation directly.

The government in general should act in such a way as to complement rather than to supplement or replace market forces. In some cases the government may accelerate market and commercial development."

2. "Government measures can be divided into selective vs general policies. General policies affect ther overall economy while selective policies influence a particular sector such as the German watch industry. The selective policies were seen as policies which are more accurate but at the same time more interfering with the free market economy. General policies were seen as policies which would be less efficient but at the same time less interfering, as well as leading to longer-term effects. On the other hand, little is known of the efficacy of specific policies, although several countries have experimented with measures for encouraging innovation. This area, it was believed, needs a great deal of further investigation.

Both general and selective policies have their appropriate place. The government's task is to determine the most appropriate mix of these two approaches.

In general, policies directed toward specific industrial sectors should be avoided. It is recognized that specific policies may be necessary in certain cases, but that such measures usually create concern by those sectors that do not benefit from the incentives provided by the government."

3. "The question of what government can do to push the transfer of technology has been approached many times

before. The general conclusion is that they often cannot do much. Government may be effective to a certain extent at a very low level, but not as a major movement. One example from the United States is the National Aeronautics and Space Administration (NASA). NASA established an elaborate system to transfer space technology to industry. It is generally agreed that the outcome from this technology transfer system was rather disappointing. Similarly the German government organized a system for transfering technology from institutions and large industry to smaller companies. The German government published extensive reports and had the information widely disseminated. A lot of money was spent on the program but the outcome, again, was not very favorable.

The reasons why these forced and formal technology transfer systems do not work are complex. First, the smaller companies often have limited technical resources as well as financial reserves. The technology, almost without exception, needs a major adaptations and the large costs of development are not available to the smaller firms. In addition, the major expense related to technological innovation is bringing the product or process to market and that must be borne solely by the firm which has acquired the new technology.

Another difficulty of these formal technology transfer systems is that smaller companies often do not know the procedures which they have to apply in order to work with governments. These procedures are often very complicated, expensive and time consuming. On the other hand, larger companies may have set up management teams who understand the procedures and they learn how to work with the government.

In Japan and other countries as well, the government sector is not experienced or motivated to understand marketing activities. On the other hand, the private sectors will often invest the same amount of energy and funds into marketing (and often more) than they do in research and development. In the government sector, most of the technological efforts go into R & D and none goes into marketing. Government products and processes are often "technology push" with all of the inherent dangers that have been found in previous research on innovation. It is not unusual for a completed product funded by the government to be unable to reach an appropriate market. We therefore see the absolute necessity of government to use industry in appropriate

ways and for government in turn to fulfill some functions such as basic research funding, establish technological priority direction, and other such systems that focus on "ends" rather than "means".

Unfortunately, in some countries there is still a lack of communication between government and industry. In Japan and Germany the government generally seems willing to listen and to accept advise from industry, however, in the United States that relationship is not as effective as it should be. Industry should use its informal power of influencing government. A problem still unanswered, which will become even more important in the coming years, is how large systemic innovations become introduced since nobody formulates them. This applies to environment, energy, safety, health, and urban transportation. These innovations must often be triggered by government."

4. "When government does participate in industrial R & D then politics may start to enter and the company reduces its flexibility. The company is less in control of its own fate. Projects are less adaptable and the industrial independence is often lost. The very nature of the interaction between government and industry puts a certain rigidity into the system.

With government intervention in industry it can become more difficult to start and stop particular projects as well as changing directions. On independent projects, new directions may be suggested by the events of new discoveries in science and technology. They may be very much better than the original plans. By preserving individual company freedom, the firm may enhance its ability to innovate rather than the other way around.

There are many examples of companies in the United States that, as a matter of policy, would not accept government participation in their research projects. These companies do not want to introduce any element of rigidity into their R & D plans. Some companies that are pursuing such a policy do have a very high rate of innovation."

5. "There is essentially a division in thinking between those who see a passive role for govenment and those who would like to see a more active role regarding industrial innovation. In the United States, the role of government is less than in the United Kingdom, Sweden, and many other countries. Priority consideration for

industrial innovations in the future will be placed on the consequences for employment, health, environment, safety and quality improvement from a social point of view. If we do find a way through all of this in the coming years it will be because we have developed our capabilities to innovate in many directions in a much more purposeful and more effective way."

ANNEX F: SCHROEDER-GUDEHUS REPORT - CONCLUSIONS

A comparative study was made by the University of Montreal of the functions and operation of the "home bases" of the technological attache systems now being used by certain representative countries. The specific countries chosen were Finland, France, FRG, the Netherlands, Sweden and the UK, and the following elements of the home bases were studied:

A. DESCRIPTION

1. Location in the administration

   (a) administrative authority
   (b) source of budget

2. Size

   (a) number of persons
       (i) professional staff
       (ii) support staff
   (b) equipment (documentation, data base, etc.)
   (c) operating budget

B. ROLE AND FUNCTIONS

1. With respect to the scientific attaché network

   (a) control, instructions, resources allocation, monitoring, briefing
   (b) services (scientific, legal, economic, trade - information)
   (c) mechanisms and tools (direct correspondence, meetings of scientific attaches, etc.)

2. With respect to the users

   (a) nature of the clientele
   (b) connections between the network of attaches and the users - obligatory or optional:
       (i) conveyor belt (mail box)
       (ii) screening and processing
       (iii) dissemination of the information received
             - principles (random or directed)
             - tools
       (iv) promotion activities ("marketing" the service)
             - tools

3. Others

   (a) administration of scientific and technical agreements
   (b) etc.

4. breakdown of time by activity

C. EVALUATIONS

1. by interviewees
2. others

The reports on each of the countries studied are available for viewing for interested parties. On the conclusion of the study, Prof. Schroeder-Gudehus prepared the attached paper, "Réflexions sur les caractéristiques d'un 'home base' efficace" (thoughts about the nature of an effective home base), giving her views on the possible design of a home base for the Canadian Science and Technology Counsellor System.

Thoughts about the Nature of an Effective Home Base

The objective of the study we were requested to conduct was to examine the bodies that serve as the base point - and support point - for the scientific attaché networks in several countries: their nature, location in the administration, method of operating and clienteles. The countries were chosen not at random, but on the basis of hypotheses about ways in which they resembled the situation in Canada. The idea was to see whether some lessons could not be drawn from foreign experiences with a view to making adjustments to the Canadian system.

Defining the Task

Before considering the effectiveness of the various home bases and the factors determining that effectiveness, we must clarify what "effectiveness" means in this context. The effectiveness of a home base can be evaluated only in terms of the objective of the system in general, since it is simply part of the machinery of that system. Thus it is important to know which of the functions usually assigned to the STAs are considered priority in a given country: the diplomatic function? administering co-operation agreements? collecting information? what type of information, and for whom? Those priorities are determined not through "scientific" analysis but by making political decisions. The question of clienteles is also a matter of political decision: is the STA system primarily to serve the foreign policy apparatus? the government administrations? the domestic industries? There can be no question of carrying out a comparative evaluation of the merits of that type of decision in this paper. We have already pointed out elsewhere that the systems in many countries reflect the desire - an unrealistic one - to have their STAs and the home base perform all those functions at the same time and with the same degree of effectiveness, but we have recently observed a tendency to give priority to activities that have direct benefit for domestic industrial strength: the ability to innovate, to produce and to export. For the home bases that policy translates into activities for channelling, processing, and if necessary "creating" information, whether that information is descriptions of products or processes or opportunities for contact and co-operation, identification of gaps in the market, analyses of trends, etc. If we assume that in Canada the desire to make the scientific attachés' work more effective follows that same direction, it will be necessary not only to do a comparative study of the organization and method of operation of the various home bases, but also to consider the difference in the needs they attempt to meet.

Needs

In other words, we must consider how the industrial sector in each country tries to keep informed of what is happening - and what is available - beyond its national boundaries, and to what extent industry finds it desirable to turn to the government for assistance. Apparently it is only in exceptional cases that the STAs' services are considered particularly effective in providing information on leading-edge processes or products, because of both the prohibitive degree of

specialization that would require on the part of the STAs and the slowness of communications in both directions. Problems of confidentiality also make industries hesitate to get the STA systems involved. They are afraid not only that the information obtained may be leaked, but also that the very formulation of the request will betray the nature of their current projects. Furthermore, they are only moderately interested in information that is not exclusive enough to give them competitive advantages.

As for the type of information sought, what we have heard in Canada from users and potential users confirms what has been observed elsewhere, that it would be wise not to overestimate the potential users' interest in isolated items of information near the leading edge of research and development. What may be sought is information on the status of a technology, a production sector, a market, opportunities for co-operation, etc.

Channels of Communication

However, the speed with which an STA system, and particularly the home base, can channel and process information is still important. In that respect systems with only one home base (like the Swedish one) are superior to those with twin bases. Moreover, even the former are increasingly adopting a practice that permits and even encourages direct contacts between users and STAs in posts for technical questions. The success of that practice depends on the judgment of the STAs and on the ability of the home base to keep up to date, but we can scarcely conceive of a system in which the home base considered that all information must pass through its hands.

The Roles of Government and the Private/Semi-Private Sector

At first glance, the STA system of the Federal Republic of Germany seems clearly inadequate. It is of the "two-headed" type, in which direct contacts are encouraged for technical questions but all communications must pass through the Department of Foreign Affairs, and the role of the Department of Research and Technology (which receives 80% of the information) is essentially limited to distributing the information. Since it is relayed twice, the information is not seen as circulating very quickly. However, it would be a mistake to conclude that the German users - industries having a high scientific and technical content, but also research institutes, universities, etc. - are suffering from a lack of access to international information and contacts. They obtain them without going through the government. This is true not only for firms and institutions that are powerful enough to maintain their own access systems. The large industrial associations consider that organizing this access on the international level (information and contacts) is part of the services they provide to their members. The country's "ecostructure" - including the financial institutions - works in such a way as to ensure that there are many and varied links with foreign countries that completely bypass the government structures. As for the collection of scientific and technical information per se, some public and semi-public bodies that are independent of the departmental bureaucracies also provide

dissemination services. Thus it is unnecessary, in other words, for the government to develop activities that are already being handled in one way or another by other private or semi-public authorities.

The internal organization, the cohesion of the socio-economic sectors, and the extent to which they co-operate with the government vary from country to country, depending on the individual political and cultural traditions of each. This necessarily affects the organization and method of operation of an STA system. In Canada, the economic sector seems to be too split up - and not just geographically - to permit, for example, a takeover of important elements of what is currently considered to be the function of Canadian STAs. The suggestion that the system could be privatized generally meets with a negative reaction from the potential users: there is no sectoral (private) body that is manifestly seen as being sufficiently representative nationally. Although sectoral "self-administration", which is so deeply rooted in the German political traditions, is not totally lacking in Canada, it is definitely not well enough developed to be able to take over a very large part of the operation unopposed. This observation suggests that the establishment and operation of an STA system in Canada must be carried out by the government.

The traditions attached to the political relationships between the government and the economic sectors also play an important part in the creation and operation of the Swedish system, which is attractive because of its autonomy. The system, and particularly the home base, operate with almost no intervention by the departmental bureaucracies, whose authority is felt only in the "board of management", a joint body (bringing together representatives of private industry in addition to departmental representatives) which meets only once every few months. In Sweden it is common practice to use joint bodies of this type. Thus this is a normal way to manage, not an ad hoc mechanism. It is a method of managing - and not, as is often the case in other countries, an exercise of putting up a smokescreen or making something legitimate by co-opting. However, Canada could borrow from this aspect of the Swedish system by associating with the STA system a joint body whose authority would be limited to that of an advisory board.

If co-operation between the government and the economic sectors in Canada does not seem as easy as in the Scandinavian countries, it might be advisable to examine the experience in France. It is well known that the French government does not have the easiest of relations with industry. As in Canada, the STA system in France for a long time served the public administrations and research institutes almost exclusively; as in Canada, the system is attached to the Department of External Relations. The Department of Industry and Research (or its equivalent) is the other support point; it succeeded the DGRST, and it is pushing for a more "industrial" orientation for the STA function. As in Canada, there is an obstacle to such an orientation: the potential industrial users are unaware of the system's existence or of the services it could provide to them, since in any case they are not naturally inclined to work with the public authorities. The association of former and currently active scientific attaches (AVRIST) has clearly given itself the objective of doing "public relations" work in

industrial circles, particularly the small and medium-sized businesses. In that concern the French system resembles the Swedish home base: the marketing of services is given strong emphasis in that country also.

It is significant that the driving forces behind AVRIST are former scientific counsellors who have passed over to private enterprise, that is to industry. This suggests that any STA system that is to be based on the needs of industry requires this kind of bridgehead. If there is not an appreciable number of these "defectors" in Canada, the bridgehead role could be played by some industrial associations, particularly since in that area the problems of representativity are not as acute as in the case of bodies that have decision-making power.

Location in the Institution

Where to locate the power to make decisions - decisions on priorities, on the selection of activities and operations, on recruitment, etc. - is certainly the most difficult problem to be solved. The experience in France seems to prove that attaching it to a foreign affairs department is not in itself an obstacle to effectiveness, although the industrial orientation we are essentially talking about here is relatively recent in France and has hardly resulted in any significant achievements yet. Placing the system in a foreign affairs department has advantages, not only because the STAs are then part of the diplomatic posts. It also enables the STA system and the home base to keep some distance from user circles. That distance itself presents some risks, but it is possible to protect against those risks: to ensure that the link between the posts and the users does not become a barrier, all that is required is to see that well qualified people are hired and that the home bases have adequate equipment (support staffs, documentation, machines). For the professional personnel, we can look at the British system: for each post abroad there is an officer whose special duty is to maintain liaison and provide logistic support to that post.

The practice of rotational assignments has so far caused problems wherever it has been attempted to recruit "career" personnel for the posts and the home base (it is significant that the British home base is under the authority of the Department of Trade and Industry). The rotation principle runs counter to the requirement that the personnel accumulate experience and maintain specialized knowledge. How this problem is solved depends on the flexibility available to the foreign affairs administrations.

Powers of Investigation and Initiative

The question of where to place the STA system can be answered only in terms of the attitude a government takes towards being represented abroad by more than one body. It would be inconsistent for Canada, at a time of integration, to attach its system of scientific attaches to a functional department and disconnect it from the External Affairs Department. To avoid having the distance from any pressure exerted by the users be transformed into isolation, corrective measures can be introduced: as the STAs' activities shift from science towards technology and the boundary between what is still R&D and what is

already marketing becomes increasingly vague, it seems essential to create stronger organic links between the STA system and the foreign trade divisions. An effective group for interaction would consist of commercial counsellors who have technical ability and scientific counsellors who have a clear understanding of the stakes involved in external trade. It does not appear necessary to leave that to occur only when the personnel happen to be so inclined. Recruitment should be done for that specific purpose.

Because of Canadian practices we cannot consider setting up an independent body on the Swedish model, but we could base ourselves on the British example: the interdepartmental group through which the user departments channel their requests and indicate their areas of interest to the STAs may produce directives that are not as clear as those the STAs would like to receive, but it is unquestionably a useful tool of communication for those who will use it. Admittedly, it operates in Britain under the Department of Trade and Industry, but there is nothing to suggest that the mechanism cannot be adapted to function under the External Affairs Department, which in this specific field of science and technology tends to make decisions by default or too much from the standpoint of political expediency.

The suggestions arising from this study could be summarized as follows:

- It is important to conduct a survey of the user circles in an attempt to determine not so much their opinions on the STA systems in Canada and other countries but rather their needs, particularly those needs for which they would consider asking for government help.

- The home base would be most appropriately set up under the External Affairs Department, with an organic relationship (but not amalgamation) with the units responsible for foreign trade.

- The home base should be given enough professional people (one officer per post, as in the British system) in a sufficient variety of fields, and those people should be exempted from the rotation system (at least for assignments in the areas of science and technology).

- The authority of the External Affairs Department should be clarified - and tempered - by establishing a governing and monitoring body somewhat like the British interdepartmental group.

- It is essential to set up a system for liaison with the provinces and the main users (industrial associations, for instance). That system should make it possible for those users to intervene on an advisory basis in the setting of priorities, for example, and should enable the home base to obtain their help in disseminating information and, in a more general way, in developing an interface between the system and the user circles.

Montreal, September 12, 1984
(sgd)
Brigitte Schroeder-Gudehus