Potential For International Cooperation In Information Technology R&D

Canada

Japan

Western Europe

Executive Summary Report

A Report to the
Department of External Affairs
Department of Communications
Government of Canada
and to
Participating Companies

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by

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1. Introduction

Information Technology (IT) affects most, if not all, aspects of business and personal communication. Increasingly, the technology is becoming more electronic as advances in computing and telecommunications technologies continue to be made at an unprecedented rate. Thus, micro-electronics, a high growth area on the materials side of Information Technology, continues to integrate more and more complex electronic circuitry into tiny semiconductor packages, both lowering cost and increasing affordability of products and services. Moreover, Artificial Intelligence (AI), an emerging area of Information Technology, is leading the way toward computational machines which will perceive, learn, understand, plan, decide and act within limited contexts of specific environments, situations and scenarios to achieve limited objectives. As time progresses, these limits will widen and allow greater potential, versatility and autonomy for machine assistance and automation.

The application of Information Technology to the office and manufacturing sectors alone can greatly facilitate access, product or service design, production and delivery, quality and price, and ultimately competitiveness and market acceptance.

The impetus for this project came from a joint initiative of the Department of Communications and Department of External Affairs in late 1985 to examine the potential for collaborative projects in Information Technology between Canada, Western Europe and Japan. The principal focus was to gather information from the private sector in the relevant countries and to determine, based on the information obtained, areas of mutual interest in advanced, precompetitive research. The USA was not included in this project, due to its proximity and familiarity to most Canadian industries, which makes such information readily available for most practical purposes.

The overriding goal of the project was to make information about relevant areas of R&D more readily available for identifying and fostering cooperative ventures among high technology firms at the "precompetitive" stage. Precompetitive usually refers to basic or applied research having a relatively long time frame, oriented towards a strategic initiative in a key technology area. Being relatively remote from the product decision and formulation stage, the precompetitive phase is considered ideal for developing strong professional and personal working relationships.

2. Objectives:

The basic objectives of the project were:

1) to collect information on the current R&D activities for information technology in Canada, Japan and Western Europe;

2) to identify potential partners in specific areas designated as promising for cooperation in informatics R&D projects;

3) to facilitate initial contacts and follow-up activities between interested Canadian, Western European and Japanese companies.

This report summarizes the results of three surveys and associated activities conducted for the appraisal of the potential for international cooperation in Information Technology R&D between Canada, Japan and Western Europe. There were four major reports produced for this project, together with a Data Base Users' Guide:

1) "Potential for International Cooperation in Information Technology R&D in Canada", P.J. Booth, Wescom Communications Research International, Vancouver, Department of Communications, Ottawa, 1988.

2) "Potential for International Cooperation in Information Technology R&D in Japan", A. Kwan, G. Dobbin, Department of Communications, Ottawa, April 1988.

3) "Potential for International Cooperation in Information Technology R&D in Western Europe", P.J. Booth, Wescom Communications, Department of Communications, Ottawa, 1988.

4) "Potential for International Cooperation in Information Technology R&D, Database System User Guide, Version 3.0", Wescom Communications International, Vancouver, Department of Communications, Ottawa, April 1988.

The project was undertaken as part of a broad initiative to appraise the situation and potential for international cooperation in Information Technology R&D (ITRD) on behalf of the Federal Government Department of Communications (DOC) and Department of External Affairs (DEA). The project was developed in support of the government's Technology Inflow Program (TIP) and sought to enhance the potential for Canadian research capabilities in mutually beneficial collaborative R&D activities in Information Technology (IT). R&D activities considered most amenable to cooperative efforts are those focusing on specific problem areas, the resolution of which would enable the application and commercialization of benefits to all participants. Such R&D is generally of a longer term nature; in effect, it makes up the early stages of investigation, development and trial of highly promising areas that will lead to profitable market applications. The early stages of R&D may be thought of as being precompetitive and an excellent stage in which to begin building strong professional and personal working relationships.

There were six major activities conducted as part of this project:

1) Industry seminars conducted in Ottawa and Vancouver by DOC, DEA and DRIE (Department of Regional Industry, Expansion);

2) Personal indepth interviews with selected firms in Ottawa and Vancouver;

3) A mail-out survey of 214 Canadian industry and research centres;

4) Personal interviews with 46 companies in Western Europe[1] in addition to several government departments, ministries, research centres and representatives of the European Economic Community Telecommunications Directorate (DG XIII);

5) Personal interviews with 14 selected research firms and government agencies in Japan;

6) The design, development and implementation of an electronic database (ITRD) containing the results of the various information gathering and analysis activities.

With the exception of the industry seminars and the Japan survey, all activities were conducted by Wescom Communications Research International Inc. while under contract to the Department of Communications. The survey of 14 Japanese firms was made by Mr. A. Kwan and Mr. Gil Dobbin of the Department of Communications. The industry surveys and database development were conducted under the auspices of the Technology Inflow Program (TIP) of DEA and under the direction of the Directorate of Systems and Networks (DCN) and with support from the Directorate of Systems Interconnection (DSI) of Communications Canada.

3. Defining Information Technology

Information Technology (IT) affects most, if not all, aspects of business and personal communications. It is a broad field which touches virtually all human activity and it concerns the techniques and tools for handling information. Information, acquired by the senses, processed by the mind, and retained in memory, can be represented, conveyed, and presented to other humans. Information can also be processed to create new information or imbedded in processes and materials to create goods and services for human use. These natural processes may also be accomplished, enhanced or assisted, using artifices such as transducers (acquisition and presentation), computers (retention and processing) and various media technologies (conveyance). Accordingly, Information Technology may be defined as follows:

> Information Technology (IT) comprises the techniques, tools and procedures for acquiring, creating (composing), extracting, storing (filing), retrieving, conveying or presenting information ultimately for human assimilation, understanding and utilization.

While Information Technology would cover all information media, whether tactile, aural, or visual, most current interest emphasizes the visual because of relevant progress in electronic microcomputer technology. Historically, visual media have been dominated by paper for both processing and conveyance as well as for input - output and storage. Paper is still the dominant input - output and storage medium for origination, presentation and retention despite some progressive displacement by the increasingly ubiquitous cathode ray tube (CRT) monitor or

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[1]U.K., France, Belgium, West Germany, Netherlands, EEC

television display. However, the use of paper for processing and conveyance is diminishing rapidly in favour of electronic media.

In view of the above it is not surprising that Information Technology (IT), of which communications is a major part, is a recognized instrument of social and economic change, shaping directions and levels of business and employment well into the future.

4. Precompetitive ITRD

In applied R&D, an early stage critical to success yet amenable to cooperation is the precompetitive stage in which scientists exchange ideas, approaches and experiences. This is a transitional stage where the nature of technological problems inhibiting the development of specific applications are investigated, technological solutions and approaches evaluated and trade-offs explored. Here, new products are formulated and business relationships forged. Here, international cooperation in advanced research can be significant.

5. ITRD Survey Topics

The ITRD topics were established after consultation through seminars and questionnaires with a representative cross-section of the Canadian IT industry in early 1987. Exhibit 1 presents the topic list used in the Canadian survey. (These topics were also used in the ITRD database.)

Exhibit 2 presents the revised topic list used for the detailed discussions held with the European and Japanese companies. This was derived from the results obtained from the Canadian survey. Appendix 1 indicates the relationship between the two sets of topics, i.e. the discussion guide and the database.

Exhibit 1

ITRD Questionnaire and Database Category/Topic List

1) Communications Technology

1 - Telecommunications Networking
2 - Transmission Media
3 - Modulation and Encoding
4 - Switching and multiplexing
99 - Other

2) Communications Systems

1 - Radio and Television Broadcast System
2 - Communications Satellite System
3 - Mobile Communications System
99 - Other

3) Communications Networks

1 - Computer Communications Protocols
2 - ISDN
3 - Local Area Networks
4 - Value Added Networks
5 - Broadband Networks for Video, Fax, etc.
6 - Communications Network Management
99 - Other

4) Office Automation Systems

1 - Text and Graphics Creation, Manipulation, etc.
2 - Database Management
3 - Electronic Mail and Messaging
4 - Electronic File Transfer and Decision Support
99 - Other

5) Computer Systems and Applications

1 - Image Recognition and Processing
2 - Voice Recognition
3 - Distributed and Parallel Processing Systems
4 - Supercomputers
5 - Fifth and Sixth Generation Computers
99 - Other

Exhibit 1 (continued)

6) Software Automation

1 - Relational Database Storage and Retrieval
2 - Computer Aided Education and Instruction (CAE/CAI)
3 - Computer Aided Design and Manufacturing
4 - Computer Integrated Manufacturing
5 - Computer Aided Translation
6 - Computer Aided Animation
7 - Electronic Publishing
99 - Other

7) Human-Machine Interface

1 - Intelligent Input/Output
2 - Speech Recognition
3 - Voice Recognition
4 - Visual Pattern Recognition
5 - Visual Display and Printing
6 - High Definition Television
7 - Flat Panel Display
8 - Three Dimensional Display
9 - Laser Printing
10 - Image and Sound Synthesis
99 - Other

8) Components, Devices and Materials

1 - Microelectronics
2 - Optical and Optoelectronic Devices
3 - Sensors and Transducers
99 - Other

Exhibit 2

International Cooperation In Information Technology R&D
Discussion Guide Topics List
used for
Japan and Western Europe Surveys

R&D Survey Topics

1) Image and Voice Synthesis

   a) Visual Pattern Recognition
   b) Voice Recognition

2) Dielectric Ceramic Materials

   a) Sensors
   b) Heat and Corrosion Resistant Ceramics
   c) Superconductive Ceramics
   d) Transmission (e.g. microwave 5-channel combiner)

3) Parallel Processing Systems

   a) Operating Systems
   b) Software Modules and Tools

4) Display Systems

   a) High Efficiency, High Intensity Displays
   b) Electroluminescent, Electrochromic Displays
   c) High Resolution Graphics Display Systems
   d) Wide Band Variable Scanning Colour Display
   e) Flat Panel Display

5) Light Sources

   a) Solid State Light Sources for Film Recorders
   b) Blue Lasers with Frequency Doubling for Film Recorders
   c) High Power Ultraviolet Sources for Printed Circuit Board Production, Direct-Read-After-Write (DRAW) Films

6) Expert Systems/Artificial Intelligence

   a) Intelligent Databases
   b) Tools and Techniques for Software Engineering
   c) Diagnostic Expert System Shell

Exhibit 2 (continued)

7) Printed Circuit Board Production Techniques

   a) Direct Writing on PC Laminates

8) Radar

   a) Radar Chromograph, Millimetre Wave Guide - 60 GHz Range
   b) Sidelooking Airborne Radar, Resolution Improvement, Frequency Stability
   c) High Power Coherent Power Sources

9) Videotex/Teletext

   a) NAPLPS Videotex in Korean, Chinese, Japanese and Thai Languages

10) Application Specific Integrated Circuits Development (ASIC VLSI Circuits)

   a) Transmission Systems T1, T2, T3 Carrier Systems
   b) ISDN Devices and Components
   c) Automated Design Techniques of System Level ASIC's
   d) RF Synthesizers to 400 MHz

11) Satellite Based Sensors

   a) Sensors for Topographic and Planimetric Mapping

12) Fiber Optics

   a) Intelligent Buildings System Design Techniques
   b) Small-scale Fibre Optic Telephone-transmission System for use between and within Large Buildings (direct and/or packet switched)
   c) Integrated Voice/Data/Video/Power/Control Services
   d) Integrated Interfaces (radio/telephone)
   e) 100 Mb/s Fibre Optics LAN
   f) Optical Fibre Couplers (active and passive)

*13) Telecommunications Transmission
*14) Encryption

* These items were included in the Europe survey only.

6. Canadian Industry Survey

The basic objectives of the Canada survey were:

1) to solicit interests in cooperative R&D with European and Japanese firms;

2) to identify current and future areas for R&D activities;

3) to notify Canadian companies of opportunities and possibilities for cooperative ventures in long term R&D informatics projects;

The research activities conducted in Canada served as the basis for the surveys carried out in Japan and Western Europe. Initially, two sets of industry seminars were conducted by Communications Canada, External Affairs and DRIE in Vancouver and Ottawa. The results supported the decision to proceed with a more detailed survey of R&D activities among Canadian firms. The decision was also made at that time to proceed with a more detailed appraisal of the R&D activities and interests of companies, agencies and research centres in Western Europe and Japan.

A detailed industry survey was conducted in Canada during the spring and summer of 1987. This was preceded by a pre-survey of 12 companies in Vancouver and a further ten companies in the Ottawa area. The results of that activity indicated a very strong interest in precompetitive R&D and the possibilities for collaborative efforts. More importantly, the results supported the feasibility of discussing precompetitive R&D activities and collaborative ventures with a much broader cross-section of Canadian firms.

The Canadian industry survey was conducted using a mail-out questionnaire administered to 214 companies across the country during the spring and summer of 1987. Potential respondents were given a questionnaire, a letter, explaining the study purpose, and a project description. Company representatives were asked to provide responses within a two week period. A telephone follow-up contact was made to all of the sampled companies and organizations in order to stimulate the response rate.

The results of the survey produced 76 usable responses which were subsequently incorporated into the electronic ITRD database. A further 25 companies expressed interest and asked to be kept on file for future reference.

The returns of 76 companies were a very encouraging number, given the exploratory nature of the project and the sensitivity of the information being requested. Furthermore, the project was considered a prototype for the development of other follow-up surveys and activities. All responding companies provided detailed information about their background, experience and interests in cooperative projects in precompetitive R&D with partners in Western Europe and Japan. Very definite interest in collaboration was expressed by 25 of the smaller and medium sized companies. Many of these firms indicated they lacked the necessary capital resources or existing facilities to undertake large scale

research. However, cooperation was viewed as an ideal way to assist in achieving their longer term objectives faster and more economically.

The Canadian survey results revealed several key R&D areas of interest which could lend themselves to joint or cooperative research with European and Japanese counterparts. The survey also provided a profile of Canadian firms active in Information Technology R&D and highlighted:

a) expenditures on R&D;
b) active projects;
c) experience in cooperative projects;
d) opinions about how to stimulate cooperation with foreign counterparts;
e) use of government programs and fiscal supports.

The most important result from the Canadian survey was the enthusiastic support for the development of cooperative activities between Canadian, Japanese and Western European firms, research centres and agencies. The survey investigated the specific research interests through the appraisal of eight major topic areas and 50 subtopics (Exhibit 1). This list was refined to include 12 main topics and 35 subtopics (Exhibit 2) and then was used for the Japan and Western European surveys.

The Canadian industry survey indicated that while it lacks a clear and long term strategic focus, there are several areas where cooperation would be feasible and where activities are already underway.

The main topic areas of interest included:

1) Image and Voice Synthesis/Pattern Recognition
2) Parallel Processing Systems
3 Expert Systems/Artificial Intelligence/Knowledge Based Systems
4) Radar
5) Sensors/Remote Sensing
6) Fibre Optics Components and Devices
7) Display Technology.

Other areas of interest were:

1) Natural Language Processing, Automatic Translation
2) Telecommunications Networks
3) Transmission Technology
4) Remote Sensing/Satellite Based Sensors
5) Very Large Scale Integrated Circuits/Application Specific Integrated Circuits VLSI/ASICs

Several ongoing Canadian R&D projects were also identified, emphasizing these R&D areas.

Those topics identified as not feasible for cooperation at this time were:

1) Materials, Superconductors
2) Lithography
3) Microchip Design and Sub-micron Processes

The results of the Canadian survey were used to direct the activities conducted in Japan and Western Europe.

7. Japan Survey

The survey of Japanese activities in Information Technology R&D was made in October/November 1987. At that time, Mr. Gil Dobbin and Mr. A. Kwan of the Department of Communications conducted an indepth survey of Japanese high technology companies. Their report provides a compendium of the many advanced information technology research projects being carried out in Japanese companies. The survey focussed on 14 private company laboratories and one government industry agency carrying out advanced Information Technology R&D. The R&D activities and companies information is contained in the ITRD database.

The primary objective of conducting the Japanese survey was to provide the broadest possible review of IT R&D activities in Japanese companies and to establish from that information:

1) the type of R&D activities being conducted;

2) the long term R&D interests of Japanese companies;

3) the opportunities for cooperative ventures and the specific R&D topics of interest for such ventures.

Dobbin and Kwan reported a wide range of IT R&D activities are underway in both the public and private sectors. Furthermore, they noted that Japan has given priority to R&D in order to ensure that its current position of leadership in world markets will not only be maintained but expanded.

Japanese firms were assessed as being in step with the USA in advanced research and applications for most areas of Information Technology, including AI. In active display devices and large semiconductor memory technology, Japan may even be in the lead. The authors concluded that, in general, Japan will be in the forefront of most advanced Information Technology within the next five years.

The more general findings of the study revealed that virtually all of the companies interviewed were quite receptive to the prospect of cooperative R&D in Information Technology with foreign companies, especially those of the United States and Canada. They would welcome meetings with companies to discuss opportunities and procedures for pursuing common or complementary interests and objectives.

The specific findings of the Japan survey are contained in the detailed report. However, some of the more important general findings can be summarized as follows:

1) The Japanese Ministry of Posts and Telecommunications indicated their support for cooperative ventures with Canadian companies.

2) The working environment for non-Japanese speaking persons is manageable for Canadian researchers. Most of the R&D laboratories and key management persons speak excellent English.

3) The application of Information Technology in Japan, as in other countries, continues to gain momentum and is becoming a most pervasive force in communications, computing, control, industrial production, employment, commercial and financial transactions, trade, entertainment and culture.

4) Japanese R&D in software is advancing rapidly and is now characteristically focusing on advanced AI in support of their ongoing Fifth Generation project. This is an area of considerable interest to Canadian firms.

5) Almost all 14 companies and the agency visited in Japan were receptive and open to meet with Canadian companies and explore what could be done together. Financial support for common efforts was suggested but this should not be a deterrent to further exploration. Possibilities exist in a wide variety of areas and formats and the potential for technology transfer and scientific exchanges were also mentioned in addition to collaborative industrial projects. These interests correspond very well with those of Canadian companies where the need to establish linkages for facilitating more indepth cooperative activities was also identified.

8. European Survey

The third major component of this study was an indepth survey and appraisal of IT R&D in selected countries of Western Europe. This was conducted subsequent to the Canadian and Japanese activities. The Canadian survey results were used to direct the discussions about relevant R&D areas among the Western European firms contacted during this study.

The Western European survey and assessment comprised indepth interviews with 46 companies and several government agencies and research centres located in the United Kingdom, West Germany, France, Netherlands, Luxembourg and Belgium. This also included discussions with officials of the European Economic Community representing the Eureka, Esprit and Race programs (DG XIII).

The main objectives of the European survey were:

1) to present the topics and subtopics identified in Canada to a select group of European firms and agencies and to assess the likelihood for establishing cooperative projects in information technology;

2) to identify prospective situations and partners for cooperation in precompetitive R&D ventures;

3) to collect information from the public and private sector about policies, programs, government initiatives and long term strategies for Information Technology R&D;

4) to identify and appraise various programs and activities which already exist to foster cooperation in precompetitive R&D such as Esprit, Eureka and Race;

5) to identify the general trends in IT and priorities for IT research and development;

6) to consider the structure and framework within which cooperative ventures could be encouraged.

7) to provide inputs for the electronic ITRD database;

Information technology R&D has been given a high priority across Western Europe. The importance of IT is reflected on an individual country basis as well as through the emphasis on various multilateral programs operated by the European Economic Community. Attitudes toward the prospect of cooperative ventures with Canadian companies were in general very positive. While the private sector must take the lead role in these ventures, the national governments and European Community will play an important function in fostering such developments.

In Western Europe, as in Japan, the government plays an important strategic and financial role in advancing R&D in Information Technology. Because there are many governments involved, coordination is significantly more complex and time consuming, particularly since the EEC has become so dominant. In this regard, it is vital to coordinate not only with each bureaucracy, but also with the EEC Directorates. This is essential if conflicts with existing partnerships and complications from rules of participation in multilateral programs are to be dealt with effectively.

The importance and influence of individual national governments together with the increasing influence of the European community makes it imperative for Canadians to fully understand the situation in Europe with respect to policies, programs, strategies and support mechanisms. Consequently, an important feature of the European Survey was an indepth appraisal of policies and programs for each country visited and for the European Economic Community. This provides a thorough understanding of the context within which cooperative ventures and research activities can take place. It also assists in clarifying what

opportunities there are for long term R&D and also what constraints exist for such developments.

The policy and institutional environment for IT development in Europe can be summarized in the following points:

1) Greater rationalization of government initiatives and consolidation of responsibility for information technology.

2) Encouragement of collaboration and sharing of resources through initiatives such as the creation of centres of excellence, funding of university/industry labs, establishment of technology transfer centres and information networks. Coincident with this, is the universal support for small and medium enterprises (SME's).

3) Development and specification of strategic programs to focus on national R&D initiatives e.g. CMOS technology, Integrated Broadband Communications (IBC), or Artificial Intelligence (AI).

4) The coordination and consolidation of precompetitive R&D throughout Europe and the United Kingdom within the EUREKA, ESPRIT and RACE programs.

5) Recognition of the need to develop European capabilities and markets, but also to create strategic alliances with foreign partners, principally in Japan and the U.S. In this respect, Canada is viewed as an attractive candidate because of its recognized expertise and access to the American market.

6) The European community programs are all receiving significant fiscal support from the organization and individual governments. Funding has been increased and interest in participation is very high. One significant development is the increased British interest resulting from the winding down and restructuring of the ALVEY program and its new applications orientation.

7) There has been, and will continue to be much greater interest in the application and commercialization of research results throughout Western Europe. This is consistent with the strategy of selecting key areas where resources should be directed and opportunities exploited. The desire is to become more efficient and effective in how resources are used and to utilize existing facilities, universities, government labs and research institutes in concert with those of industry.

8) While most European governments and the EEC programs support increased R&D for small and medium enterprises, private sector R&D is dominated by about twelve large firms. These large firms account for approximately 80% of annual R&D expenditures but they play an important role in supporting the activities of smaller firms throughout Europe. The extent of cooperation between small and medium sized companies is more limited than is the case with large companies. Canadian firms are relatively unknown and inexperienced in the

establishment and conduct of R&D and therefore they will have to make greater efforts to develop linkages and create awareness among large European companies.

Among the European firms there was a pervasive and positive response to cooperative projects and a desire to learn more about the Canadian initiatives in this area. The most encouraging results, where immediate opportunities for cooperation exist, were obtained in the Netherlands, France and the European Economic Community program directorate. The other countries demonstrated positive responses as well, but for a variety of reasons, further investigations and efforts will be needed to identify specific project opportunities. In all cases, government and industry will have to take the initiative in pursuing and refining R&D activities of mutual benefit to Canada and Western Europe. Effective use must be made of the Science and Technology Development counsellors at the various Embassy posts to provide the necessary interaction and ongoing liaison with European firms and agencies.

The scope and nature of the research initiatives, now being conducted in Europe, are very diverse, addressing the full range of IT topics. Areas where collaboration was most likely were:

1) Image and Voice Synthesis/Pattern Recognition: (Topic 1)*

   a) Automatic Translation
   b) Pattern Recognition
   c) Voice Synthesis

2) Parallel Processing: (Topic 3)*

   a) Transputers, Super Computers
   b) Machine Developments/Software Development of all types.

3) Display Systems and Technologies: (Topic 4)*

   a) Photo Detectors (Optical Integration)
   b) Flat Panel Displays/using Ferroelectric Crystals
   c) Electronically held Bi-electrons, Electro Luminescent Displays
   d) Thin Film Transistors

4) Expert Systems and Artificial Intelligence: (Topic 6)*

   a) Formal Methods, Expert System Tool Kits
   b) Neural Networks
   c) Software Engineering
   d) Knowledge Based Systems/Applications
   e) Network Architecture (IBC, ISDN and Fibre Optics)
   f) Computer Vision Systems

5) Application Specific Integrated Circuits VLSI and Microchip Design: (Topic 10)*

a) Sub-micron C-mos technology
b) X-ray and Chemical Lithography
c) ASICS (various types)
d) Dry Etching Techniques
e) Micromechanics
f) Megachips
g) Physical Properties for Microchip Design

6) Fibre Optics: (Topic 12)*

a) Coherent Systems, Multichannel Systems
b) Blue Lasers, Lithium Niobate Compounds
c) Couplers and Junctions for Opto-electronic Devices
d) Optic Sensors
e) Optic Star Networks/Optic Switching Techniques
f) Non-linearity in Optic Communications and Materials

7) Telecommunications Transmission: (Topic 12,5)*

a) Integrated Broadband Communications
b) ISDN Components and Systems
c) Open System Interconnection (OSI)
d) Devices for Optical Transmission
e) High Bit Rate 1.55 Microns Single Mode Fibers

8) Encryption:

a) Encryption Algorithms, Zero Algorithms
b) Smart Card Technologies
c) Programmable Smart Cards

* These refer to the discussion guide topics.

The opportunities for cooperation in Western Europe with the public and private sector are diverse and quite promising. While the dominance of the existing national programs and those of the EEC may inhibit Canadian participation in some respects, European companies are receptive to the idea of cooperation and anxious to learn more about Canadian capabilities and begin the process of defining joint ventures.

Initial steps in this process could include the specification of science and technology agreements by the government, R&D missions with industry, scientific exchanges and the establishment of research networks and information exchanges. The most important consideration however is that the initiatives of the federal government to stimulate joint ventures and cooperative projects be maintained. Dissemination of the results to the Canadian and Western European R&D community will also be critical. Furthermore, it will be necessary for industry

to provide timely information concerning their ongoing research projects, capabilities, and interests in cooperation, in order to take advantage of the opportunities identified in this report.

9. Summary and Recommendations

The results obtained from the Canada, Japan and Western European surveys, together with the preliminary information collected in Canada demonstrate the potential for matching the research topics and subtopics identified by Canadian, European and Japanese companies, agencies and research centres.

Overall, the results of the project to date have been very encouraging with only a few cases identified where cooperation and collaboration in IT R&D projects were perceived negatively or with little interest. In fact, developments in Europe support the need for greater international cooperation within their established programs and creation of new ventures on a bilateral basis. Ample opportunity exists in both cases for long term precompetitive R&D. Likewise, in Japan the spirit of cooperation and the recognized need for long term R&D development is well established. Canadian firms therefore have a good chance of creating partnerships. Smaller Canadian firms must however create awareness of their capabilities, demonstrate competence and show that they are able to support their side in joint ventures.

The most likely first steps in all cases will be the setting up of agreements, supported by national governments and the private sector, detailing their intention to support cooperative projects. This should be followed by information exchanges, missions and scientific exchanges. Numerous opportunities were identified in the course of this study in support of the latter activity. The most important and critical factor however will be the pursuit by individual companies of the specific opportunities which this project has specified. But these provide only a tentative beginning which should lead to other and more diverse ventures. Governments will have to assist in the process by providing information and expertise. In addition, the type of coordination functions and leadership embodied in the objectives of this project should help initiate the process of collaboration. Ultimately however, it is individual companies who must take the lead, demonstrating their skills, searching for adequate partners and defining longer term objectives, which will result in new R&D activities and long term initiatives.

The following exhibits provide a summary of the main areas of IT R&D activity where cooperation was identified as feasible by Japanese and European Firms. The exhibits present the relevant topics and reveal the companies expressing interest in those topics. Those topics of particular interest to Canadian companies are also identified in the exhibits.

Exhibit 3

International Cooperation in Information Technology R&D
Potential Areas of Collaboration
Japan
Topics by Company

1. Image and Voice Synthesis/Pattern Recognition *

   NEC
   CANON
   NTT
   MITSUBISHI
   RICOH
   SHARP
   OMRON TATEISI
   FUJITSU
   HITACHI
   OKI
   TOSHIBA

2. Dielectric Ceramic Materials/Superconductivity/Sensors

   NEC
   RICOH
   SHARP
   MATSUSHITA
   SUMITOMO
   OKI
   TOSHIBA

3. Parallel Processing Systems *

   CANON
   NTT
   JRC
   SHARP

4. Display Systems *

   NEC
   CANON
   NTT
   JRC
   RICOH
   SHARP
   MATSUSHITA
   FUJITSU
   HITACHI
   OKI
   TOSHIBA

5. Light Sources

TOSHIBA

6. Expert Systems/Artificial Intelligence *

IPA - SIGMA
NEC
CANON
NTT
MITSUBISHI
RICOH
SHARP
OMRON TATEISI
SUMITOMO
FUJITSU
HITACHI
OKI
TOSHIBA

7. Printed Circuit Board Production Techniques

Mainly internal use, as in SHARP

8. Radar

Under consideration, as in CANON

9. Videotex/Teletext *

NEC
JRC
SHARP
SUMITOMO

10. Application Specific Integrated Circuits Development ASICs and VLSI

NEC
JRC
RICOH
SHARP
OKI

11. Satellite Based Sensors

NEC
JRC
TOSHIBA

12. Fiber Optics *

MITSUBISHI
JRC
OMRON TATEISI
MATSUSHITA
FUJITSU
TOSHIBA

* Topics of particular interest to Canadian firms

Exhibit 4

International Cooperation in Information Technology R&D
Potential Areas of Collaboration
Western Europe
Topics by Company

1. Image and Voice Synthesis/Pattern Recognition *

   SPIN
   Transferpunt
   Dutch Eureka Secretariat
   Multihouse,Special Systems Industry
   VanDale Lexicographic
   Telenorma
   Cognitec
   CRIN
   INPG
   XCOM
   ITMI-CAP Sogeti
   Bull
   French Association for New Media
   CERISE
   K.U. Leuven
   Alvey Directorate
   Logica
   Rutherford Appleton

2. Dielectric Ceramic Materials /Superconductivity /Sensors

   Dutch Eureka Secretariat
   VDI/VDE
   CNET Bagneux
   LETI
   IMEC
   Mullard

3. Parallel Processing Systems *

   SPIN
   Suprenum GmbH.
   INPG
   Bull
   BIM
   Alvey Directorate
   Logica
   Imperial College

4. Display Systems *

Heinrich Hertz
Telenorma
LETI
Micado
Bull
Alvey Directorate
Imperial College

5. Light Sources (Lasers)

Transferpunt
Heinrich Hertz
CNET Bagneux
LETI
Alvey Directorate

6. Expert Systems/Artificial Intelligence *

SPIN
Transferpunt
VIFKA
Philips
Telenorma
Cognitec
CRIN
ILOG
INPG
ITMI-CAP Sogeti
Bull
CERISE
BIM
K.U. Lueven
Alvey Directorate
Logica
Rutherford Appleton

7. Printed Circuit Board Production Techniques

Holland Elektronica
Fraunhofer Institute
CNET Grenoble
IMEC

8. Radar

no company identified

9. Videotex /Teletex *

XCOM
Bull

10. Application Specific Integrated Ciruits Development ASICs and VLSI *

Dutch Eureka Secretariat
Holland Electronika
Philips
Heinrich Hertz
Fraunhofer
Telenorma
FTZ
CNET Grenoble
Bull
IMEC
Alvey Directorate
Plessey Research Centre
Logica
Mullard

11. Satellite Based Sensors

Transferpunt
Ministry of Industry France

12. Fibre Optics/Components /Transmission *

Philips
Heinrich Hertz
FTZ
CNET Bagneux
IMEC
Alvey Directorate
Plessey Research
Rutherford Appleton

13. Telecommunications Transmission *

Heinrich Hertz
Telenorma
FTZ
CNET Bagneaux
XCOM
SEPT Caen

14. Encryptions/ Transactions *

ITMI-CAP Sogeti
SEPT Caen

* Topics of particular interest to Canadian Firms

Appendix 1

R&D Survey - ITRD Database Topics Cross-Reference By Discussion Guide Topics

Survey	Database			Survey	Database		
1.1	7.4			7.1	8.99		
1.2	7.2	7.3	7.10	8.1	1.99		
	5.2						
2.1	8.3			8.2	1.99		
2.2	8.99			8.3	1.99		
2.3	8.99			9.1	3.1	4.1	7.5
2.4	8.99	1.4	1.3	10.1	8.1	1.1	2.99
					3.2	3.3	
3.1	5.3			10.2	8.1	1.1	3.1
3.2	5.33			10.3	6.3	8.1	
4.1	7.5			10.4	8.1	1.99	
4.2	7.5			11.1	8.3		
4.3	7.5	4.1					
4.4	7.5			12.1	6.3	3.3	3.4
					3.5	4.3	7.1
4.5	7.7			12.2	1.1	1.4	3.3
					3.4	3.5	4.3
5.1	8.99	8.2		12.3	3.5	3.3	3.4
					4.3		
5.2	8.99	8.2		12.4	1.1	3.1	
5.3	8.99	8.2		12.6	8.2		
6.1	4.2	6.1	7.1	12.6	8.2		
6.2	6.1	6.3					
6.3	6.1	6.3					
	6.1	6.3					