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Potential For International Cooperation In Information Technology R&D In Western Europe

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

DSS Contract # 36100-6-4258/01GT

by

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Foreword

Project Overview

This project was undertaken to identify opportunities for international cooperation in pre-competitive R&D in Information Technology and to help Canadian industry initiate and develop cooperative ventures. It includes:

1) the collection of information on current R&D activities in Canada, Japan and Western Europe;

2) the identification of potential partners in specific priority areas identified as promising for cooperation in IT R&D by Canadian industry, and

3) determination of initial contacts and proposed follow-up activities between interested Canadian, Japanese and Western European companies and research centres.

The project is an initiative of the Department of Communications in support of the Technology Inflow Program (TIP) of External Affairs. It seeks to enhance Canadian research capabilities in mutually beneficial collaborative R&D activities in Information Technology (IT). R&D activities considered most amenable to cooperative effort would be those focussing on specific problem areas, the resolution of which would enable application and commercialization of benefit to all the participants. Such R&D is generally of a longer term nature, in effect, the early stages of investigation, development and trial of highly promising areas that will lead to profitable market applications. This early stage of R&D may be thought of as being precompetitive and an excellent one in which to begin building strong professional and personal working relationships.

The Report

This report provides a detailed appraisal of the situation for R&D in informatics in all the major centers of Western Europe. It addresses individual countries and organizations and the multilateral programs of the E.E.C. These have become the focal point of much of the effort for European pre-competitive R&D. As a result, Canada must make efforts to be involved in these programs if they are to participate in cooperative ventures. The analysis presents a review of the R&D frameworks through an appraisal of policies and government support strategies. Detailed assessments are made for individual companies, agencies and research centers on a country by country basis. This provides the identification of technology activities, research interests and opportunities for cooperative ventures.

The report is divided into four parts. The reader is referred to the different sections depending on their particular area of interest.

Part I	Overview of the Project and the European Situation
Part II	Summary of the EEC Multilateral Programs: EUREKA, ESPRIT and RACE
Part III	Detailed Appraisals on a Country and Company Basis of Policies, Programs,Research Initiatives and interests for cooperation
Part IV	Supporting Appendices

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The author wishes to thank the individuals responsible for this project at the Department of Communications and External Affairs. In particular, Dr. Y.F. Lum and his staff Mr. Gil Dobbin and Mr. Andy Kwan were of significant help and their insight and continued belief in this work from its inception to the completion phase were invaluable. Thanks are also due to the TIP program manager, Mr. Brian Cox and to his staff for managing and coordinating the European surveys.

The assistance of the various Technology Development Officers (TDO) and Science Counsellors was critical to the success of the European survey. In particular, special thanks are extended to:

Dr. Dennis Lafeuille, TDO, Paris
Mr. Peter Whitby, TDO, London
Mr. Mark Chappell - Science Counsellor, London
Dr. Christian Lukner, TDO, Bonn
Mr. Chris Rowley - TDO, The Hague
Mr. John Pearce, Commercial Counsellor, The Hague
Ms. Brigitte Leger - Science Counsellor to E.E.C., for Canada, Brussels
Mr. Jean Marion, Science Counsellor, Brussels

The Science Counsellors and Technology Officers were responsible for arranging meetings and coordinating the itinerary throughout Western Europe. In most cases the officers or counsellors attended the meetings and assisted in the interviews. Their help, advice and support were greatly appreciated.

Special thanks are extended to the company representatives and government officials who participated in the European survey. Finally, the assistance of the staff at Wescom, Mr. Richard Smith and Ms. Esther Lam, in support of the project was very much appreciated.

Executive Summary

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

This report provides a detailed and indepth appraisal of current activities in information technology R&D across Western Europe. This activity compliments similar work carried out in Canada and Japan. The results of which, together with the details of an electronic database (ITRD database), are presented in companion volumes to this report:

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

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

This report is based on an indepth survey of forty-six companies and several government agencies and research centres located in the United Kingdom, West Germany, France, Netherlands and Belgium. The survey also included discussions with officials of the European Economic Community EUREKA, ESPRIT and RACE programs.

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 and pre-competitive 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 input to the electronic ITRD database;

In Western Europe, as in Japan, the government plays an important strategic and financial role in advancing R&D in Information Technology. In this situation, there are many governments and 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. This is essential if conflicts with existing partnerships and complications from rules of participation in multilateral programs are to be avoided.

Information technology R&D has been given a high priority in Europe. This is reflected on an individual country basis as well as through the various multilateral programs operated by the European Economic Community. Attitudes toward cooperative ventures with Canadian companies are, in general, very positive among European firms and agencies. While the private sector will play the lead role in these ventures, the national governments and European Community will play an important role in fostering such developments.

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 this report is the in depth appraisal of policies and programs for each country visited and for the European Economic Community. This should provide the reader with a thorough understanding of the context within which cooperative ventures and research activities could take place. It also assists in clarifying what opportunities there are for long term R&D and also what constraints exist to such developments.

Policies and structures for stimulating R&D and encouraging joint ventures vary somewhat across the countries examined. In all cases there is a clear recognition of the importance of IT and the need to create an environment

which is conducive to long term development. There are also major changes occurring in the strategy for development and the roles of various government departments in that process. Some of the more prevalent aspects are summarized below:

1) 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 of precompetitive R&D throughout Europe and the United Kingdom within the EUREKA, ESPRIT and RACE programs.

5) The 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 North American market and expertise.

6) The European community programs are all receiving significant support. 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 applications orientation.

7) There has, 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 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 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 will have to make greater efforts to develop linkages with large European companies, where they are relatively unknown and inexperienced, if joint R&D projects are to be developed.

The survey of forty-six companies of varying size, expertise and research interest provided insights into many aspects of the European R&D scene. There was a pervasive positive response to cooperative projects and a desire to learn more about the Canadian initiatives in this area. The most encouraging results, and where the most immediate and probable opportunities for cooperation exist were obtained from the Netherlands, France and the European Economic Community. 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 interaction and 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

* Topics refer to Discussion Guide Topics.

There are significant opportunities for cooperation in Western Europe with the public and private sector. While, to some extent, the existing national programs and those of the EEC may limit Canadian participation, European companies are receptive to the idea of cooperation, anxious to learn more about Canadian capabilities and to 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 initiative 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 be critical. Furthermore, it will be necessary for industry to

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

PART 1 - Project Overview and European Situation

1. Introduction

This report presents the results of a recent survey conducted by Wescom Communications Research International Inc. investigating current activities in Information Technology Research and Development in Western Europe. It addresses the potential for collaborative R&D in selected areas between Western Europe and Canada. The survey was done, inter alia, in support of the Department of Communications, project in International Collaboration in Information Technology R&D, i.e. the ITRD project. It also provided input to the electronic database developed as part of this study.[1]

A detailed appraisal of the situation for IT R&D was conducted in Canada as a precursor to the European survey. The Canadian assessment involved seminars, meetings, personal interviews and a mail-out survey to approximately 200 companies and research centres. The result of that activity was the identification of relevant topics and subtopics for IT which could serve as a focus for discussions about collaborative or cooperative projects. The list of topics used in the European survey is presented in Appendix 1.

A similar survey was carried out in late 1987 by a research team from the Department of Communications examining the potential for collaborative projects in Japan. A two week mission was conducted between September 1987 and October 1987 when 14 IT companies were contacted.

1.1. Purpose and Objectives

The work was done in two phases:

1) preliminary on-site briefings and initial appraisals;

2) indepth survey of European companies, firms and agencies.

The objectives of the 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 R&D ventures;

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[1]"Potential for Cooperation in Information Technology R&D, Database System, Users Guide", Wescom Communications Research International, April 1988.

3) to collect information from the public and private sector about the current state of precompetitive R&D in Information Technology within Western Europe, including policies, programs, projects and long term strategies;

4) to observe the general trends in IT and priorities for IT R&D;

5) to examine specific programs and activities which already exist to foster cooperation and precompetitive R&D such as ESPRIT, EUREKA, RACE and ALVEY;

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

7) to provide input to the electronic ITRD database.

1.2. Scope and Format of the Report

This report presents the views and observations derived from the interviews conducted in Western Europe as part of the ITRD project. It includes the results of meetings held with the various Canadian government's Technology Development Officers (TDO's), Science and Technology counsellors (SANDT) and representatives from 46 agencies, associations, institutions and firms visited in July/August, 1987.

The report is divided into four parts:

Part I	Overview of the Project and the European Situation
Part II	Summary of the EEC Multilateral Programs: EUREKA, ESPRIT and RACE
Part III	Detailed Appraisals on a Country and Company Basis of Policies, Programs, Research Initiatives and Interests In Cooperative Ventures
Part IV	Supporting Appendices.

All information contained in this section is also available in electronic format as part of the ITRD database system designed and implemented for this project.

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

Increasingly, Information Technology is becoming more electronic as advances in computing and telecommunications technologies continue to be made at an unprecedented rate. Microelectronics, the 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.

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.

1.4. 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 specific applications are contemplated, technological approaches evaluated and trade-offs explored. Here, new products are formulated and business relationships forged. Here, international cooperation in advanced research can be significant.

1.5. ITRD Survey Topics

The ITRD topics were established in consultation with a representative cross-section of the Canadian IT industry through seminars and questionnaires in early 1987. These were subsequently refined into a discussion guide for use in the European Survey.

1.6. Overview of Survey Activities

The major phase of field work activities took place in November/December 1987 as a follow-up to the preliminary phase in July 1987 when seven key meetings were held in Europe[2].

Visits for the main survey were arranged by the Technology Development Officers and Science Counsellors throughout Europe. Their recommendations were derived from the meetings and visits carried out in July as well as from a review of the documents and reports collected at that time. Contacts included representatives of large and small companies, industry associations, government laboratories, government agencies, universities, and university/industry consortia.

A total of 46 interviews were conducted in six different areas by the consultant[3] from Wescom Communications Research International. These were distributed in the following manner:

1)	Netherlands	9 interviews;
2)	West Germany	7 interviews;
3)	France	18 interviews;
4)	Belgium	3 interviews;
5)	EEC	3 interviews;
6)	United Kingdom	6 interviews;
	Total	46 interviews

In addition to these primary interviews, information was also collected from representatives of seven government organizations and three major research centres. The latter are reported at the conclusion of the section outlining programs in the U.K. Agencies or associated companies are also referenced where appropriate.

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[2]the July trip itinerary is provided in Appendix 2.

[3]All interviews were conducted by Peter J. Booth, Wescom Communications Research International Inc., Vancouver, B.C.

A majority of the meetings and discussions were conducted in major urban centres, although other sites were also visited. For example, in France visits were made in Paris, Caen and Grenoble; while in West Germany, Bonn, Frankfurt, Berlin and Darmstadt were included. In Holland interviews were conducted in Delft, The Hague, Amsterdam, Eindoven, and Utrecht. Similarly in the U.K. visits were arranged in London, Southampton, Oxfordshire and Cambridge.

The interviews were attended in almost all cases by the technology officer from the Canadian Embassy. Most discussions were conducted in English although in France and Belgium several of the interviews were conducted entirely in French. During the meetings, questions were presented in a general discussion format focusing on the nature of the organization, its characteristics, experience and interest in joint ventures with Canadian firms and agencies. The main interest was the companies current and planned R&D activities. As much as possible, the discussions were directed around the research topics defined from the initial Canadian survey.

1.7. Overview of European Situation

Interest among the European participants towards the prospects of developing joint ventures with Canadian firms was very positive. Of the 46 companies and agencies visited all had experience in precompetitive R&D, were familiar with collaboration and most indicated their desire for closer ties with Canadian companies. In several cases contacts had already been established or projects initiated. It was evident however, that projects will have to be pursued on a case by case basis and will require significant support and assistance from government organizations in Canada and Europe.

The following general observations were derived from the interviews:

1) There is a need for governments to play an active role in fostering discussions between prospective partners and providing the infrastructure for subsequent developments.

2) A requirement exists for continuous follow-up with potential partnerships, particularly at the early/preliminary planning stages.

3) Financial support will be needed for Canadian firms wishing to participate within one or more of the multilateral programs available in Europe: ESPRIT, EUREKA, RACE or ALVEY.

4) Continuous and regular updating of the information collected from Canadian and European firms will be needed in order to ensure that timely and relevant partnerships are encouraged.

5) The development and fostering of a framework, program or strategy within which collaborative R&D activities could be encouraged, similar in concept to Britain's ALVEY program or the EEC, RACE and ESPRIT programs should be encouraged.

6) Greater emphasis should be placed on establishing science and technology agreements, and negotiating closer ties with the existing European Community programs (RACE, ESPRIT, EUREKA and ALVEY).

7) There is a need for the development of a more aggressive attitude and approach by Canadian firms and agencies to pursuing R&D opportunities in Europe. Typically, Canadian firms were characterized as failing to follow through with proposals, or not spending adequate time to develop projects.

8) More detailed investigations are needed on the manner by which Canadian firms could participate in ongoing European program. This must consider the potential for financial support to Canadian participants and access to Canadian ventures by European firms.

9) Continued appraisal and assessment of Canadian and European policies for the development of longer term R&D programs and strategies will be an ongoing requirement.

R&D initiatives in Europe are being directed to a very great extent by the major multilateral programs of EUREKA, ESPRIT, RACE and ALVEY. This is even more the case at the present time than was the situation two years ago, due to:

1) the increased funding being provided to existing cooperative programs (ESPRIT funded at 1.6 billion ECU's 1988-1992; and RACE funded to a maximum of ECU 800 million on a 50% cost sharing basis per project);

2) the expansion of the number of European countries eligible for participation in the multilateral programs (EFTA members);

3) the down-scaling of funding and alteration in the scope of activities for the British ALVEY program;

4) the identification of key R&D projects which serve as a focus for cooperative efforts, either through the EEC or by private initiatives (e.g. C-mos, parallel processing, coherent systems, IBC, voice and image synthesis, automatic translation);

5) the dominance in Europe of a select group of companies capable of defining, funding and carrying out precompetitive R&D (BULL, CGE, Thomson, Nixdorf, Siemens, AEG, Olivetti, STET, ICI, GEC, Plessey, Philips, Digital, Sperry);

6) a strategic committment to the development of European expertise in informatics technologies to serve a growing domestic requirement and to become more prevalent in the international markets.

Virtually all of the companies contacted were participating in some aspect of ESPRIT or RACE. As a result, discussions concerning joint ventures or cooperative R&D initiatives were referred, in almost all cases, to those programs. Important questions were raised about how Canada could participate and the funding available to support their initiatives. Despite those enquiries, there were

generally favorable responses to Canadian partners and the potential for collaboration.

The EEC multilateral programs are now at a critical stage since proposals for the 1988-1992 ESPRIT, RACE or ALVEY activities have been solicited. These were to be reviewed in March/April 1988 with selection of successful applications expected to be announced in June/July. The successful candidates represent ideal prospects for collaboration with Canadian companies. In these cases projects have already been outlined, thereby facilitating detailed appraisals of where Canadian expertise would be most suitable and where European capabilities are most appropriate.

One important aspect to the EEC's programs is a declared interest in small and medium sized enterprises (SME's). These are defined as organizations with less than 500 employees actively involved in R&D and which have responded to the ESPRIT/RACE requests for proposals.

1.8. Topics Identified for Potential Collaboration

The principal areas of interest identified as a result of the European survey were:

1) Image and Voice Synthesis/Pattern Recognition:
   a) Automatic Translation
   b) Pattern Recognition
   c) Voice Synthesis

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

3) Display Systems and Technologies:
   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:
   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:
   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:
   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:
   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

1.9. Trends in Micro-electronics Research for Europe

A report, recently produced by VDF/VDE[4] of Germany for the FAST program of the EEC, examined the emergence of new informatics technologies and identified their importance to European industrial development. The authors made note of several relevant factors:

1) Individual development of innovations with comparatively small investments have become less frequent, with small and medium sized enterprises concentrating on applications of new technologies, i.e. product management rather than basic research.

2) A very small number of European firms and research facilities are responsible for most of the development of sophisticated technologies requiring large scale capital investment and long term research.

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[4] VDI/VDE, Key Technologies, Turbulent Changes in Industry as a Result of Innovative Dynamics, FAST, Forecasting and Assessment in Science and Technology Report 148, Directorate General for Science, Research and Development Commission of European Communities March, 1987.

3) One of the greatest barriers to the implementation of new technologies is the shortage of qualified personnel.

4) Efforts have been extensively and one-sidedly concentrated on product development. Intensification of the development of new technologies is a prerequisite for the elimination of a growing dependence on supplies of technologies located outside Europe.

5) Basic research/strategies and development activities require anywhere from ten to twenty years lead time.

In the field of micro-electronics, the following observations emerged:

1) Integrated Circuits:
Within the next five to ten years it will be possible to achieve the manufacture of structures from 1 micron to those around .2 microns. This will utilize x-ray beam lithography with advanced new materials.

2) Storage Facilities:
These will increase from the common 1-megabit storage facilities to 64-megabit capacity. Development work will require multinational cooperation due to extremely high costs.

3) Fast Chips:
Manufacture of fast chips will emerge, using extremely thin, amorphous silicon and silicon carbide layers.

4) Micro-structure technology:
Processes will involve the use of light optics, x-rays, electrons, ions, and laser beams for etching.

The superimposition of different but related materials such as gallium arsenide and gallium aluminum arsenide will lead to three-dimensional integrated circuits.

5) Surface Mounted Technologies:
Electronically conductive adhesives in the 150^0 - 170^0 range will lead to simpler and faster work cycles, energy savings, and fewer rejects with heat sensitive components.

6) Software:
The principal development areas are software engineering:
   a) tool kits and aids which perform the programming functions of software engineers;
   b) functional languages of the fourth and fifth generation computer;
   c) computer aided design and simulation programs for preliminary test evaluations;
   d) expert systems, machine translation, lexical databases, knowledge based systems.

7) Lasers:
   a) High energy lasers greater than 20W levels for use in the metal-working or chemical industry;
   b) Lasers with extremely short wavelengths to be employed in the manufacture of chips with structures under 1 micron. These can also be used in the photo-chemical process for large molecular structures such as polymers and organic tissues.

8) Sensors:
   a) Optical sensors as integrated parts of the transmission of data along fibre optic cables. This involves the coupling of optical and electronic signals in large scale networks.
   b) Chemical sensors used to probe concentrations of certain atoms, molecules and ions in gases, liquids and plasmas.

9) New Sensor Developments Include:
   a) Technologies for electronic sensors in thin and thick film technologies with integrated signal electronics on a silicon base;
   b) development of micro-mechanical sensors based on silicon;
   c) micro-optical sensors on opto electronic fibre optic or integrated optic bases, including adapted signal processing, solid state ion conductors and conducting polymers.

10) ISDN:
   a) Narrow-band ISDN using existing telecommunications networks and broadband ISDN using fibre optic facilities.
   b) Integrated broadband communications (IBC).

The EEC sponsored report raises a number of critical issues for the growth and development of informatics in Europe. The identification of key growth areas provides direction for potential collaborative efforts and gives further justification for pursuing specific technology areas. At the same time the report indicates that innovation in the high technology area and particularly micro-electronics seems to be prevalent in small and medium sized companies for product development while basic R&D and long term more strategic projects have tended to be the responsibility of a handful of large firms. There seems to be only limited potential for basic research among the SME's without fairly large scale government support. Those activities which have taken place have tended to require the development of cooperative ventures in conjunction with government labs, universities and industry. Funding requirements to support the necessary R&D initiatives in the future are expected to increase significantly over the next few years. This will place even greater emphasis on the need for cooperation and partnerships between governments, industry and universities. There is also increased attention being given to the initiatives of foreign companies and governments although at present most of the efforts are directed to the multilateral programs of the EEC.

PART II - European Economic Community Multilateral Programs

1. EUREKA, ESPRIT, RACE - Overview

Assessments of the ongoing European Community programs in information technology were made on the basis of discussions with the Science and Technology Counsellors for the mission of Canada to the EEC and interviews conducted in November and December 1987 with officials in charge of DG XIII, the telecommunications, information industries and innovation sector of the EEC. Discussions were held at the Brussels headquarters[5] of the EEC, Telecommunications Directorate with the following individuals:

1) Mr. Christopher Wilkinson, Director General

2) Mr. Spyros Konidaris, Manager RACE Program

3) Mr. Tony Knott, Manager ESPRIT

4) Mr. Nagelmaker, Manager SME, Task Force

A key part of these discussions centered on the potential for Canadian participation in the cooperative programs, available support mechanisms, funding possibilities and policies toward third party participation. The other area of interest was the various on-line database services currently developed for the Community.

1.1. EUREKA

This program was formally created at the European Technology Conference held in Paris on July 17, 1985. There are 19 European countries and the Commission of the European Communities (EEC) participating in the initiative. This includes the 12 community member states, 6 EFTA countries and Turkey. EUREKA was formally initiated in 1985 when 72 cooperative proposals were adopted costing an estimated 3.2 billion ECU$[6] over a two to ten year period.

The basic objective of EUREKA is to make Europe's research scientists and manufacturers better able to master and develop the advanced technologies needed to ensure the present and future competitiveness of Europe.

The focus of EUREKA activity is on:

1) manufacturing technologies;

2) computer communications;

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[5] Directorate General, Telecommunications, Commission of the European Communities, Rue de la Loi 200, B 1049 Brussels, Belgium,
Telephone: 322235 53 43, Telex: 21877 Comcu-B

[6] 1$ ECU = CDN$1.5

3) materials;

4) biotechnology;

5) advanced forms of transportation.

The first three categories account for 60% of the total resources to be used for EUREKA. Some of the important and more relevant characteristics of the program are:

1) companies are the principal originators of proposals;

2) EUREKA is essentially an instrument for cooperation between industries at the product development stage. About 80% of participants in the projects come from industry with only a small proportion coming from universities and public sector research centres.

3) projects are designed to encourage firm level participation, rather than government or institutional activities;

4) EUREKA is cooperative at the inter-governmental level and financing of projects is entirely a matter of the participants on a case by case basis;

5) EUREKA is mainly concerned with developing products, processes and services having identifiable market potential;

6) projects must come directly from companies without reference to a strategic program, an objective or framework defined in advance apart from the broad reference made to the field of high technology. Agreement reached on a project by a number of firms is presented to member states and checked for eligibility.

This latter point is perhaps the most significant with respect to potential Canadian participation since it is here that the nature of specific projects must be considered. EUREKA is principally a market oriented initiative, whereas much of the focus of Canadian activities is or at least should be towards precompetitive R&D ventures. However, it is also recognized that the distinction between precompetitive and market oriented research is fuzzy and therefore the classification of projects must be done on case by case basis. The critical concerns will be whether or not a project is precompetitive or product development (market oriented) and whether there are opportunities for collaboration. The important task for the Canadian initiatives will be to search within the various structures for suitable partners and collaborative opportunities.

Appendix 3 contains a summary of recent EUREKA projects along with the participants, funding and duration.

1.2. New Developments for EUREKA

In September 1987, 58 new projects were approved for EUREKA with a budget of 709 million ECU's, boosting the overall program to 165 projects with a total budget of 4,000 million ECU's. Out of the 58 new projects 20 are in the robotics sector and 11 in biotechnology. Consequently, there has been a movement away from computer and telecommunications technology.

In late 1987 questions were raised about whether or not greater direct government involvement should be encouraged in EUREKA. The general consensus supported less direct involvement and greater private sector initiatives. In contrast, France was in favour of utilizing indirect supports to strengthen individual company initiatives. It was believed the proposed measures would create unbalanced support for companies in various EEC member states, thereby leading to unfair trade practices.

The possibilities for third party participation has recently received considerable attention. At the present time formal entry is still barred to non member states. However, requests for participation have been made by Hungary and Yugoslavia but no agreement has been reached on their applications.

At present, the procedural code regarding participation has the following conditions:

1) backing of all industrial partners in the project;

2) backing of the governments involved;

3) backing of all 19 member countries.

These procedures will apply equally to all third party applicants including Canada. Discussions with the EUREKA Secretariat indicated proposals would be examined on a case by case basis and initiatives must be made at the firm level. Thus, Canadian companies with suitable technical capability and financing could pursue projects with firms from qualified countries, on a third party basis, at the present time.

1.3. European Strategic Program for Research and Development in Information Technology - ESPRIT - Overview

The European Council approved a concept known as the European Technology Community (ETC) in 1984 at the same time it agreed to support the EUREKA program. The ETC initiatives are designed to be more public sector oriented and are formalized through the European Council and enshrined in the single European Act. This stipulates the community shall adopt a multi-annual framework program setting out all its activities in the field of research and development, to be implemented through specific complementary programs developed within each activity.

Programs under the ETC of greatest interest to Canada are: The European Strategic Program for Research and Development in Information Technology (ESPRIT) and Research and Development in Advanced Technologies for Europe (RACE). These are oriented specifically to precompetitive activities, are government led, are open to all participating countries and involve national laboratories and research institutes.

1.4. ESPRIT Objectives

The basic objectives of the program are:

1) to provide the European Information Technology (IT) industry with the basic technologies to meet the competitive requirements of the 1990's;

2) to promote European industrial cooperation in precompetitive R&D in IT;

3) to contribute to the development of international standards;

4) to place more emphasis on IT applications, technology and technology transfer with particular regard to SME's; and

5) to support new applications for providing more complex and reliable systems to end users.

Projects in ESPRIT and RACE must fit into a strategic program identified in close cooperation with scientific and industrial centres. The scientific, technical and economic criteria for project selection are quite strict and designed to ensure that proposals are in line with the objectives of the program and that the best use is made of the public funds. A significant amount of control is exercised by individual member governments in the choice of programs and definition of annual work plans.

At the present time universities are involved in almost 80% of the ESPRIT projects. A recent analysis showed that on average each ESPRIT project brings together five different partners.

1) two large companies;

2) one small firm;

3) two universities or public sector centres.

Small firms account for about 40% of the industrial partners involved in the projects.

In July 1987 meetings were held in Brussels to discuss the potential areas of activity for the ESPRIT program and to consider Canada's role in those activities. A Canadian delegation expressed interest in the Information Technology and Telecommunications areas and associated opportunities. At the same time proposals were put forward regarding the ITRD project and the potential for matching partners in R&D. This was received positively by the EEC representatives who also indicated they were open to a more systematic relationship with Canada in the area of telecommunications, standards and Open Systems Interconnections (OSI).

In a more general context, discussions also dealt with the future of Science and Technology (S&T) cooperation. Proposals were put forward for both sides to explore "the furthering of cooperation" in its S&T activities including full participation at the level of programs, sub-programs or on a project by project basis. Among other points, it was agreed that increased attention be given to small and medium enterprises (SME's) and the private sector for science and technology cooperation.

1.5. ESPRIT Research Project Areas

ESPRIT projects are now being conducted in the following areas:

1)	Micro-electronics	45 Projects
2)	Software Technology	42 Projects
3)	Advanced Information Processing	44 Projects
4)	Office Systems	39 Projects
5)	Computer Integrated Manufacturing	30 Projects

Priority areas for future ESPRIT work (1988-1993) of relevance to the Canadian initiatives include:

1) <u>Advanced Components, Microelectronics and Peripheral Technologies</u>:
   a) ASICS
   b) Gallium Arsenide
   c) High Density Integrated Circuits
   d) High Speed Integrated Circuits
   e) Multi-function Integrated Circuits

2) Peripherals:
   a) Mass Storage/Retrieval Systems
   b) Non-impact Printers
   c) Displays
   d) Devices with Logic Sensors

3) Production Technologies, Methods and Tools for System Design and Information Processing Systems:
   a) System Design
   b) Knowledge Engineering
   c) Advanced Systems Architecture
   d) Signal Processing

4) Use and Integration of IT Application Technologies:
   a) Computer Integrated Manufacturing
   b) Integrated Information Systems
   c) IT Application Support Systems

5) Integrated Information Systems:
   a) Architecture and Software Tools
   b) Application System Engineering
   c) Office Systems
   d) Business Systems
   e) Home Information and Security Systems (Domotique)
   f) Wide Area Information Systems

6) IT Application Support Systems:
   a) Human Factors and Man Machine Interfaces
   b) Workstations
   c) Distributed Systems
   d) Storage and Retrieval Systems

Appendix 4 provides a description of ongoing ESPRIT projects, detailing their purpose, partners, funding and duration.

1.6. ESPRIT II

A new phase of activity for ESPRIT was initiated in 1987, known as ESPRIT II, with a budget of 1.6 billion ECU. This emphasized IT applications, technology transfer and SME's. The framework for the project were specified as:

1) The program must continue precompetitive R&D in areas which build upon gains made earlier, enabling already established efforts to be maintained and capitalised upon;

2) R&D projects should be started in areas of exceptionally promising developments;

3) Cooperation both across IT sectors and between manufacturers and users should be consolidated, creating a multiplier effect and spawning productive collaborative efforts;

4) The scope should be enlarged to include enabling technologies which have the potential to be used across a broad range of applications;

5) Actions must be undertaken which encourage the creation of enhanced capabilities in basic research in IT;

6) The effort in preparation of international standards must be intensified;

7) Technology transfer should be promoted in the IT sector with particular emphasis on the capabilities and the needs of SME's;

8) Full advantage of the European dimension should be taken by admitting the participation of organizations established in EFTA[7] countries.

A fundamental shift in the basic objectives for ESPRIT has now taken place with emphasis on a demand driven strategy. This includes the integration of IT into application systems and to user activities in business, production and related fields. The topics of relevance to Canada addressed in the second phase program are:

1) Microelectronics and Peripheral Technologies;

2) Information Processing Systems;

3) Knowledge Engineering;

4) High Speed Integrated Circuits;

5) Advanced System Architectures;

6) Speech and Image Synthesis;

7) Architectures and Software Tools;

8) Wide Area Information Systems;

9) Storage and Retrieval Systems;

10) Home Systems.

The general requirements for ESPRIT project submissions are specified as:

1) The program comprises projects of precompetitive R&D carried out by means of contracts, executed within the Community and through the coordination of research and development activities carried out under the programs of the Member States and of the Community.

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[7] European Free Trade Association

2) Participation in projects in the ESPRIT program will be open to all companies, irrespective of size, universities and other educational establishments, research establishments and interested individuals within the European Community and, it is proposed, in the EFTA countries.

3) Projects with participation by the above-mentioned organizations from the EFTA countries must comply with normal Community program criteria, i.e. at least two industrial partners from two different Member States will also be required to participate.

Two broad types of projects: Type A and Type B have been specified:

1) Type A Projects:
These are projects that are individually described in the Workprogram[8] with their specified intermediate and long-term objectives. They usually require large resources, both human and financial, and considerable infrastructure having rigorous planning and project management procedures. Large projects comprising integration of several technologies are referenced as "Technology Integration Projects" (TIPS) in the Workprogram.

2) Type B Projects:
These are covered by "research themes" and they usually require smaller resources than those of type A. Organizations may submit proposals under any category.

The intention was to allocate no more than 25% of the Community's total contribution in 1987 to new projects which fall below a threshold of 100 man years of R&D effort. Contracts may cover Research and Development projects to be carried out in accordance with the aims set out in the Workprogram, selected according to the evaluation criteria.

Proposals may be for a maximum duration of five years. For a large project a definition phase may be proposed during which the main options will be examined, objectives will be fully defined and project activities will be prepared in detail. Initial contracts for successful proposals are usually let for a duration of between two and three years while, a definition phase contract will probably span six to twelve months.

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[8] ESPRIT Work Program, Commission of European Community DG XIII, Telecommunication, Information, Industries and Innovation, 22 July, 1987, Brussels.

1.7. Potential for Canadian Participation

The above criteria set out the requirements for participation in ESPRIT. While EEC and EFTA countries are the only eligible participants, some scope for formal third party participation is offered in the newly defined Type B projects. Under special circumstances the commission might adopt slightly amended rules with regard to collaboration thereby providing Canadian companies and research centres the opportunity to participate within the ESPRIT program.

Discussion with the EEC secretariat indicated that such proposals would have to demonstrate:

1) considerable promise;

2) offer technical expertise not otherwise available within Europe; and

3) have the non-member partner fully funded through its own resources.

All such proposal submissions would be adjudicated by the program management committee of ESPRIT.

1.8. Research and Development in Advanced Communications - RACE

R&D in Advanced Communications Technologies in Europe (RACE) is a program of research and development designed to enhance the capabilities in advanced telecommunications for the European Community. The program supports collaboration by telecommunications operators, research centres and industry to define future requirements and opportunities for advanced telecommunications technology.

The overall goal of the program is:

1) the introduction of Integrated Broadband Communication (IBC) taking into account evolving ISDN and national strategies, progressing to community wide services by 1995.

The period of work defined for RACE is 1987-1991 with precompetitive and pre-nominative work expected to require about 800 million ECU.

1.9. RACE Objectives

The specific objective of RACE are:

1) to promote the community's telecommunications industry so as to ensure that it maintains a strong position at European and world levels in a context of rapid technological change;

2) to enable the European network operators to confront, under the best possible conditions, the technological and service challenges with which they will be faced in the future;

3) to offer opportunities for service providers to improve cost performance and introduce new or enhanced information services which will earn revenue in their own right and give support to other productive sectors of the community;

4) to make available to the final users, at minimum cost and with minimum delay, the services which will sustain the competitiveness of the European economy over the next decades and contribute to maintaining and creating employment in the community;

5) to accompany the formation of an internal community market for telecommunications equipment and services as a basis for sustained strength on world markets;

6) to contribute to regional development within the community through the support of common functional specifications for equipment and services permitting the less developed regions to benefit fully from the efforts of Member States.

1.10. RACE Program Strategy

The RACE program was divided into three phases:

1) Definition Phase:
To execute initial work as required in order to focus future R&D accurately toward specific functional requirements in the network and terminal areas.[9]

2) Main Program Phase I (1987-1991):
   a) to develop the technology base for IBC;
   b) to carry out precompetitive development necessary for the provision of trials, equipment and services for IBC demonstration projects;
   c) to support the work of CEPT and CCITT in the formulation of common specifications and standards.

3) Main Program Phase II (1991-1996):
   a) to develop the technology base for enhanced IBC equipment and services beyond 1995;
   b) to promote and implement a continental European market with common standards capable of supporting the scale of production necessary to enter the world telecom and terminal market.

A wide range of participants are likely to be active in the RACE program but special attention is being given to SME's, specialized research organizations and universities. The program is expected to provide a framework in which the strengths of SME's will be expressed and market opportunities created by fostering linkages to large telecommunications companies and service providers. Similar benefits will likely accrue to research organizations and universities.

1.11. RACE Third Party Participation

Although this is still very much restricted to European nations, the RACE program makes some allowance for the participation of non-member European countries. The Definition Phase was directed to the 26 so-called CEPT (Council of European Post and Telecommunications) nations. In the main program the commission will allow for the interest expressed by industry, operators and service providers in COST (Cooperation in Science and Technology) countries. Private or Public organizations established in COST countries will be permitted to submit proposals and be signatories where a framework agreement on R&D cooperation has been concluded with the corresponding company. At the present time entry for Canadians could only be facilitated through a third party arrangement with a participating firm, research agency or university.

Discussions with representatives at the RACE directorate reemphasized the restrictions on non-member participation. However, they also indicated that proposals received from two member states, which also include a non-member

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[9]The RACE definition phase project list is attached in Appendix 5.

partner, would be given a review by the RACE committee. It is unlikely, however, that projects not satisfying at least the two member requirement would receive serious consideration for funding.

1.12. RACE Program Phase 1988-1991

The RACE program is in a similar position to that of ESPRIT with a call for proposals now being prepared. The main interest of the new program phase focuses on Integrated Broadband Communications (IBC) which involves three main activities:

1) the building of a consensus on strategies, functional specifications and implementation planning;

2) precompetitive R&D work oriented toward enabling IBC techniques and the exploration of markets for IBC applications and services;

3) precompetitive work through which results can be channeled to standardized bodies.

Some of the specific RACE projects now underway are:

1) Digital HDTV - Transmission;

2) TV Sound and Video Signal Coding;

3) Synthesis and Facsimile Pictures;

4) Low Cost Flat Panel Displays;

5) Digital TV Image Sensors/Recording Technology;

6) Integrated Optical Networks;

7) Optic Switching;

8) Optic Sources, Detectors, Modules;

9) Passive Components;

10) AI Software.

The scope and scale of the RACE program make it imperative for Canada to examine the various project areas and where possible to identify companies and organizations in Europe likely to respond to the new RFP. Many of the firms and agencies contacted during our field work indicated cooperative activities should take place within the context of RACE or ESPRIT.

1.13. Canadian Participation in RACE

Canadian firms have expressed interest in many of the areas being pursued in RACE. As the next phase is defined, further opportunities are likely to occur. However, there are several immediate concerns which should be considered in the context of collaborative and cooperative activities:

1) The RACE program is very much oriented to creating a European market and products to support IBC.

2) The RACE program is not available to non-qualified European firms. Thus, Canadians with services, expertise or products will have to make their entry through a private sector firm or in collaboration with an eligible research institute or agency.

3) The ITRD focus is on precompetitive activities and therefore potential partners are likely to emerge in research institutes and universities. These constitute 50% of the RACE participants.

4) While SME's are encouraged, this is generally considered within the context of their liaison with large firms. This may create some problems for smaller Canadian firms since attempting to match them to small European firms may not be viewed as desirable. Hence, efforts will have to be directed to the full spectrum of RACE participants, both private and public sector as well as large and small companies.

5) The directed focus of the RACE program means much of the development will result in products for the European market, meeting European standards and requirements. Ultimately, the goal is to provide European firms with improved ability to compete in world markets. In some ways these objectives run counter to those of Canadian industry who also must compete in world markets and in many cases against European consortia. Thus, each potential venture must be scrutinized to ensure the benefits accrue to both sides and in the Canadian case that the industry as a whole gains from the experiences.

1.14. Summary EUREKA, ESPRIT and RACE

There is a strong tendency for European firms/agencies/organizations to direct the prospects for cooperative ventures with foreign counterparts toward the existing multilateral programs. These are perceived to offer a number of advantages:

1) government institutional support;

2) funding;

3) availability and access to other partners;

4) community-wide benefits;

5) longterm opportunities in key technologies.

In many cases experiences with Canadian companies or agencies is limited and knowledge of their capabilities very sparse. Furthermore, there is an overriding perception of the difficulty inherent in attempting to conduct research on a cooperative basis at a distance. In addition, there are very few precedents available to judge the plausibility of such ventures. Related to these concerns are the overriding issues of funding and the role government organizations are expected to play in fostering these projects.

Cooperative R&D projects within the EEC programs are most likely to emerge through:

1) Canadian firms offering their capabilities to principals already active in RACE or ESPRIT, i.e. on a third party basis;

2) A third party arrangement in EUREKA (although this program is not, strictly speaking, designed to support precompetitive R&D);

3) A commercial venture between interested potential participants in a project of mutual benefit and which provides complementarity of skills and capabilities. In such ventures governments can play an important role by providing start-up funds, encouraging discussions, or funding missions for the initial exchange of information and concept identification;

4) Through an association or exchange with the private sector and a government or university research organization. In Europe major research centres have been encouraged and developed by the government(s). These address many different areas within "informatics" or "information technology". The labs receive government, university and industry support and act as the main focal point for precompetitive activities. These include:

   a) IMEC in Holland
   b) Appleton/Rutherford in the U.K.
   c) CNET-LETI in France
   d) Heinrich Hertz in Berlin
   e) FTZ in West Germany.

These centres are responsible for a very high proportion of the precompetitive research and serve as a complement to the large multi-nationals such as Philips, Thomson, Siemens and ALCATEL, etc. Since these centres are already in operation, have expertise and receive government/industry support, they represent ideal candidates for Canadian firms or agencies wishing to establish liaisons in Europe. These centres can also act as partners, be contracted to perform specific tasks on a project or provide technology as part of a specific research program.

1.15. EEC Database Services

The EEC on-line database and information services have significant relevance to this project. One of the most extensive is the ESPRIT Information Exchange System (IES). This provides data communications support for the exchange of information between participants in ESPRIT projects, who are geographically separated, and with the Community and national administrations involved in program and project management. The service provides for computer communications, remote access to computers, electronic mail and message interchange, the running of computer-based conferences, and the interchange of computerised files, applications and system programs, graphics, etc. It permits common preparation and editing of tests and reports, both managerial and technical in nature, and the storage, retrieval and dissemination of documentary and statistical information.

1.15.1 EUROKOM

EUROKOM is a computer-based conference, mail and message system installed at the Computer Centre of University College, Dublin. It is a UNIX[10] based facility providing access to the electronic mail, file transfer and other facilities available to the European UNIX Users' Group.

1.15.2 EUROCONTACT

Another IES facility, of particular interest is EUROCONTACT. This is a database for expression of research interests by European organizations conducting, or interested in conducting, research in the fields of information technology and telecommunications.

Each entry in the EUROCONTACT database is divided into three blocks of information:

1) information about an organization (e.g. location of the person, contact person, etc.)

2) a profile of an organization (e.g. location of the organization, its activities, references, etc.)

3) research interests of an organization (e.g. research experience, planned research, etc.)

The two primary objectives of EUROCONTACT are:

1) to stimulate contact between organizations capable of working together in EEC sponsored programs in the areas of information technology and telecommunications;

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[10](UNIX is a registered trade mark of Bell Laboratories)

2) to assist organizations in identifying partners for planning projects and answering tenders.

Any organization in one of the Member States of the European Communities involved in information technology or telecommunications research may be included in the EUROCONTACT database by completing a EUROCONTACT data entry form and submitting it to the Commission of the European Communities.

1.15.3 B.C. NET

In addition to the IES database, the community has recently instituted a new service specially oriented to SME's. This is designed as a network for exchanging information among business clients. The system is known as B.C. Net and provides interested parties with the opportunity to make inquiries about specific projects or to make company profiles available for distribution to potential joint venture partners. Access to the database is made on the basis of 600 advisors or consultants who provide a type of brokerage function between the various parties. Companies are accessed and then appraised for potential matching for collaborative or joint ventures throughout a keyword system. The system uses a mailbox concept to ensure confidentiality, restricting non-authorized access to the database.

B.C. NET constitutes a group of database services operated by the EEC which includes Eurocom and Euroguichet. This is another databank providing detailed information on European companies. Euroguichet is currently in the prototype phase offering information to the Community members three ways:

1) Commission to Companies;

2) Companies to Commission;

3) Company to Advisors from the Commission.

In total, the European Community operates over twenty different databases through its on-line services. Information on the EUREKA, ESPRIT and RACE projects is available either directly through the database services or by request from the EUREKA, ESPRIT or RACE secretariats. Access to these could be facilitated at the present time through the Canadian embassy. There are plans to link these "online" with the ITRD database.

Part III - Country and Organization Detailed Analysis:

Overview

This section of the report presents the results of the organization and country assessments conducted during the European survey. The findings are presented on a country by country basis according to the visits.

In each case preliminary appraisals were made prior to the in-depth survey, the results of which have been incorporated into this appraisal. There are, essentially, two parts to each review. First, the country situation is reviewed and an indepth appraisal of the policies and support mechanisms for informatics R&D is presented. The second part is the review of the individual company, agency and research centres detailing the specific activities and research interests.

The European survey was conducted between November 22, 1987 and December 13, 1987. The itinerary on a country bases was:

1) November 22 - November 25 Netherlands

2) November 27 - December 1 West Germany

3) December 2 - December 7 France

4) December 8 - December 9 Belgium

5) December 9 - December 10 Brussels - C.E.C.

6) December 10 - December 13 United Kingdom

In each visit assistance was provided by the Technology Development Officer or Science Counsellor from the Canadian Embassy.

The companies and organizations visited are presented at the beginning of each country/organization review. In each country, organizations and government departments were contacted by the Canadian Embassy TDO or SANDT, counsellor prior to the visit by the project consultant. During the visits the purpose and objective of the project were explained and then the assessment of each organization was conducted. The areas of potential cooperation and R&D topics derived from the Canadian industry survey were used during the discussions with European organizations.

1. Netherlands

1.1. Overview

Information in this section was obtained in two phases. The first included discussions with Canadian officials in the Netherlands and two government departments involved in technology policy; SPIN[11], the new government/industry consortia for R&D and the Council of Informatics Technology. Additional information was obtained from published reports documenting activities in high technology and R&D. The second part included firms, agencies and government organizations actively participating in research and development activities for informatics contacted during the indepth survey carried out in November/ December, 1987.

1.2. Organizations Visited

1) Canadian Government Technology Officer, Canadian Embassy;
2) SPIN, Industry Liaison Coordination Officer;
3) Amsterdam University, Technology Transfer Centre;
4) Dutch EUREKA Secretariat;
5) Holland Elektronica;
6) VIFKA Industry Association for Office Technology;
7) Philips;
8) EEC Liaison Officer;
9) Multihouse Software;
10) VAN DALE Lexicographic.

1.3. Government R&D, Policies and Programs

Expenditure for R&D in the Netherlands totalled approximately NFL9.4 billion in 1986 or about CDN$5 billion. About one half of this came from the private sector and the remainder from the public sector. In the past few years R&D expenditures to universities have been reduced and greater emphasis has been placed on industrial R&D. About 75% of the country's research and development expenditures come from its five largest industry players: Shell, Unilever, Philips, Acso and DSM.

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[11]Project for Stimulation of Cooperation in Information Technology

Priority areas for R&D expenditures have been identified as micro-electronics, informatics, special materials (ceramics) and bio-technology. With respect to cooperative arrangements the three main partners are the United States, Great Britain and West Germany. Netherlands firms are active in twenty-five EUREKA and ESPRIT projects. Over 300 different Dutch firms and organizations are included in the EUREKA database.

INSP is the most recent strategic plan outlined for the Netherlands Informatics Sector. This is aimed at attaining a stronger position in the field of informatics and information technology. A project team for information technology research has been set up to stimulate and coordinate strategic research initiatives.

INSP is coordinated by a high level inter-departmental steering committee which includes; The Ministries of Education and Science, Economic Affairs, Agriculture and Fisheries, Home Affairs and the Dutch PTT. The principle thrust of its policies are aimed at reinforcing the private sector in the field of information technology, promoting its development, supporting research, and reinforcing the competitive position of Dutch technology producers, at home and abroad. It also aims to reinforce and expand the application of Dutch information technology products in trade and industry. The following application areas are being promoted:

1) office automation;

2) production automations;

3) services provision;

4) micro-electronics;

5) telecommunications;

6) software.

SPIN operates within the INSP and is designed to undertake strategic research which rests on the borderline between informatics and other disciplines. The organizations main task includes setting up and managing research programs in consultation with trade and industry, the scientific community and other experts. Over a five year period 1986-1990 SPIN is expected to receive a total of NFL 50 million from the Ministry of Economic Affairs, NFL20 million from the Ministry of Education and Science and NFL22 million from the Ministry of Agriculture.

Appendix 6 contains a summary of key information technology organizations, agencies and institutes in the Netherlands.

1.4. Government Policies for R&D Stimulation

A major emphasis in the technology policies of the Netherlands is the desire to increase direct government support of R&D performed by individual firms. The reason for this is the recognized need to stimulate the industry's own

expenditures on R&D. The scheme includes instruments for providing direct funding to the private sector such as subsidizing the salaries of employees and allowing technical development credits to firms.

Dutch authorities have chosen R&D strategies which focus their programs and policies toward specific technologies and places greater emphasis on cooperative linkages between companies, research institutes and universities. The underlying premise is the need to encourage efficient division of labour and cooperation between the various performers of R&D and to stimulate increased collaboration. Industrial research and technology development in small or medium sized firms, having limited in-house research capacity, are a priority.

Discussions with the Ministry and Policy Directorate for Technology identified four major government supported programs:

1) medical technology;

2) materials technology;

3) informatics;

4) bio-technology.

Government support is provided for three types of studies:

1) feasibility studies for R&D;

2) research projects;

3) demonstration projects.

Another government focus is the applications of R&D to enhance productivity within small and medium size business. To support this, credits are provided to firms to subsidize their adoption of the following technologies.

1) production automation;

2) electronic services;

3) government databases;

4) micro-electronics and products;

5) software; particularly AI expert systems.

Government officials indicated that, at present, there are no specific programs designed to stimulate or support collaboration with Canadian firms. However, the government, with its emphasis on export development and its stated objective of fostering collaborative and cooperative research activities, clearly encourages such endeavors.

The Dutch Council for Informatics Technology (RITE) is a private organization set up to identify projects and to stimulate collaborative research and development in informatics. Members include leading software users such as banks, airlines, insurance companies, hardware, software vendors and software houses. At the present time there are forty companies in the organization and two programs now underway addressing:

1) software engineering;

2) ISDN.

1.5. Future R&D Strategies - Decker Commission

An R&D strategy review was recently completed as part of the Decker Commission. The commission report emphasized the need to reinforce technology policies and programs within the Netherlands through:

1) raising the training level of the work force;

2) enhancing the quality and usability of public sector research to encourage the interplay between the market and research institutes;

3) broadening R&D activities in small and medium sized firms by promoting a more competitive R&D climate for large companies operating on an international scale and thereby improving the chances for young, technologically oriented firms.

One of the principal recommendation of the Decker report was the recognition of the need to improve the diffusion of knowledge from the universities, and technological institutes. This emphasized the need to ensure research is usable and of value to the domestic and international market. The government's role is seen as providing the financial and administrative support to "knowledge firms" providing results to industry for product development. In this respect these centres of expertise are viewed as playing an integral part in the precompetitive stages of R&D. They represent therefore one of the main sources of collaboration and cooperation for precompetitive R&*d with Canadian firms.

The Decker report noted that R&D is concentrated in too few firms where the 30 largest account for 90% of all expenditures. New technology policies should be designed to stimulate R&D activities on a larger and broader scale, especially among small and medium sized firms. Special emphasis it is argued, should be placed on internationally operative companies in order to make them comparable with those of other countries.

The commission emphasized the need for the government to provide greater financial incentives for participation in the EUREKA and RACE programs.

Joint R&D projects have been instituted with Israel and Canada in the past few years and several companies are already active in the Netherlands:

1) Cognos

2) AES

3) Northern Telecom

4) MITEL

5) MATROX

6) GEAC.

1.6. EUREKA, ESPRIT and RACE Participation

Netherlands' participation in the EUREKA, ESPRIT and RACE programs is diverse with several different projects ongoing and many firms involved in joint ventures. Sample projects include:

1) Submicron Silicon Process:
Philips Research Laboratories N.V.
Department Elcoma
P.O. Box 218
5600 MD Eindhoven
Contact: Dr. Holtwijk

Joint European submicron silicon process technology, as well as development of manufacturing and design capability.

2) Mobidick:
Van Dale Lexicography B.V.
21C Mariaplaats
P.O. Box 19232
3501 DE Utrecht

The development of an on-line general purpose bilingual dictionary kit that will also contribute to the development of standards in the field of linguistic software in particular with respect to the organization of lexicographical data.

3) Ink Jet Printing:
Stork X-Cel B.V.
P.O. Box 105
5830 AC Boxmeer
Telephone:
Contact: Mr. T. Maas

Development of a computerized "contactless" printing method using digital image information input.

4) Digital Audio Broadcasting (DAB):
Philips International B.V.
P.O. Box 218
5600 MD Eindhoven
Telephone:
Contact: Mr. H. Wessels

(Digital Audio Broadcasting). This project investigates the extent to which digital facilities for sound transmission and reception, particularly for mobile reception, can bring about improvements in sound quality.

5) Fastcat:
Special Systems Industry B.V.
14 Lange Voorhout
2514 ED The Hague
Telephone:
Contact: ir. R.F.H. Nitzsche

Fastcat is designed as a high speed multi-lingual computer assisted translation (CAT) system. The focus of FASTCAT is to provide the human translator with state of the art electronic tools that will assist in the translation process.

2. Detailed Company/Firms/Agency Reviews/Netherlands

2.1. Country: Netherlands

Organization: SPIN; Project for Stimulation of Cooperation in Information Technology

Contact Name: Mr. J.W. Vasbinder, Assistant Director

Location: Kluyverweg, Postbus 316
2600 AH Delft
Telephone: 015 787330
Delft University, Delft

1. Overview:

SPIN was set up by the Dutch government in 1985 as an experiment in fostering cooperative ventures between industry and universities. The program is designed to foster R&D among small and medium enterprises through the establishment and funding of cooperative projects in informatics. The program will end in 1989.

Four points dominate SPIN's mandate:

1) to identify university research projects in the Netherlands;

2) to undertake and encourage collaborative research between industry and universities;

3) to provide financial support to industry wishing to undertake R&D projects;

4) to develop longer term collaborative projects beyond the initial five year mandate.

Two programs are administered; a large scale program where between 25% and 50% of the total costs are provided and a maximum of FL 5 million per project is allowed. The second is the small Business Innovative Research Program which is directed to original research in information sciences among small/medium enterprises and universities.

The program has been set up for a five year period and is now in the last phase of operation. Phase I supported concept definition activities among potential partners. Phase II supported further project development of those activities deemed desirable from Phase I. Phase III projects require a firm commitment from industry partners and guaranteed funding from the private sector in order to qualify for government assistance.

While universities participate in SPIN most of the emphasis is now coming from industry. When projects are approved scientists are available from the universities to participate in the research teams. Industry provides funding while the universities conduct the research with the results jointly shared by the participating partners.

SPIN has also developed a computerized search service designed to match Dutch companies having an interest in cooperative research projects. There are approximately 2,000 firms listed at the present time.

2. Research Activities:

Projects already underway include:

1) Speech synthesis technology; the emphasis is on Dutch language. The partners include the University of Utrecht, the government and the PTT.

2) Prisma; this project is an amalgam of Philips and the Universities of Amsterdam and Utrecht. It is designed to produce a prototype fifth generation parallel processing computer with appropriate system hardware and software.

3) Flexible automation and robotics research using very small series and performing discrete tasks.

4) Software engineering centres - six universities have been brought together with ten to twenty software houses, to actively pursue projects in:

   a) AI
   b) telematics
   c) man machine interaction
   d) natural language processing.

Other more general research areas are:

1) parallel processing;

2) man/machine communication;

3) knowledge based systems;

4) 3D image processing;

5) medical informatics;

6) telematics.

Some of the projects and firms include:

	Organization	Project Area
1)	NW KEMA - Annhem	Advanced functional software programming

	Organization	Project Area
2)	Electronson B.V. - Lienpde	Pre-master tools for optical disc
3)	RITE - Amsterdam	Judicial expert system
4)	U. Limberg - Maastricht	Communication networks in institutions
5)	Eurographics - Haarlem	Graphics software, high resolution systems
6)	Stitching, Montevideo - Amsterdam	Computer generated 3-D graphics
7)	U. of Delft - Delft	Real time digital video production technology
8)	Diaconessenhuis-Heemstede	Medical diagnosis database using optical discs
9)	Nederlands Meteorological Institute	Parallel processing for meteorological analysis
10)	Artificial Intelligence Research - Amsterdam	Expert systems for machine learning
11)	Automated Images - Amsterdam	Computer generated holographic images
12)	Waterloopkundig Lab - Delft	Integrated expert system with massive programming
13)	Inspektor Research Systems B.V. Amsterdam	Software for registration and analysis of sudden infant death syndrome
14)	LCN Foundation - Nijmegen	R&D project for implementation of an environment for the specification of different architectures for various production rule systems (software).

3. Cooperative Activities:

While SPIN does not undertake research it does function as a coordinating and funding agency for such ventures. There is definite interest in coordinating activities with Canadian firms, universities, government labs or agencies.

Phase III research activities are expected to commence in February/March 1988 and this will provide a focus for Canadian firms having expertise and experience in appropriate areas. SPIN will circulate topics from Canada among its members and solicit responses and interest in joint ventures. Lists of projects approved for Phase II and Phase III are available to interested parties from the SPIN director.

2.2. **Country:** Netherlands

Organization: Transferpunt, University of Amsterdam

Contact Name: Dr. R. Thijsse, Director

Location: University of Amsterdam, Amsterdam

1. Overview:

The University, transfer centre functions as a liaison office between small and medium enterprises and the university. The centre provides assistance in matching small Dutch firms wishing to undertake basic R&D with university resources or other firms.

A major activity is the development of an electronic database detailing on-going R&D at the University of Amsterdam. This is being funded by the Ministry of Education and will be completed in the coming year.

2. Research Activities:

The research expertise of the centre relevant to the Canadian initiatives, include:

1) image and voice synthesis;

2) artificial intelligence;

3) laser technologies;

4) satellite based sensors.

The transfer centre would assist Canadian firms in identifying suitable partners or in facilitating exchanges of experts in particular areas of interest.

The following is a list of projects of interest to Canadian partners:

1) Expert Systems/Artificial Intelligence:

a) Project: Informatics Research Oriented Toward 5th Generation Computer System
Faculty: Informatics
Contact: Faculty Secretariat
Key Word: Information systems, software engineering, dispersed systems, computer, data bank.
Expertise: Informatics, software engineering, expert system, life sciences, natural sciences, language

b) Project: Fundamentals of Semantics
Faculty: Informatics faculty work group
Contact: Mr. T.M.V. Janssen
Key Word: artificial intelligence, data banks, automatic translation, computer linguistics
Expertise: Aemantic

c) Project: Learning, Internal and External Conditions
Faculty: Psychonomy
Contact: Mr. L. de Leeuw
Key Words: learning, expert system, informatics, man-machine interface cognitive, ergonomy
Expertise: expert systems, man-machine interface, elementary education, secondary education, concentration capacity.

d) Project: Knowledge-based Reasoning Systems (including expert systems)
Faculty: Informatica
Contact: Mr. J. Treur
Key Words: expert systems, knowledge banks
Expertise: development of knowledge based systems

e) Project: Social Aspects of Informatics
Faculty: Social-scientific Informatics
Key Words: expert systems, computer systems, informatics (social aspects) use of expert and computer systems
Expertise: social aspects of informatics

2) Image and Voice Synthesis:

a) Project: Acoustic-phonetic Aspects of Automatic Speech Recognition
Faculty: Institute for Phonetic Sciences
Contact: Professor L.C.W. Pols
Key Words: automatic speech recognition, speech recognition

3) Parallel Processing Systems:

a) Project: Data Banks
Work Group: Informatics
Contact: Professor R.P. van de Riet
Key Words: informatics, data bank, parallel processing
Expertise: informatics, data bank, automation, information dissemination

b) Project: Software Technology
Work Group: Informatics
Contact: Professor A.S. Tanenbaum
Key Words: software technology, compiler building, system programming
Expertise: automation, software development, compiler building

3. Cooperative Activities:

The centre has agreed to provide a matching service for possible partners based on Canadian interests. They will also circulate the topics and subtopics among small and medium sized enterprises. A matching of the topics with the interests of university researchers will also be provided.

2.3. **Country:** Netherlands

Organization: Dutch Eureka Secretariat

Contact Name: Mr. Joost A.J.M. de Jong, Coordinator

Location: Herengracht 9 - 2511 EG
The Hague, Netherlands
Telephone: 3170656930

1. Overview:

The secretariat coordinates the Dutch participation in the EUREKA programs, assists industry in developing projects and aids in developing partnerships. The Netherlands defined two types of projects for EUREKA; one in which companies jointly develop new technologies and where government plays a mediating role in establishing the cooperation. The second covers cooperative ventures in which governments have a stronger role and can influence existing or future markets. In this case there is consultation between government and industry regarding the strategy to be adopted.

2. Research Activities:

The following is a list of current EUREKA projects involving Dutch participants and which could offer opportunities to Canadian firms:

Title: Industrial Laser

Summary: Evaluation and development of industrial lasers for material processing

Participating Countries: Germany, France, Italy, United Kingdom, Austria, Belgium

Cost: 83.00

Duration: 120 man months

Title: COSINE - Cooperation for Open Systems Interconnection Networking in Europe

Participating Countries: United Kingdom, Finland, Netherlands, Norway, Germany, CEC, Sweden, Switzerland, Iceland

Duration: 12 man months

Title: ES2 - Automatic design and production of custom chips using direct printing on silicon wafers

Summary: The objective of the project is to use software and printing technology so as to minimize the efforts in producing custom made chips

Participating Countries: France, Germany, Italy, Netherlands, Norway

Cost: 94.00

Duration: 36 man months

Title: Carminat system

Summary: System for acquisition, transmission, processing and presentation of information to improve the safety of the driver and to make trips easier and more efficient, including electronic car monitoring an/or navigation system

Participating Countries: Netherlands, France

Cost: 52.00

Duration: 48 man months

Title: HDTV - Compatible high definition television system

Summary: Development of a 50 HZ based HDTV system along with an evolutionary development from the MAC-packet concept; and compatibility with MAC transmitters and receivers

Participating Countries: Germany, United Kingdom, Netherlands, France, Switzerland, Belgium, Italy, Sweden

Cost: 180.00

Duration: 48 man months

Title: Super conducting wires and magnets for very high field magnetic applications

Summary: Study of important parameters for development of technology of high field super conducting magnets. The long term goal is the realization of high magnetic field super conducting coils in the range of 20 Tesla

Participating Countries: Austria, Switzerland, Netherlands

Cost: 8.00

Duration: 36 man months

Title: JESSI - Joint European Sub-micron Silicon Initiative

Summary: To develop submicron silicon process technology as well as manufacturing and design capability by 1995. The resulting technical targets could be: 1) very high complexity (10 to 100 million transistors/chip) 2) very high speed IC (5 Gbit/s)

Participating Countries: Germany, Netherlands, France, Italy

Cost: 3.60

Duration: 12 man months

Title: MOBIDICK - Multi-variable on-line bilingual dictionary kit

Summary: To develop an on-line general purpose bilingual dictionary kit including information storage on CD ROM, for users on ordinary PC's, for spelling, hyphenation, grammar and style. Contribute to standards of linguistic software

International Countries: Netherlands, France, United Kingdom

Participating Countries: Netherlands, Switzerland

Cost: 3.50

Duration: 36 man months

Title: Ink Jet Printing

Summary: Development of a computerized "contactless" printing technology using digital image information input

Participating Countries: Sweden, Netherlands, Germany, Switzerland

Cost: 13.90

Duration: 36 man months

Title: DAB - Digital Audio Broadcasting System
Demonstrate technical feasibility of the digital terrestrial radio network, and work out the most promising solution. To give a digital radio standard

International Countries: United Kingdom, France, Germany

Participating Countries: Germany, Netherlands

Cost: 38.30

Duration: 60 man months

Title: Eurolaser: High Power Excimer Lasers

Summary: Design of Excimer laser test facilities to investigate reliability of components for multi-kilowatt industrial excimer laser. Create European network of component and system subcontractors

International Countries: United Kingdom

Participating Countries: Germany, France, Netherlands, Greece, Sweden

Cost: 14.70

Duration: 96 man months

Title: Eurolaser: Hipulse Excimer Laser

Summary: Development of a system which can deliver a power of at least 1 kilowatt, having a number of features (divergence, uniformity, high frequency operation, wavelength extension techniques)

Participating Countries: Italy, Netherlands

Cost: 10.00

Duration: 48 man months

3. Cooperative Activities

Canadian firms are welcome to participate in the EUREKA projects but specific conditions must be satisfied:

1) Project benefits must be oriented primarily towards European partners.

2) Foreign participation cannot be "too large" and generally should be in a supporting role rather than as a primary player.

3) Projects are generally more product and market oriented than strictly precompetitive/pre-normative R&D.

4) Projects are country oriented and therefore contacts should be made directly with Dutch firms.

Canadian project proposals will be circulated among Dutch firms through the EUREKA bulletin. Access will also be provided to the EUREKA project database using key words and topics to match Canadian and Dutch research interests.

The Dutch secretariat will provide access to the Echo database along with the necessary keywords and topics specifying ongoing projects. Initially this will be coordinated through the Canadian Embassy. Inquiries could be made directly through the TDO and SANDT counsellors. It may be possible ion the future for interconnection via the ITRD database service.

2.4. **Country:** Netherlands

Organization: Holland Elektronica

Contact: Dr. M.A. Geurtsen

Location: Bredewater 20
Postbus 190 2700 AD Zoetemeer
Holland

1. Overview:

Holland Electronica was established by the Association of the Mechanical and Electrical Engineering Industries (FMA) and a close association exists with the Netherlands Centre for Micro Electronica. Holland Electronica has more than seventy members with its main objective: the promotion of and participation in the growth of the electronics industry.

The means used to achieve this objective are:

1) promotion of interests with public authorities;

2) mutual contact and exchange of experiences;

3) reconnaissance of technology developments;

4) education.

Contacts are maintained with the Foundation Centres for Micro-electronics (SCME in Eindhoven, (CMET) in Delft and Twente. Liaison is also provided with technical universities and the Ministries of Economic Affairs, Education and Sciences, Social Affairs and Defence.

2. Research Activities:

The organization is oriented around five basic themes:

1) surface mounting technology;

2) design-on-silicon;

3) quality of electronics products;

4) production process;

5) automation processes.

The association represents companies active in:

1) electronic components/opto-electronic devices;

2) factory automation;

3) data communications - networking;

4) parallel processing systems/AI systems;

5) system design.

3. Cooperative Activities:

Holland Electronic can provide introductions for Canadian companies to Dutch firms for each of the topic/subtopic areas. They also could assist in the organization of visits and meetings between Canadian and Dutch companies and agencies.

The association has agreed to disseminate the list of Canadian R&D topics and subtopics among its members and to assist in coordinating responses. Inquiries concerning Dutch firms could be provided directly to the association or through the Canadian Embassy, Technology Development Officer in the Hague (Mr. Chris Rowley).

2.5. **Country:** Netherlands

Organization: VIFKA

Contact: Mr. B.W. Pel, Secretary

Location: Postbus 560
2800 AN Gouda
Telephone: 01820 39122

1. Overview:

VIFKA is an organization representing about 250 importers and exporters of office equipment. Included in this association are 50 small and large size companies actively involved in the software business. Most companies simply market software. However, there are some actively engaged in production and research.

2. Research Activities:

Several members of VIFKA conduct research on software developments for artificial intelligence. Although the association representatives could not reveal details of specific projects, the following companies are active in the areas of expert and knowledge based systems. Detailed information on the companies, their interests and activities could be obtained directly from the VIFKA secretariate.

1) ABC - Lelystad;
2) Bolesian - Steenovenweg;
3) Comdes - Bloemendaal;
4) Data Force - Westelijk Halfrond;
5) HAS - Kadelway, Amsterdam;
6) MATRIX Software - Keizer Karelplein - Nijmegen;
7) Ned. Technical Studies Centre - Van Diemenstraat, Amsterdam;
8) Nixdorf - Milweg, Vianen;
9) Systel - Nijvenheidsweg, Heemstede;
10) Unihouse - Doesburgweg, Gouda.

3. Cooperative Activities:

VIFKA will circulate Canadian R&D topics and subtopics among members, solicit responses and inform the TDO at the Canadian Embassy of any enquiries. Canadian firms should contact the Canadian TDO directly for further information.

2.6. **Country:** Netherlands

Organization: Philips

Contact: Mr. R.J. Niehuis, Coordination Officer
Mr. Ledeboer, European Affairs Coordinator
Mr. P.J. Turner, Director Legal Affairs and Assistant Secretary

Location: P.O. Box 218, 5600 MD
Eindoven - The Netherlands
Telephone: 3140783748 Telex: 35000

1. Overview:

Philips is the leading R&D organization for informatics in the Netherlands. It is one of the largest organizations in Europe and among the world leaders in informatics. Its 1985 annual sales were about US$25 billion and it employs 340,000 people worldwide. The company operates in 70 countries and has joint venture agreements with AT&T, Control Data, Siemens, DuPont and Matsushita. R&D expenditures total about seven percent of annual turnover or US$1.6 billion. Most of the fundamental research is conducted at the Eindoven centre in the Netherlands.

The most prevalent form of cooperative and joint ventures for the company is in product development rather than basic R&D. However, specific activities are now ongoing for:

1) Broadcast Television Systems (BTS);

2) ASICS, 16 bit microprocessor for home information systems;

3) Ceramic components;

4) MAC transmission standard HDTV;

5) VLSI ISDN integrated circuits;

6) Advanced system for machine translation and natural languages;

7) Multi layer structures of magneto-optical materials for erasable recording;

8) Fast integrated circuits in gallium arsenide for applications in supercomputers;

9) Monomode optical fibers with minimum dispersion over a wide wavelength range;

10) Polycrystalline silicon on glass surfaces for flat panel displays;

11) CMOS integrated circuits with Siemens.

2. Research Activities:

Presently 35 cooperative ventures are underway as part of the EEC programs. These represent a total committment of about 2,470 man years. Philips contributes about one third of the project costs.

The Philips research program is conducted by 4300 people in eight laboratories located in six countries. The main lines of research are defined by the central research management team with projects determined on the basis of the company's medium and long term objectives.

RACE and ESPRIT programs are the main collaborative information technology research programs for the company.

3. Cooperative Activities:

Philips have requested that information be supplied about the type and nature of Canadian R&D interests. They would like to investigate the potential topics and partners in terms of their longer term strategies. They also indicated that the ongoing EEC programs offer the best opportunities for collaboration and suggested that Canada should investigate ways of gaining access to the current projects.

Discussion with the company officials revealed a cautious approach to the concept of joint ventures with Canadian companies. Their principal concern was the need to know what agencies and firms are potential candidates for collaboration, what their interests are, what is their experience with such ventures and what resources and funds could they draw on for setting up partnerships.

2.7. **Country:** Netherlands

Organization: EEC Liaison, Project Office

Contact: Dr. Willem Enterman, Director

Location: Scheveningseweg 68
Postbus 13766
2501 ET Den Haag

1. Overview:

The EEC liaison office serves as a coordinating and information disseminating agency for the various programs run by the European community. The agency provides newsletters and attempts to bring the appropriate parties together when project opportunities are identified.

Canadian participation in the EUREKA, ESPRIT or RACE programs requires at least two member states as the prime project participants. At this time, Canadians can only participate if all principals agree and if an EEC review committee has no objections.

Some of the most important items for consideration in developing cooperative ventures within any of the ongoing programs are:

1) the signing of confidentiality agreements;

2) the creation of the spirit of cooperation;

3) the understanding of the "intellectual property issues";

4) the understanding of applicable laws in Canada and Europe.

2. Research Activities:

There were no specific research projects discussed although the office will coordinate specific requests with Dutch companies.

3. Cooperative Activities:

The liaison office agreed to distribute the Canadian R&D topics list to agencies and firms in the Netherlands and to provide information on new projects and opportunities for the 1988/89 period. The contacts will be maintained through the TDO officer in the Canadian Embassy in The Hague:

Mr. Chris Rowley
Canadian Embassy
Postbox, 30820
2500 GV The Hague, Netherlands
Telephone: 070 614111

2.8. **Country:** Netherlands

Organization: Multihouse, Special Systems Industry

Contact: Dr. Jens Van Der Heide

Location: Delftweg 72
Rijswijk

1. Overview:

Multihouse, a division of Special Systems Industry, is one of the largest system house operations in the Netherlands. In 1986 the volume of business was approximately Dfls.117 million. The company focuses on the IBM family of computers, System 36 and mainframes, Digital Computer products and UNIX software. The company is involved in several research projects in cooperation with Dutch Universities and other companies. One of its member companies is active in the development of computer-aided translation and publishing in a multilingual environment known as FASTCAT.

2. Research Activities:

The FASTCAT project involves the development of a high speed automatic translation system which is composed of:

1) a velotype keyboard;

2) multilingual simultaneous translation software;

3) network and transmission software.

The aim of this project is to develop systems for rapid computer aided translation. This considers a network configuration where a number of translators can work in a local and global environment. The concept is expected to allow translators in different countries to access national language databases simultaneously.

A unique keyboard has been developed whereby the legend of the key tops can automatically be changed to the character sets being used. The company has developed a keyboard allowing fast entry of text into a computer by means of a digital stenographic approach known as Velotype.

3. Cooperative Activities:

The company is looking for partners for the development of new communication protocols and improvements to translation software. In particular, the project team are interested in text processors for different languages: Italian, French, English and Dutch. They would be particularly interested in companies having expertise in automatic translation in the linguistic and lexographic processes.

Representatives from the parent company of SSI, Multihouse were interested in Canadian capabilities and were enthusiastic about the prospect of introducing a foreign partner into the project. Their long-term goal is to gain access to the North American market once the project has proceeded beyond the basic R&D phase.

2.9. **Country:** Netherlands

Organization: VanDale Lexicographic B.V.

Contact: Dr. W.J. Vercouteren

Location: Utrecht 21c Mariaplaats

1. Overview:

Van Dale Lexicographic is one of the largest dictionary publishers in the Netherlands. One of their specialties is the production of automated bilingual dictionaries developed from lexical database.s. These include French/Dutch, Dutch/French, German/Dutch, English/Dutch and Dutch/English versions. The company is also a major electronic publishing concern in the Netherlands and has developed several lexical databases in joint ventures with companies such as Wang and IBM.

Another important line of business is automatic translation mainly for business clients. In this context the company provides multilingual information to software companies in the form of spell check, word list, etc. One of the overriding goals of the company is for the establishment, of long term research strategies leading to the development of a fully automated bilingual dictionary.

VanDale employs twenty staff drawn mainly from Dutch, French, Belgium and German Universities. A significant proportion of the companies money is being directed to basic research in machine translation, where a ten year strategy for R&D has been outlined.

2. Research Activities:

The company began a major research project in 1986, aimed at the development of an on-line Bilingual Dictionary kit. This project, known as MOBIDICK, is being supported by the EUREKA program. The total project funding is estimated at 3.5 mi ECU of which 9 million will be used in the initial development phase.

The principals in the project include Van Dale, Alps, Dictionaire Le Robert Fr., and Philips Home Interactive Systems, Netherlands.

3. Cooperative Activities:

Partners are being sought with experience in the field of monolingual and bilingual lexicography as well as those with knowledge of CDROM technology. Interest is strongest towards those companies having experience in machine translation and intelligent databases design as well as those with French language capability. Canadian participation would be welcome, depending on the particular area of experience and available funding.

3. West Germany

3.1. Introduction

The initial visits to Germany were made in July 1987 when interviews were conducted with the Federal government Ministry of Research and the Canadian Embassy Science and Technology officer. The indepth surveys were administered between November 27 and December 1, 1987. Visits were made to the following organizations, agencies and government departments:

1) Ministry for Research and Technology, Bonn

2) VDI/VDE, West Berlin

3) Heinrich Hertz Institute, West Berlin

4) Fraunhofer Institute for Microstructure, West Berlin

5) Suprenum, Frankfurt

6) Telenorma, Frankfurt

7) FTZ, Deutsche Bundespost, Darmstadt

3.2. Policies and R&D Strategy for West Germany

The West-German government has recently placed renewed emphasis on increasing R&D expenditures for industry. The 1960-1980 period witnessed an overall decline in expenditures in the belief that industry was strong enough to maintain its own programs. This did not take place however, and R&D activity declined. In 1983 the government renewed its interest and developed a strategy to stimulate six areas of research among small and medium sized firms:

1) micro-electronics - integrated circuits/submicron structures;

2) communications technologies (ISDN and IBC);

3) software system architectures and parallel processing,(AI);

4) computer architecture and optical computers;

5) peripherals and computers;

6) innovation diffusion and IT applications.

The federal government is expected to play an indirect role through improving technical infrastructure, encouraging long term projects, and assisting in collaborations between research centres throughout the country. Other initiatives include increased use of specialized information and data banks oriented around high technology areas.

The government initiatives are aimed at:

1) extending and improving the utilization of specialized information;

2) guaranteeing access to specialized databases;

3) promoting international cooperation and joint development of information data banks on a bilateral basis;

4) improving the production, distribution, creation and acquisition of scientific information in a variety of fields;

5) increased application of high speed data transmission, optical disks and digital networks;

6) increased use of expert systems, natural query languages and database design techniques.

The following national priorities have been identified:

1) the establishment of ISDN throughout Germany;

2) the development of broadband ISDN and optical communications;

3) development of a German Research Network comprised of research groups in universities, research establishments and private sector firms;

4) the creation of new computer structures which advance the development of computers in various areas such as speech and picture recognition as well as knowledge processing.

3.3. Quesir Report for R&D Strategies (BMFT)

The West German strategy for the development of basic research in Information Technology was outlined recently in the 1987 Quesir Report.[1] This recommended that basic research was urgently needed in the following areas:

1) design and manufacture of equipment and technology of integrated circuits at .2 microns;

2) development of materials and procedures for installation of modern integrated semiconductor devices of high power density;

3) fast signal processing;

4) modern sensors utilizing fibre optics, integrated optics, silicon micro-mechanics, ion and gas sensitive materials;

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[1]Research and Development Strategies, Germany, Ministry of Research and Technology, H. Quesir, Bonn, 1987.

5) architectures, operating system strategies and programming aids for application-oriented parallel computer systems;

6) methods and tools for error-proof and fail safe hardware and software systems (warranty architectures);

7) design techniques and basic research work related to Expert Systems;

8) full motion images for vehicle and robot control, or quality control inspection of products and component parts;

9) fundamental principles for new storage media and peripheral techniques;

10) architecture models and design strategies for VLSI microchips with more than 108 transistor functions which provide for internal safe-checking (automatic testing) of circuit elements;

11) the development of new display technologies particularly high resolution screens and monitors.

The 1987 Quessir Report emphasized the need for greater cooperation within the country among the universities, research institutes and industry. This was viewed as critical to maintaining advances in research and at the same time ensuring an industry perspective. The report recommended that industry be involved at the earliest possible stage in the research process and that it contribute fully in the sponsorship and financing of research programs.

3.4. Summary of Policies and Programs

At the present time, the policy environment for per-competitive R&D in Germany is in a period of transition. Collaborative projects are actively encouraged through various government and industry programs and existing industry/ university consortia. There is also a strong emphasis on support for small and medium enterprises (SME's). Interest for collaborative projects is quite good but as in many other European countries, interest seems to be highest in applications oriented projects.

4. Detailed Company/Firms/Agency Reviews/West Germany

4.1. Country: Federal Republic of Germany

Organization: VDI/VDE - Technology and Information Centre

Contact: Mr. Heinrich Reverman
Technology Director

Location: Budapester Strasse 40, D-1000 Berlin 30
Telephone: 030260919

1. Overview:

VDI/VDE have been in operation for the past ten years functioning as a non-profit organization, administering and operating high-technology programs on behalf of the government. The organization assists companies and groups in developing project ideas and acquiring necessary capital assistance. At the present time they are administering a project which encourages small enterprises to develop specialized micro-electronics applications. The government will support reliable ventures up to 75 percent while the firm must provide a corresponding 25 percent. A similar program is administered on behalf of the Senate of Berlin as part of a regional industrial development strategy. One of their major roles is to facilitate technology acquisition for German companies.

VDI/VDE also coordinates meetings and disseminates information to engineering societies and the scientific community. They also publish weekly newsletters as well as a report on various topics of interest in informatics and electronics.

2. Research Activities:

A micro-peripheral program is currently being administered which is designed to encourage developments in optical sensors. Funding is provided for R&D in:

1) intelligent sensors;

2) digital sensors.

3. Cooperative Activities:

VDI/VDE are well placed to provide the necessary liaison for Canadian firms and have considerable experience in that function. Some of the potential problems identified by their company spokesman were:

1) lack of familiarity with Canadian capabilities and limited knowledge about the breadth of our research capacity;

2) difficulty in sustaining cooperation between partners with limited international business experience;

3) the need to bring partners together to facilitate initial discussion and assessment of capabilities;

4) the need to develop a specific project framework, stating clear objectives and requirements for joint ventures.

The specific area of interest identified for possible collaboration was:

Sensors:
a) optic and chemical
b) intelligent sensors
c) digital signal processing

4.2. **Country:** Federal Republic of Germany

Organization: Heinrich Hertz Institute

Contact: Dr. Heydt, Director, Optics Division

Location: 37, Einsteinufer, D-1000 Berlin 10
Telephone: 030-310020

1. Overview:

The Heinrich Hertz Institute conducts research and development in a wide number of areas related to the field of telecommunications. In 1985/86 the institute had a budget of DM30.6 million. The largest share was obtained from the Federal Ministry of Research and Technology while other contributors were the Deutsche Bundespost, the European Community and the Society of the "H.H. Institute".

The institute has two main divisions:

1) Communication Systems:
   a) switching and transmission system
   b) signal processing and terminal equipment
   c) human factors engineering
   d) optical signal processing
   e) economic and social studies

2) Integrated Optics:
   a) epitaxy
   b) process technology
   c) lithography
   d) measurement technology
   e) component integration

Research projects are currently being conducted on:

1) broadband communications;

2) micro-electronics and digital signal processing;

3) broadband transmission technology;

4) switching and distribution of broadband signals;

5) epitaxy;

6) lithography;

7) integrated optics;

8) process technology;

9) lithium niobate technology;

10) process and device modelling;

11) materials analysis and measurement technology;

12) optical signal processing;

13) broadband services;

14) video telephone;

15) high definition television (HDTV).

2. Research Activities:

The following projects were identified as offering the greatest potential for cooperative ventures:

1) Optical Switching:
Properties of optical non-linearities. This project will be conducted over the next four ears. It investigates the impacts of non-linear effects on optical multichannel systems. A related study investigates whether the usual electronic repeaters in use today may be replaced by optical amplifiers. This addresses the possibility that several carriers with low channel requirements can be processed simultaneously by the same optical amplifier.

2) Lithium Niobate Technology:
This investigates switching, modulation and polarization transformation. The project examines the fabrication of passive wave guide structures, wave guides, polarization, insensitive Y-branches, star couplers and phase modulators.

3) Optical Subscriber Lines:
Coherent optical subscriber lines with four optical channels, with spacing of only a few GHz between the channels.

4) Single Mode Fibre:
Utilization of single mode fibre for transmission of HDTV signals.

3. Cooperative Activities:

The extent and likelihood for partnerships with Canadian companies and research centres would be conditioned to a large extent on:

1) the expertise and capability of the participants;

2) potential for longer term developments with industry in the product development phase;

3) available manpower and facilities at the institute;

4) need to define projects which are not in conflict with those of West German companies such as D.B.P., Siemens and Bosch.

The institute could provide a focal point for a variety of potential research projects. It provides a world class facility with an excellent record of cooperative research principally in the area of telecommunications.

The institute agreed to review the various topics and potential Canadian participants. However, it is very much oriented to specific on-going research projects and does not typically cooperate with small and medium sized foreign enterprises. In addition, their policy is to undertake cooperative ventures within the institute's long term strategic plan. These activities are, in most cases, being conducted with German or European companies.

The most likely immediate possibilities exist for scientific exchanges and visits with large companies or through government labs and agencies.

4.3. **Country:** Federal Republic of Germany

Organization: Fraunhofer Institute of Microstructure Technology

Contact: Dr. Wolfgang Benecke, Head, Micromechanics Department

Location: Dillenburger Strasse 53, D-1000 Berlin
Telephone: 03082998-0-310

1. Overview:

There are 34 Fraunhofer Gesellschaft Institutes (FLG) with a total staff of 4,000, operating with a budget of over DM450 million throughout West Germany. The FLG is actually a society for the advancement of applied research which contracts with industry and government agencies for R&D projects in the fields of natural and engineering sciences.

The principal activities of the Institute are aimed at developing submicron technology for integrated silicon circuits. In support of that objective, the fundamentals for high-resolution patterning, advanced lithography, x-ray lithography and physical etching are tested and developed.

2. Research Activities:

The main research activity involves the use of x-ray lithography. In this process structures are fabricated with x-ray lithography and transferred into semi conductor material by means of plasma and ion-etching techniques. Radiation induced etching and deposition are other research interests. These activities include:

1) high resolution lithography using x-ray sychlotron radiation;

2) plasma and ion etching and layer deposition techniques;

3) radiation induced etching and deposition techniques.

The centre has fully equipped labs, clean room and measurement devices including:

1) scanning electron microscopes;

2) mask measurements: optical and electro-optical length and overlay measurement;

3) exposure systems for x-ray lithography;

4) systems for reactive ion etching.

3. Cooperative Activities:

The centre has been involved in cooperative ventures with a large number of industrial clients in Germany but has not had very much experience with foreign partners. There are no immediate plans for co-venturing, however the institute would examine individual project submissions falling within its specified areas of interest. The principal limitation on cooperative with Canada is the institute's mandate to undertake "European" projects.

4.4. **Country:** Federal Republic of Germany

Organization: Suprenum, GmbH

Contacts: Harold Barth, Director
Dr. Klaus Peinze, Managing Director
Dr. Karl Heinz Werner, Advisor

Location: Hohe Strasse 73, Bonn
Telephone: 02 236680521

1. Overview:

Suprenum is a new company, dedicated to the development of a multi-processor/multi-level computing system for numerical applications. This represents a joint project by more than a dozen partners from research, academia and industry to develop innovative computer systems for large scale scientific computing.

Partners in the Suprenum project (according to their particular interest) include:

1) Application Software:
Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt (DFVLR), Dornier GmbH, Gesellschaft fuer Mathematik und Datenverarbeitung (GMD), Kernforschungsanlage Juelich GmbH (KFA), Kernforschungsanlage Karlsruhe, GmbH (KfK), Duesseldorf University;

2) Language level:
GMD, Darmstadt Technical University, Bonn University;

3) System Design:
GMD, Krupp Atlas Elektronik GmbH, Stollmann GmbH, Stollmann GmbH, Braunschweig Technical University, Erlangen-Nuernberg University.

2. Research Activities:

The project is focused on three aspects:

1) super-computing;

2) parallel computing;

3) multi-level computing.

The proposed system operates using a multi-processor architecture in which the distributed computer units are not subordinated to a central control but operate autonomously. In the local memory architecture, the individual processors each have their own memory contention. In local memory machines the performances attained by increasing the numbers of processors is limited by the demands made on inter-processor communications. These demands depend on specific applications.

Phase I of the Suprenum project is designed to develop and build a high performance computer from commercially available components. This is composed of:

1) A computer consisting of single board processors ("nodes") connected by a two level bus system;

2) Node processor: 32/64-bit processor MC 68020 fast floating point vector unit, 2MByte of private local memory;

3) Bus link of (up to) 16 nodes forming a cluster on a 19" pullout board;

4) A matrix of Suprenum buses (horizontal and vertical bus link, (based on the upper ring bus);

5) The complete system comprises the computer, clusters and front-end system. This consists of a programming computer, an operating system computer and maintenance computer.

3. Cooperative Activities:

Suprenum is interested in proposals from Canadian companies which address:

1) applications and algorithms using grid structures;

2) innovative language concepts, supporting automatic distribution of processes and data, automatic sectorizing and parallelization;

3) system operations and operating systems which support automatic distribution strategies, investigation of interconnection structures and dynamic grid structures.

The company is interested in identifying Canadian firms, labs and agencies with expertise in parallel processing software for systems development and applications such as:

1) pattern recognition;

2) voice recognition;

3) speech synthesis;

4) other "short vector" applications.

Suprenum is very interested in establishing a Canadian contact for R&D, product development, and marketing in North America.

4.5. **Country:** Federal Republic of Germany

Organization: Telenorma, GmbH

Location: Mainzer Landstrasse 1228-146
6000 Frankfurt am Main 1, West Germany
Telephone: 0692662546

Contact: Mr. Johannes-Georg Schosnig, Director, Strategic Planning

1. Overview:

Telenorma is Germany's third largest communication company in terms of sales and the number of employees. The Telenorma Group consists of 15 sales and manufacturing companies in West Germany and abroad. Major shareholders in the company are Robert Bosch and AEG.

The company is committed to the development, production, sale, installation and maintenance of systems and equipment in: Private Communication Technology, Public Communication Technology and Information Technology. It is a major supplier of public switching equipment and is actively engaged in the countries ongoing ISDN program.

2. Research Activities:

Research and Development activities are handled mainly through Robert Bosch and include: customized semi-conductors, switching circuits and office communication systems.

The company's main areas of interest are:

1) ISDN;

2) ASICS;

3) Switching Systems;

4) Parallel Processing;

5) Voice Recognition;

6) Expert Systems;

7) Display Systems and Technology.

In all cases the research areas are directed to the companies core business interests of telecommunications applications. Specific activities are:

1) ISDN:
The utilization of fibre optic technology in house for wide band data transmission in the ISDN environment. The ISDN interface for customer premises PABX equipment.

2) ASICS:
The design and testing of custom chips for use in PABX equipment providing the facility for full ISDN capability.

3) Switching:
The development of digital switching equipment and requirements for broadband communications. In cooperation with Plessey they are participating in an ESPRIT project incorporating variable bit rates in universal information transmission.

3. Cooperative Activities:

Telenorma is one of the largest suppliers and manufacturers of communications equipment in Europe. It's main stream activity is product development while most of its research activities are conducted through BOSCH. It is not primarily a research organization but has strong interests in those activities. Its main interests for Canada rests in the product development area rather than basic research and development.

4.6. **Country:** Federal Republic of Germany

Organization: FTZ, Deutsche Bundespost

Contact: Mr. Rolf Roga, Director Public Relations

Location: Am Kavalleriesand 3
6100 Darmstadt, West Germany
Telephone: 06151832007

1. Overview:

FTZ is the research arm of the Deutsche Bundespost (DBP) and employs over 3,000 people in various fields of advanced research. Their main interest and research program is directed to the needs and requirements of the Deutsche Bundespost ISDN, Broadband communications, Fibre Optics and Networks Integration. These activities are developed in cooperation with the DBP and the Ministry of Research and Development (BMFT). Liaisons are maintained with all of the major universities and domestic research institutes such as Heinrich Hertz. FTZ also works closely with manufacturers such as Siemens, Messerschmitt, Telenorma, Nixdorf and AEG. Cooperative R&D projects are now being conducted within ESPRIT, RACE and EUREKA. Other ventures are being developed with CNET in France and selected Italian firms.

2. Research Activities:

The FTZ research program is focused on the following areas;

1) information processing;

2) transmission systems;

3) antennae and wave propagation;

4) solid state electronics;

5) switching systems.

Associated with the FTZ is WIK, the Scientific Institute for Research in Advanced Telecommunications. Set up as part of the FTZ in 1982 it is located in Bonn. The centre's mandate is to examine and track developments in telecommunications. Their activities include:

1) monitoring the development of information science and supplying the application orientated results to DBP;

2) research of all non-technical aspects of communications services as well as the socio-economic implications of information and communication technologies;

3) providing advisory services for the DBP management;

4) stimulating the interest in scientific analysis of the communications services at the high school level.

Economic and policy research is focused on:

1) economic, political and legal issues for the industry;

2) post and telegraph policy in western industrial countries;

3) tariff policy in industry;

4) socio-economic effects of information and communication technologies;

5) economic aspects of individual communication services.

3. Cooperative Activities:

There were no specific areas identified for international collaboration with Canadian firms. However, the broad nature of the activities of the FTZ should encourage further inquiries and already there are regular exchanges of scientists from telephone companies and research institutes around the world. Several visits and exchanges have already been arranged between the FTZ the communications Research Centre and other Canadian government centres. The most likely areas for future activities, in the short term, are scientific exchanges and visits.

4.7. Summary West Germany

The most promising opportunities identified in West Germany were:

1) AI parallel processing machines - Suprenum.

2) X-Ray lithography and dry etching techniques - FHE. A strong interest exists for developing cooperative activities in the use of X-Ray techniques.

3) Opto-electronics - The Heinrich Hertz Institute emphasized several areas of interests: non-linearity, coherent systems, phosphor systems and HDTV. The Institute has become more active in contract research and has a mandate to develop international ventures.

4) Telenorma: Voice recognition, parallel processing, display systems and ISDN devices. All are primarily in the product development stage rather than basic research.

5) FTZ are a major centre of telecommunications research. They however were not interested in identifying specific areas where cooperation could be developed. They were prepared to respond to proposals and contacts which should be directed through the Ministry of Communications. WIK has a mandate to track international activities in telecommunications and to conduct R&D. This may represent a suitable candidate for contacts with Canadian universities or policy research units within the federal government.

5. France

5.1. Introduction

The appraisal of the French R&D programs was made, as in all other cases, in two phases. The first occurred in July, 1987 when discussions were held with the Science and Technology officers at the Canadian Embassy in Paris, French government officials at the Ministry of Industry and representatives from the French Telecommunications Organization DGT. The indepth survey was conducted between December 2 and December 7, 1987. In addition to the government departments and Canadian embassy, the following companies were visited:

1) Cognitech - Software Engineering, Paris;

2) CRIN/INRIA - Research Centre, Nancy;

3) CNET/Telecommunications Research Centre, Bagneux;

4) ILOG, Software, Paris;

5) LETI, Electronics Laboratory, Grenoble;

6) INPG, National Centre for Informatics and Applied Mathematics, Grenoble;

7) CNET, Telecommunications Research Centre, Meylan;

8) XCOM, Software Engineering; Monthonnat - St. Martin, St. Ismier, France;

9) ITMI/CAPSOGETI, Software, Meylan;

10) MICADO, Association of French Engineers and Graphic Arts, University of Paris, Paris;

11) SEPT, CNET, CAEN;

12) BULL, Paris;

13) Thomson, Paris;

14) French Association of New Media.

5.2. Policies and Programs for R&D in Informatics

An indepth review of the policies and programs for Informatics in R&D in France indicated the following general findings:

1) There is significant interest and activity in the ESPRIT, RACE and EUREKA programs.

2) The government strategy is oriented towards indirect support of R&D initiatives and encouraging greater use of government and university research facilities.

3) The National Centre for Science and Research (CNRS) has been restructured and placed under the supervision of the Ministry of Research and Technology. Greater emphasis is being placed on establishing linkages with industry and commercializing research results.

4) To further its domestic initiatives a network of information agencies has been established offering support and advisory services (CRITTS) to small and medium sized firms in technology acquisition. Technology transfer centre are now being established to coordinate efforts between local research centres, universities and firms. The Ministry of Research and Technology is assisting in greater regionalization of these centres and they have placed a high priority on small innovative firms.

5) To encourage research by industry, the government has instituted a 25% tax credit on year to year increases on research expenditures up to a maximum of FF 3 million.

6) Organizational changes, designed to improve the capabilities for promoting high technology in France have also been instituted. The Ministry of Research and Technology has been put in the forefront of a renewed effort to develop policies for promoting science and technology. One interesting aspect to the reorganization scheme is that nationalized firms such as BULL are no longer obliged to consult the Ministry on their R&D programs. This provides a much higher degree of autonomy for these firms and also means more diversity can be introduced into their activities.

7) Large firms are expected to play the main role in R&D and will continue to receive the majority of financial support from the government.

Precompetitive research and much of the "goal oriented" research in France is concentrated in the "Public Science and Technology Institutions", (EPST). One of the main centres is the Centre National de la Recherche Scientifique (CNRS). CNRS is linked directly to the Ministry of Research and maintains cooperative relationships with several other centres.

New legislation dealing with research and technology development for the 1986-88 period was voted on by the French Parliament in 1985. At that time four basic principles were defined:

1) concern to step up industrial research;

2) to increase employment in science and technology;

3) to increased resources for research personnel;

4) monitoring of R&D activities to ensure quality and efficient use of resources allocated to R&D.

Special attention has been placed on the electronics sector which is considered critical to the overall economic growth of the country. Within the sector the government has set out to create one or two national champions with whom the relevant activities of other French electronics firms could be coordinated. In the computer field, for example, BULL is France's only major participant, in small as well as large computer systems. In telecommunications the DGT currently plays the main role, although Thomson has influence particularly in the provision of certain types of equipment for the defence industry.

The government recently launched a series of public/private sector cooperative projects. About FF 1.5 billion was allocated to this program between 1983 and 1987 and agreements have recently been signed by manufacturers such as BULL with Siemens, while ICL, BULL and Siemens are cooperating to develop a computer factory along with Olivetti, Thomson and Matra.

5.3. Government Sector R&D, CNES, CNET Initiatives

The government sector, non-university research system includes a number of influential R&D agencies. The most important of which are the Atomic Energy Commission (CEA), the National Space Research Centre (CNES) and the National centre for the Study of Telecommunications (CNET).

The National Centre for Studies in Telecommunications CNET, is the main centre of telecommunications and informatics research in France and its laboratories are located in seven different locations each dedicated to a particular research area. The technology areas include:

1) fibre optics;

2) silicon chip/integrated circuits;

3) broadcast;

4) networks, switching, ISDN;

5) local networks;

6) smart cards, EMS circuitry.

CNET is also the focal point of French collaboration on the RACE program. Their research thrusts are focused on:

1) terminal technology;

2) high performance IC's;

3) integrated opto-electronics;

4) broadband switching;

5) passive optical components;

6) technology options for long distance;

7) communications software.

CNET's research activities encompass several of the areas identified in the Canadian ITRD Survey. These include:

1) Silicon Microelectronics:
Research on basic techniques and materials;

2) Optoelectronics:
   a) liquid phase epitaxy (LPE)
   b) molecular beam epitaxy (MBE)
   c) organometallic epitaxy (OMCVD)
   d) silica fibre and polymar fluoride glass fibers for optoelectronics;

3) Displays:
   a) flat screen using electro-luminescent displays or thin film transistor addressed liquid crystal displays
   b) displays using electro-luminescent colors;

4) Information Techniques:
   a) signals, systems and transmission techniques
   b) computers and data processing
   c) switching techniques
   d) signal processing, speech processing, image processing and meteorology.

A detailed description of selected CNET projects is provided in the interview summary. Appendix 9 presents a summary of the various CNET projects in different multilateral cooperative projects.

6. Detailed Companies/Firms/Agency Reviews/France

6.1. Country: France

Organization: Cognitech, Software

Contact: Dr. Michel Clerget, Vice President Software Engineering

Location: 167 Rue Du Chevaleret
750143, Paris
Telephone: 33145837300

1. Overview:

This relatively young company was formed in 1984 by a group of academics and engineers formerly employed at Renault. In 1986 they had 62 employees and generated sales of FF 212 million. The company's main activity is in the development of AI software. In general, most of their work centres on application specific software using expert systems rather than basic research.

The principal research areas are:

1) custom designed expert systems;

2) image processing;

3) natural language interface software.

2. Research Activities:

The company is involved in a FF 30 million R&D project examining Knowledge Engineering software. The aims of the project are:

1) to assist knowledge engineers through the software development process;

2) to introduce methodologies for developing AI specific systems;

3) to provide the components for expert systems using a "tool box" approach incorporating inference and object languages.

3. Cooperative Activities:

Although the company has limited experience in international collaboration, they are presently participating in an ESPRIT project together with GEC and Marconi.

There is a strong interest in developing ties with Canadian companies. The most immediate prospects were for scientific and expert exchanges to develop and define collaborative ventures focusing on Knowledge Based Systems.

6.2. **Country:** France

Organization: National Centre for Informatics Research, CRIN

Contact: Jean Paul Haton, Director

Location: 54506, Vandceuvre, Nancy
Telephone: 83912118

1. Overview:

Mr. Haton heads a lab which is part of The Institute National de Recherche en Informatique et en Automatique (INRIA). A number of specialized labs are affiliated with INRIA each conducting basic research in informatique and automatique. Collaborative projects are conducted with industry in addition to scientific exchanges. The main purpose of the research activities are:

1) to undertake basic research;

2) to develop experimental systems;

3) to disseminate results to industry;

4) to identity new long range research interests in informatiques.

2. Research Activities:

CRIN is dedicated to the development of AI as part of a broad national funded project (PRC) similar to the British ALVEY program. The main areas of activity for CRIN are:

1) man/machine interface;

2) AI natural language processing, using database lexigraphic and error processing techniques;

3) intelligent databases;

4) expert systems, utilizing phonetic decoding and speech transcription.

3. Cooperative Activities:

This meeting was extremely short due to Mr. Haton's very busy schedule. However, a few general areas were discussed which are directly related to the areas of Canadian interest. Mr. Haton agreed to provide more detailed information on CRIN's activities if specific inquires were forthcoming.

While no specific joint projects were identified, Mr. Haton is a prime contact for information about R&D activities now being pursued in France. He has an excellent understanding of what is being done, who are the principal researchers and where their activities are conducted. Mr Haton would be an ideal contact for further information on R&D programs in AI throughout France and he has agreed to act in that capacity. Inquiries can be made either directly or through the Canadian Technology Development officer.

6.3. **Country:** France

Organization: Centre National D'Etude Des Telecommunications, CNET Centre B Bagneux, Paris

Contact: Mr. Benjeman Joukoff, Chief, Bagneux Laboratory

Location: 196 Avenue Henri Ravera
Bagneux, F922220 France
Telephone: 33-1-45295396 Telex: 202266 F

1. Overview:

CNET was established in 1944 as an inter-ministerial research and development centre operated by the Ministry of the P&T. Two main activities are conducted: scientific research and technical research. The main areas of scientific research are:

1) applied mathematics;

2) data processing;

3) solid state physics;

4) terrestrial environmental physics;

5) communication sciences.

Technical expertise and research results are made available to French industry for the further development of telecommunications equipment and setting of standards.

Technical research interest are:

1) design and development of new technologies;

2) design and manufacture of electrical components;

3) data processing applications;

4) communication network and system studies;

5) new telecommunications services studies.

2. Bagneux - Activities:

The Bagneux lab is one of two in Paris and is dedicated to physical studies and transmission. The other Paris lab conducts research on databases and telephony. The three divisions of the Bagneux facility are:

1) physical materials and micro structures;

2) optoelectronics and materials for components;

3) microelectronics.

These two labs are complimented by another two where research is conducted in data processing, speech synthesis, fibre optics, lasers, photo receivers and optical simulation.

There are several common projects between the sites:

1) fibre optic transmission in the 560 mgbt. rate;

2) use of 5.55 micron wavelength modulators;

3) use of lithium niobate (this activity has now been transferred to Alcatel).

3. Research Activities:

Experiments at Bagneux are directed to the development of micro-optoelectronics which associate the processing of electronic and optical signals. The more general areas of activity range from studies on the physical properties of materials to the demonstration of the feasibility of devices and circuits.

Two specific projects discussed are:

1) Organic Materials:
The engineering and production of crystal growth in support of materials for non-linear parametric crystals. This project is designed to assess the properties of organic materials to provide thin films or optical guides. The project is being carried out under the ESPRIT program with Thomson, ICI and Namur of Belgium.

2) Integrated Devices on Phosphate:
This involves optical integration of photo detectors with lasers. This is another ESPRIT project operated in conjunction with CGE, HHI, SEL, Thomson, STCL and Telefunken.

Several other collaborative research initiatives are currently being pursued as joint efforts involving the Bagneux facility with other research centres Caen, Rennes, Grenoble, Lannion and Paris.

These projects include:

1) CONCERTO:
A software workshop integrating activities relating to the evolution of software, software design and implementation (completed in 1986).

2) MONOMODE:
A monomode optical fibre interurban transmission system with long regeneration hops operating at very high capacity.

3) PROTEUS:
Design of an NMOS component with 70,000 transistors intended for signal processing with hardware and software development tools.

4) MARATHON:
A modular digital network for communication with mobile subscribers in the 900 MHz band for speech, data and messages.

5) RENAN:
A life-size ISDN experimental project in the local network (in the Tregor and the Ile-de-France areas).

6) SARDE:
An electronic system for documentation archiving and search.

7) CLEMATITE:
A liquid crystal flat screen for Minitel, controlled by a thin-film transistor matrix.

8) ECRINS:
A specification for a new multi-service subscriber exchange.

9) ARIOSTE:
Development of tools for an OSI-ARCHITEL protocol validation centre.

10) SMARTIX:
Networks and data means for research centres.

11) ARAVIS:
Implementation of validation tools and methods for telecommunication systems software.

4. Cooperative Activities:

The Bagneux facility is one of several labs operated by CNET. They are active in a number of cooperative research projects which may have relevance to Canada. Their mandate however, is rather strictly defined making it difficult to deviate from the original ESPRIT program. Collaborative projects would have to be considered in the context of ESPRIT or RACE and be defined by the needs of French companies.

Given the close association between CNET and the French DGT it is most likely that scientific exchanges would be more suitable than cooperative projects. Other problems were identified with respect to ownership rights and intellectual property. CNET is only now attempting to have the right to grant licenses to third parties.

CNET Bagneux represents a extremely good centre of excellence for R&D in telecommunications and informatics. It's close association with the telecommunications industry in France however makes it difficult for foreign companies to develop cooperative projects. There may be more possibilities if contacts and scientific exchanges could be initiated through government channels and departments such as CRC. This would create greater awareness of Canadian capabilities and help in the identification of relevant areas of complimentarity to initiate joint, long term R&D projects.

6.4. **Country:** France

Organization: ILOG

Contact: Mr. Pierre Haren, Directeur General
Mr. Jerome Chailloux, Scientific Manager
Mr. Marc Fourrier, Partner in Eurosept Associes

Location: 9, rue Royale, 75008 Paris
Telephone: 1142 68 13 44 Telex: 305 551 F

1. Overview:

ILOG is a relatively small company with assets of 1.2 million francs. It was created in March 1987 as an affiliate of INRIA to facilitate the industrial spin-off of research results in artificial intelligence.

The company is working on the development of Artificial Intelligence tools and software engineering. It has specialist knowledge of Le-LISP[2], and provides European companies with software intelligence tools, services and consultancy.

ILOG's activities cover four complementary fields:

1) the development and implementation of Le-LISP (French dialect LISP);

2) the development of tools for the construction of expert systems;

3) advice on the use of these tools;

4) training in AI techniques and expert systems.

2. Research Activities:

1) Le-LISP Version 15.2:
This is a LISP[3] system originally developed at INRIA, consisting of an interpreter, a compiler, a programming environment and virtual graphic interface.

Le-LISP was designed to support high level systems for computer-aided design, expert systems, computer-aided education, simulation, and to address a range of common problems arising in Artificial Intelligence and its associated fields.

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[2]Le LISP - a proprietary product of ILOG

[3]LISP - Logic Inference System Program

2) AIDA:
This is a software tool using sophisticated graphic interfaces for programs written in LE-LISP. AIDA is built around an image description language which reduces the user's interface programming to the task of assembling certain basic components (scroll bars, menus, button, line editors, etc.). The user has only to define the reaction of these basic components by different manipulations of the keyboard, mouse, etc. Each combination of basic components can be used in higher level assemblies, allowing the user to build up a library of components (text editor, tree editor, simple and multiple image selectors, etc.).

AIDA uses VIRTUAL BITMAP display in the 15.2 version of Le-LISP. It is currently operational on SUN and Vax machines, and will shortly be available on all machines supporting VIRTUAL BITMAP displays.

Highlights are:

a) flexibility of use and a powerful language;
b) a large number of predefined components to build up a control panel;
c) the image description language can easily be extended due to the use of LE-LISP object-oriented primitives;
d) tools for interactive development, debugging, and the construction of extensions for AIDA.

3) CLASSIC:
This is a tool for the development of expert systems adapted to classification, data analysis and diagnosis. It consists of object and rule editors, a rule compiler and an inference engine.

The object classes are represented by prototypes that are linked by hierarchical relations. Presented with an incomplete description of an object, CLASSIC runs through the tree structure to find the prototypes that are the closest match to the object. During the reasoning, the rules complete the object to be classified by adding descriptions of a higher symbolic level than were contained in the initial data obtained by sensors or numeric computation.

CLASSIC uses fuzzy reasoning based on the probability theory thereby creating a highly efficient means of expressing uncertain or imprecise knowledge.

The use of fuzzy reasoning allows CLASSIC to manipulate imprecise and uncertain data. By distinguishing the object's degree of compatibility from its degree of incompatibility with the prototypes, CLASSIC produces reliable solutions even when dealing with incomplete or contradictory information.

CLASSIC is currently in use at AEROSPATIALE for the diagnosis of antenna failures and at INRIA for scene analysis.

4) SMECI

This is a generator of expert systems adapted to the design, simulation and configuration of tasks. The software consists of six interconnected modules: two rule and object editors, a rule syntax checker, an inference engine, and an environment for developing graphic applications. It offers a flexible object-oriented representation using active values and coherent management constraints. This representation is integrated in typed variables, first order logic and user-extensible predicates. The control mechanisms are based on the concept of locally controlled rule sets. Multiple "world" management is widely used in its applications. The system allows reasoning upon reasoning, which makes it possible to realize, for example, a self-explaining expert system.

The integration of a description language, structured prototypes and objects with an efficient and sophisticated rule language evaluating and comparing the quality of the states produced makes this a suitable tool for configuration and design problems.

SMECI is in use at:

a) AEROSPATIALE;
b) Scientific and Technical Centre for Civil Construction;
c) Ministry of the Sea;
d) Centre for Technical Studies on Equipment at Aix;
e) Programming and Analysis Centre of the French Navy.

3. Cooperative Activities:

The main areas where cooperation would be encouraged are: software tool development and Reference Applications.

The company currently has some contact with Canada through a project at the University of Laval. This involves the Engineering school for soil mechanics in the development of expert systems for analyzing slope stability.

The company is amenable to cooperative ventures with AI companies in Canada, particularly those with experience in LISP.

6.5. **Country:** France

Organization: LETI, CEA-IRDI[4], Electronics, Technology and Instrumentation Division

Contact: Mr. Ph.Coeur, Manager Materials and Components
Mr. J. Duchene, Manager Thin Films and Microtechnics

Location: Grenoble, Cedex F
85X 38041, France
Telephone: 74884006 Telex: 320323 F

1. Overview:

LETI is a division of the Centre for Nuclear Studies (CEA) which specializes in electronics, materials and instrumentation. The Grenoble centre employs 650 personnel, has an annual budget of 300 million FF and pursues three main streams of activity:

1) silicon micro-electronics;

2) optical devices;

3) instrumentation.

Several research projects are now under way, the ones most relevant to Canadian interests are:

1) silicon materials;

2) magnetics;

3) photo detectors (infrared technology for military applications);

4) thin films;

5) flat panel displays and sensors;

6) materials.

Much of the centres research is conducted on a cooperative basis with about 50% carried out in conjunction with CEA and the remainder with industrial clients. The centre maintains close ties with the universities and the CNRS[5]. Projects are usually set up on a joint basis where research labs and personnel are shared for periods of two to three years. Basic, precompetitive research is usually facilitated through joint ventures with universities, CNET or CNRS.

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[4]IRDI - Institute for Industrial Technology and Development Research

[5] Centre National de la Recherche Scientifique

2. Research Activities:

While LETI is actively pursuing several precompetitive research areas, only two or three are directly related to Canadian interests.

1) Flat Panel Displays:
This activity is based on two different technologies; Liquid Crystal Displays (LCD) and cold emission cathode ray tube (CECRT).

a) LCD's:
Precompetitive research is directed to highly multiplexed colour displays using the ECB effect (Electronically controlled Birefringence). The main characteristics of the prototypes developed to date are: 250 x 960 pixels, 9 inch diagonal, 8 colour transmissive mode 5 to 10 images/sec. contrast 5:1. These operate in the French minitel colour mode.

Other initiatives are being pursued which will provide 960,000 pixels in 64 colour video mode. Other more advanced research is examining smectic chiral ferroelectric liquid crystal displays which present an intrinsic memory effect (bistable operation) and very low switching times. Systems are also currently being tested having 288 x 480 = 140,000 pixels on a 5 inch diagonal operating in 8 colour video mode (T.V.).

b) CECRT:
Cold emission flat cathode ray tubes are being tested which allow the emission of electrons by field effect using microtips in a flat cathodic tube. The matrix structure of the display is made up of the crossing of wire cathodes and wire grids. The electrons use phosphor to emit light. The main characteristics are:

i) density of microtips 10(4)/mm(2)
ii) switched voltages (grid/cathode/:40V)
iii) polarization anode
iv) 32 x 32 points
v) luminance 300Cd/m(2)
vi) power (1 w/dm^2)

2) Sensors:
a) New Materials:
i) CdTe and HgI_2 for radiation sensors
ii) BaF_2 as a scintillator
iii) $LiNbO_3$ for pressure and force sensors
iv) LaF_3 for ion-sensitive sensors

b) Electronic Components:
The main activities in this areas includes:
i) Applications of microelectronic and thin layer technologies for electronic micro-sensors.
ii) Silicum for the detection of flame and smoke (licence held by SICLI)

iii) Cylindrical thin-layer magnetometers
iv) Ion-sensitive sensors in various hybrid technologies
v) Magnetic field micro-sensors
vi) Micromechanical sensors on a monocrystalline substrate (acceleration, pressure)
vii) Applications of the properties of fibers optics and integrated circuits signalling to a variety of sensors; polarimetric current sensors (optical fibers); pre-processing, distance-proximity - vibration.

3. Cooperative Activities:

LETI are one of the most advanced centres for basic research in selected areas of micro-electronics in France. The centre encourages collaborative research activities but prefers to develop longer term projects on a partnership basis and through sharing of facilities and personnel. Although the centre is a government agency, there is a strong industrial and private sector orientation. In that respect it presents a good potential candidate for collaboration with Canadian firms or government labs. The most promising areas of collaboration are: Flat panel displays, materials, sensors and scientific exchanges.

6.6. **Country:** France

Organization: National Polytech Institute of Grenoble, INPG

Contacts: Professor Gerard Veillon, Director of Informatics and Mathematical Applications
Professor Rene Carre, Director, Speech Communications

Location: INPG, Domaine Universitaire
38402 Saint Martin-D'Heres,
Cedex, 38402

1. Overview:

The National Polytech (INPG) was set up in 1971 as a technological University specializing in a wide range of industrial fields. Although primarily an academic institution, it maintains close ties with the industrial world. The institute brings together the seven different engineering schools of Grenoble with a total student population of almost 3000. There are 22 laboratories of which 19 are associated with the CNRS. These labs address microelectronics, materials, electronics, mechanics, computer science and energy.

One of the newest developments is the creation of the Institute for Intelligent Machines (IMI). This centre was formed from the laboratories specializing in:

1) fundamental research and AI;

2) computer aided design/machine architecture;

3) parallel processing;

4) image processing;

5) pattern recognition;

6) speech communication.

2. Research Activities:

The IMI conducts research in cooperation with industrial partners and was set up to encourage joint research activities with other research centres and universities. Exchange programs have been conducted with over 60 foreign countries and a wide variety of individual research laboratories. A number of student and scientific exchanges have already been established with the University of Ottawa and the University of Montreal.

At the present time projects are being conducted in:

1) speech recognition, (robot control);

2) neuro-networks;

3) image processing;

4) machine translation.

Some of the areas where cooperation could be pursued are:

1) integration of AI into image processing;

2) use of parallel processing for image analysis;

3) knowledge based systems in image processing;

4) man machine communications;

5) Simultaneous Translation (four languages developed).

In the field of electronics 13 different labs conduct applied research in the following areas:

1) ICP:
Spoken communication. The production, perception, analysis, synthesis and recognition of speech. Man/machine communication.

2) TIRF:
Image processing, pattern recognition, three dimensional vision systems and cellular logic.

3) LPCS:
Physics of semiconductor components, production of integrated circuits. Three dimensional integrated circuits; SOI silicon on insulator; sub-micronic components. VLSI magnetic captors; noise and fluctuations.

4) LEMO:
Microwaves: imagery, integratable circuits in the millimetre wavelength range, fast processing circuits. Opto-electronics: guided wave optics, optical stability.

5) LAG:
Modelling and system control, optimization and flexible manufacturing systems.

6) CEPHAG:
Signal analysis, underwater acoustics, atmospheric acoustics, ocean magnetic signals, geophysical signals.

7) LEG:
Actuators in robotics. Motor controlled.

8) LMPG:
Silicides for integrated circuits. Magnetic recording materials

9) LIFIA:
Fundamental computer science and artificial intelligence, mathematical models for systems, computer models for intelligence. Robotics, Musical computer science.

10) LCS:
Circuit design (VLSI, ULSI), VLSI-CAD testing, card design (real time, microprocessor cards); system design (parallel machines).

11) TLM 3:
Techniques of data processing, mathematics, microelectronics and quantitative microscopy. Parallel algorithms and silicon algorithms.

12) LGI:
Computer system architecture. Fundamental computer science and programming. Databases, software engineering, Parallelism, communication, and integrated circuits.

13) ARTEMIS:
Work group on mathematical and computer system techniques. Specification languages. Production control models, simulations, graphic semantics and image synthesis.

3. Cooperative Activities:

One of the principal objectives of the INPG is the specification and implementation of cooperative and collaborative research projects. There is interest particularly in the context of the IMI, to establish linkages with Canadian firms and research centres who have experience in: AI, knowledge based systems, image processing and machine translation. While it is essentially an academic centre, it nonetheless offers opportunities to industrial and government laboratories.

6.7. **Country:** France

Organization: CNET, Grenoble

Contact: Jean Paul Klein, Project Manager, Centre Norbert Segard

Location: Chemin du Vieux Chene
BP 98 38243 Meylan Cedex
Telephone: 33,76 514109 Telex: 98072F

1. Overview:

The Norbert Segard Centre (CNET) at Grenoble is the first public research centre in France devoted entirely to the field of silicon microelectronics. The centre was built in 1981 and is one of seven CNET centres located in four different areas dedicated to R&D in telecommunications. This centre employs 310 people of which 180 are engineers and senior managers.

The major tasks of the centre are:

1) circuit design;

2) modernization of the tools to manufacture circuits for use in telecommunications and associated physics research.

2. Research Activities:

Specific results achieved by the centre over the last few years include:

1) production of a complex signal processing microprocessor, with a total of 77,000 transistors;

2) creation of the CASSIOPEE system of integrated circuit design software. This is one of the most advanced systems in the world and now forms part of all major European programs, following its selection for the French national CAD program;

3) creation of models for electrical and technological simulation of integrated circuit operation;

4) creation of a data base to monitor the production of integrated circuits;

5) production of a new ultra-fast transistor;

6) development of technology to produce double metal CMOS integrated circuits with minimum etching to one micron;

7) improvement in machines used in the circuit manufacturing process, particularly those used in laser etching, surface characterization, quartz tube cleaning, laser microprocessing and microwave plasma etching;

8) improvements in techniques to produce transistors on a silicon-on-insulator substrate.

Exploratory studies span four basic fields of operation:

1) electron and photosensitive masking resists: physic-chemical characterization, multi-layer assembly (e.g. two layer with DUV transfer), addition of coloring and inversion processes;

2) electron beam lithography; writing strategy, proximity effects, recognition of alignment marks, performance limits;

3) Deep UV (DUV) lithography (200-250 nm): evaluation of the possibilities of this technique for dimensions of O.5 um, studies of DUV-resin interaction;

4) investigation into the conditions of dielectric polymers (Spin On Glass polymides) for use in lateral insulation and metallic interconnections.

The centre is active in the ESPRIT program where two important projects are currently underway.

1) CVS, study and development of design tools for integrated circuits.

2) Spectre, VLSI/CMOS submicron process.

The centre maintains close associations with public laboratories ,universities and the CNRS.

3. Cooperative Activities:

Research activities of most relevance to the Canadian interests are:

1) Video signal processing circuits which use the same chip for functions such as filtering, dematrixing and digital analog conversion. This uses CMOS technology developed in house at the CNS. This is part of an effort to improve capabilities for network digitalization.

2) CAD activities focus on the development of computer aided design using new procedures such as silicon compilation. The aim is to develop a collection of software operations on a work station with graphic facilities using a single data management system and single user interface. The study takes into account developments in workstations and data processing languages such as ADA, LISP and C.

3) Lithography: The aim of this research is to facilitate the production of units whose dimensions are considerably less than one micron, ranging from 0.5 to 0.05 um. The activity has two aspects; studies of an exploratory nature, and project support requiring submicron lithography. Most of the centres activities are designed to support domestic priorities for telecommunications.

4) The possibilities for cooperative research are most probable in the areas of CMOS, Lithography and CAD technology. The centre has experience with the University of Sherbrook in the area of CAD but this has not yet led to a specific project definition.

5) Silicon on Insulator: One technique developed at CNET, uses a zone mini-melting process, whereby a polycrystalline silicon layer is deposited on silicon oxide which will act as an insulation oxide. The SOI is produced on a wafer 100 mm in diameter.

A second technique is based on the oxidation of porous silicon. A method and machine has been developed which can be used to prepare porous silicon in the highly doped buried layer of an N/N+/N substrate type epitaxial structure, and to form the porous silicon in the N + layer. Following oxidation, SOI islets are obtained. The insulation oxide is equivalent to thermal silicide. The wafers can then be used in conventional technology, but the techniques also allow greater latitude in the selection of parameters such as thickness of insulation oxide or of the SOI film and doping of active layers.

6.8. **Country:** France

Organization: XCOM

Contact: Mr. Bernard Sempe, President

Location: St. Ismier, ZAC Le Pre Milliet Montbonnot-St. Martin
BP 29 38 330 St. Ismier-France
Telephone: 76 520046 Telex: XOP 980 281

1. Overview:

XCOM is a medium size company specializing in four areas of communications research activities:

1) design and manufacturing of graphic pallets;

2) voice recognition systems using speech synthesis;

3) transmission networks;

4) display terminals.

The company has a plant in Grenoble with offices in Rennes and Paris. It carries out the design and manufacturing of products in the areas of image, speech processing, and transmission networking.

2. Research Activities:

Principal areas of interest are:

1) videotex editing and display systems;

2) speech processing, voice synthesis and recognition;

3) voice mail, man/machine interaction.

The company's main strength resides in the custom design of communication systems for individual clients. The main focus at present, is on digital voice systems and the use of packet switching network technology. Graphics systems are generally operated in CEPT standard although there is strong interest in various types of conversion software.

3. Cooperative Activities:

Cooperative activities with this company would most likely occur in product development rather than R&D. They are particularly interested in three dimensional graphics and software for speech synthesis. One of their main product lines is a voice mail system and associated interface software. XCOM has expertise in the area of electronic message switching although this product areas has not been developed to any great extent at this time.

The company's interest in collaboration would be limited to firms with expertise in graphics systems or in voice recognition. There is only limited experience with international collaboration.

6.9. **Country:** France

Organization: ITMI-CAP Sogeti

Contact: Bruno Dufay, Director Artificial Intelligence
Maurice Schlumberger, Chief Research, Grenoble

Location: ZIRST, Chemin Du Pres
38240 Meylan
Telephone: 76903381, Telex: 9870 334 F

1. Overview:

ITMI is a subsidiary of the software house Cap Sogeti. The parent company has operations in Europe and the US and it employs 6,858 people and earned US$424 million in 1986.

The company provides a wide range of services and products in the data processing field and has a particularly strong interest in the various applications of:

1) robotics, computer vision;

2) software engineering;

3) AI/expert systems, natural language, dialog systems;

4) man/machine interface systems;

5) security systems for computers.

Cap Sogeti only recently acquired ITMI, a company specializing in AI and Robotics. Research focuses on the integration of AI, computer vision and robotics. This involves the programing of robots using specialized languages such as LM, for manipulation. One system now being examined allows robots to extract gradient measures from full video images in order to perform specific functions and tasks in real time. The main applications for these robots are in industrial process control.

The LM language was developed in co-operation with the French IMAG laboratory (Computer Science and applied Mathematics at Grenoble). The LM language has three parts:

1) textual programming language;

2) Formal base compatible with pre-LM software;

3) a development tool for computing assistance utilities.

The language has a simple pascal syntax, facilitating writing, comprehension, and program modification.

2. Research Activities:

In addition to the general area of robotics the company is active in the following:

1) Computer Vision Systems:

Systems have been developed which utilize advanced computer software with hardware to present robotic/vision systems, comprised of a vision sensor, camera and central electronic processing unit. The processing unit carries out the following tasks:

a) segmentation of digitized image;
b) image feature interpretation.

ITMI has developed a global vision system (GTR) specifically designed to combat the conditions of speed and ambient lighting. GTR, operates in real time on a camera signal: the signal is digitized and the segmentation phase prepared by determining the information constituting the image contrast points (or contours). A second process contracts visual features based on information sent by the GTR. The software architecture is based on AI, which ensures no redundancy.

2) Robot programming and Industrial Vision:

The company's existing product in robotics include:

a) Propel; An expert system for designing process plans. The program assists in defining activities for determining the sequence of operations to perform a manufacturing exercise. This software incorporates AI techniques into the decision making activity associated with the process.

b) Pilotex: A system for the construction of continuous process monitoring assistance using expert systems. The system runs a variety of micro and mini computers systems and operates in French and English. The programming language is LISP.

c) Vision Edge: A single board vision processor for PC-AT Compatibles.

3) AI/Project Management:

These activities are diverse and cover the full spectrum of software applications, customized projects and database development. The most relevant areas of advanced research are focused on refinements and extensions of artificial intelligence and expert systems. Emphasis is directed towards an ESPRIT project known as PIMS.

PIMS is a joint effort with the Turing Institute, University of Amsterdam, London Business School, London School of Economics University College London. It aims to develop a business oriented

software system through the creation of a Project Interpreted Management System (PIMS).

The main objective is to provide computer based support for the project manager of a software development team. The system incorporates expert and knowledge based system to assist the manager in decision making. This is accomplished by:

a) an information system, reporting on project status;
b) intelligent assistance offering advise and warning;
c) possible action based on past experience to allow exploration and analysis of decisions.

3. Cooperative Activities:

Cooperative research activities would be possible in the areas of image synthesis, expert systems robotics, and vision systems. The company has an interest in image analysis particularly in the area of optical sensors, and advanced processing software.

Experience in cooperative projects has already been gained through participation in the EUREKA and ESPRIT programs. Although there have been no previous contacts with Canadian companies there was considerable interest in relevant areas of expertise.

6.10. **Country:** France

Organization: Service D'Etudes Communes des Postes et Telecommunications, SEPT, CAEN

Contact: Mr. Michael Venard, Chief of Telecommunications, Assistant Director
Mr. Marc Sinou, Electronic Payment and Monetique, Division Chief

Location: 42, rue de Coutures, Caen CEDEX (France)
Telephone: 31759200 Telex: 171257F SEPT CAE

1. Overview:

The SEPT/CAEN research centre was established in 1983 under the authority of the Director General of Post and Telecommunications. New facilities were completed at CAEN in 1986 and today 170 research personnel are active in the investigation of:

1) electronic mail/transaction systems;

2) electronic payment systems;

3) open system interconnection;

4) security systems and encryption.

2. Research Activities:

The majority of the centre's research effort is directed toward so-called "Monetique": money transfer and smart card technologies. In this context the centre has been examining the development of more secure systems for EFT and ways of improving the memory capabilities of smart cards. The main thrust is toward memory cards or "smart cards" as opposed to EPROM cards.

Smart card uses include banking and non-banking applications. Research is addressing not only the technical issues of reprogrammable cards but economic issues, transmission and encryption.

The discussions at Caen revealed that virtually all encryption is now based on "key" systems. Thus the centre has become a world leader in this area and provides support to many banking and telecommunications system operators.

Key systems are based on algorithms which can be contained on a memory or smart card. The current strategy is based on the principle of a zero information algorithm.

3. Encryption Techniques:

There are two projects now underway, designed to assess different encryption techniques and "key" systems. The main theme of the research is on questions of system "integrity" and "public key algorithms".

The most recent efforts are directed toward the use of zero information algorithms using smart cards. A related activity is the fabrication of circuits which allow the computation of algorithms at .2 sec. making it possible to operate at 128 kbps (the speed of ISDN).

Related to encryption are experiments dealing with the use of; image recognition, pattern recognition, bio-metric authentication, and voice recognition.
Biometric authentification focuses on the use of pattern recognition techniques. This includes signature finger print and voice verification techniques. All of these techniques are being incorporated directly onto smart cards for high speed interactive verification.

4. Cooperative Activities:

Cooperative activities were of interest to SEPT/CAEN, particularly for encryption techniques incorporating the "zero information algorithms". CNET is not interested in processor technologies but they are open to specific suggestions from Canadian companies. The close connection of CNET to the DGT and the French telecommunications industry may present some concern to Canadian firms. However, there are several research areas which seem to offer a high degree of complimentarity to interests of Canadian firms.

Cooperative projects, scientific and student exchanges are being pursued actively by the centre. There are already close ties with the University of Caen where student and professional exchanges are encouraged. International liaisons are maintained through the ESPRIT and RACE programs. Further contacts with Canadian agencies and public research centres would be welcomed.

6.11. **Country:** France

Organization: Micado

Contact: Pierre Soubry, President

Location: Universite Pierre et Marie Curie, Tour 66-Couloir 6656, 4 Place Jussieu, 75230 Paris Cedex 05
Telephone: 43547054

1. Overview:

Micado is the association of French engineers specializing in the areas of graphics and computing. It represents the individuals, universities and companies active in the fields of CAD/CAM and graphics design. The association maintains a central library, publishes a journal, produces seminars, conferences and trade shows.

2. Research Activities:

In addition, the organization serves as a coordinating centre for several different associations and universities involved in research on CAD/CAM advanced graphics and audio visual systems. It represents approximately 200 different firms and agencies using or developing advanced CAD/CAM and audiovisual graphics systems. Included in the association are many of the large French manufacturing and high technology firms:

1) Aerospatiale
2) Renault
3) ALCATEL
4) Digital Equipment
5) BULL
6) Data General
7) MATRA
8) UNISYS
9) CNES/CNET
10) Control Data

3. Cooperative Activities:

The association executive welcomes the inquiries from Canada and indicated their willingness to circulate information among the membership and direct responses to Canadian Embassy representatives. However, since this is an association its main advantage will be to serve in a distribution and dissemination function among the users and suppliers of CAD/CAM systems.

6.12. **Country:** France

Organization: BULL

Contact: Mr. Jacques Fleuret, Director Scientific Group
Mr. Francois Salle, Corporate Scientific Director

Location: Rue Jean Jaures, 78340 Les Clayes-Sous-Bois
Telephone: 34627598 Telex: 699077F

1. Overview:

BULL, a large multinational informatics company with operations throughout the world generated, revenues in 1986 of 18 billion FF (US$3 billion). About 30% of this total was generated outside France with the majority derived from its operations in West Germany. The total work force in 1987 was 26,800. Approximately 10% of annual revenues are dedicated to R&D activities. Two research centres are maintained in France and a further seven development centres exist around the country. The main centres are located at Louveciennes and Les Clayes-sous-Bois with other specialised research centres located at:

1) Le Pecq:
   Development of custom applications in office automation

2) Les Clayes-sous-Bois:
   a) Group Research Centre
   b) Medium and large-scale systems
   c) CAD/VLSI
   d) High Performance systems

3) Trapes:
   Memory Card

4) Angers/Joue-les-Tours:
   Minicomputers, medium and large-scale systems

5) Louveciennes:
   a) Group Research Centre
   b) Software development for medium and large-scale systems
   c) CAD Centre
   d) Networks
   e) Applications

6) Paris-Gambetta:
   a) Medium and large-scale systems
   b) Applications

7) Massy/Les Ulis:
   a) Microcomputers
   b) Office automation systems
   c) Corporate communication
   d) Microcomputing

8) Belfort:
   a) Peripherals
   b) Magnetography

9) Crolles/Echirolles (Grenoble):
   a) Technical, scientific and industrial minicomputers
   b) Communications
   c) UNIX centre.

The company is also a partner in several centres outside France specializing in the following activities:

1) The German production management software development centre;

2) ECRC Munich (Bull-ICL-Siemens); Artificial Intelligence, Decision making tools;

3) USA; microprocessor cards and microcomputers;

4) Brazil; medium scale systems.

While the company is essentially product oriented it has a very strong and established research focus. It's main activities and research interests are:

1) VLSI design;

2) magnetic tape storage technology;

3) software engineering, applications software;

4) artificial intelligence.

BULL is essentially a manufacturer of microelectronics equipment and systems. The company manufactures and sells products in four main areas:

1) general purpose data processing;

2) scientific and technical information;

3) distributed data processing; and

4) office automation professional microcomputing.

2. Research Activities:

1) Software Development and Research:
AI software development and engineering are the main thrusts of the company. They work in conjunction with a variety of software houses to provide services, systems and integrated products. At the present time inter company cooperations are being pursued with NEC, Ridge

Computers, Convergent Technologies and Olivetti. Within Europe, Bull is cooperating with most of the major microelectronics and telecommunications companies including CGE, THOMSOM, NIXDORF, SIEMENS, OLIVETTI, STET, ICI, GEC, PLESSEY and PHILLIPS.

BULL is active in 26 different ESPRIT projects focused on: semiconductors, computer architecture, AI and Knowledge Based Systems.

2) Information Systems:

The company offers the following product lines and services:

a) General Purpose Systems:
Development of the Bull DPS 7 line of systems including the Bull DPS 7000 integrated departmental computer and its operating system.

b) Scientific and Technical Systems:
Development of a range of UNIX products adhering to international standards and providing for the porting of a number of application programs. Distributed data processing and office automations systems: Development of a family of high performance multiple compatibility micro and mini computers (BULL Questar and BULL Micro lines).

c) Communication:
Development and validating of European and international OSI standards. Support of ISO/DSA network architecture for various product lines.

d) Data Storage and Processing Systems:
Development of the Bull CP8 chip card. Development of high speed, non-impact printing systems.

e) Software Engineering:
Creation of a number of application programs providing users with corporate information and communications solutions (ICS), CAD, CIM, etc.

f) Distributed Systems Architecture:
The target of this research work is to provide users of distributed systems with communications, resource sharing, computing and filing. Developments cover a number of fields:
i) digital computing
ii) symbolic computing
iii) fault tolerance
iv) data storage and processing
v) communication procedures
vi) graphic processing
vii) office automation, etc.

3) Artificial Intelligence:
Group BULL and ECRC (the European Computer Industry Research Centre created jointly by BULL, ICL and Siemens) are conducting research work on the following subjects.

a) knowledge representation and expert systems
b) deductive access to data bases
c) logic programming (Prolog and its extensions)
d) man/machine interaction (processing in natural languages)
e) corresponding architectures

Application software packages include:

a) SP-PROLOG, XILOG (a particularly high performance PROLOG interpreter utilizing MS-DOS, Le-LISP - under license from INRIA)
b) COMMON LISP (under license from LUCID) and
c) KOOL, a language for knowledge representation which is the basis for the construction of a number of expert system applications.

4) Software Engineering:
The research objective in software engineering is directed to:

a) software specification and prototyping languages;
b) advanced compiling: methods for overall optimization and vectorization;
c) design and validation of communication protocols;
d) software engineering support.

An applications program has been developed to provide support in theses areas. The program known as EMERAUDE has the following features:

a) Unix based built around a V kernel;
b) supplies programmers with a common environment for developing programs and operates using interconnected workstations in an interconnected environment.

5) Hardware Engineering:
One of Groupe BULL's strong points is its competence in the design of very large-scale integrated circuits. Extensive work has been carried out on the methods and tools for the design of circuits, simulation, and functional testing. Groupe BULL has competence in the field of micro-packaging which has resulted in the development of VLSI circuits making up the integrated BULL DPS 7000 system.

6) Scientific Supercomputers:
This field is of strategic importance at the national and European levels. In 1980 groupe BULL began working on the manufacture of a super computer with several other French firms BULL carried out the development work for hardware and software. Through the development of the vector super computer, Groupe BULL has acquired significant technological expertise of value to other potential collaborative partners developing super computers.

7) The Office of the Future:
BULL's office automation technology addresses the following areas:
a) multimedia editors and storage systems for processing texts, graphics, voice, etc.
b) artificial intelligence techniques for decision applications
c) ergonomically designed software application packages
d) high performance technological systems (high throughput local networks, digital optical disks, etc.).

One application package now under development: PLOUME is a multimode software package for the interactive creation of multiple type fonts text editing and insertion of graphic objects, drawings, photographs and mathematical formulae with high print and layout quality.

3. Cooperative Activities:

The European Computer Industry Research Centre ECRC is an industrial research centre in Munich supported as a common resource by the European computer manufacturers BULL, ICL and Siemens. The creation of the centre reflects current European thinking which is directed to consolidating Europe's presence in the electronic data processing market. This includes scientific cooperation (the European Community's ESPRIT programme), standardization (through agreements between the twelve EEC member-states), and implementation of technical standards (ROSE network project, EMERAUDE software engineering project etc).

The ECRC is an independent company under German law, with the three manufacturers sharing its operating costs. The research workers are recruited either from the member companies or from public sector research centres and universities.

Cooperation with the member companies is exercised mainly through the transfer of personnel. In this case the companies provide staff to the ECRC (or recruit staff. Assignments are regulated by renewable contracts covering a period of three years. Collaboration on specific projects is implemented at various levels. For example, representatives from each company sit on the Scientific Committee and joint seminars are organized on all major projects.

Basic research is carried out on behalf of the three member companies, which use the results as required. Rights to the results of the research are shared by all three companies. Thus one company might use certain research results in developing a business communication system, whereas another might use them in developing an industrial automation system.

The centre's research programme is structured around two key concepts:

1) the fundamental role of knowledge bases in developing decision making systems;

2) the importance of logical programming in implementing concepts.

Given these two central concepts, research is proceeding in two directions:

1) man/machine interaction;

2) data processing system architecture.

3. Knowledge Bases Research:

The goal of the research effort in this area is to develop an intelligent database system capable of:

1) representing complex structured objects;

2) using declarative knowledge to handle deductive information, create dynamic overviews and promote the dynamic synthesis of information;

3) effectively administer the rules of data integrity and consistency.

Various approaches are being investigated:

1) semantic modelling;

2) automatic verification of integrity constraints;

3) interfacing relational databases to logical programming languages (PROLOG);

4) defining logically formulated request languages.

BULL has considerable experience in cooperative and joint projects and is interested in developing new ventures consistent with its long term strategic plans and product development activities. Thus, it would like to receive further information on Canadian activities and expertise in the relevant areas.

The most promising areas for exchanges and cooperation are in the fields of AI, Knowledge based and expert systems. In general the company favours working within existing programs such as ESPRIT and RACE but they would be interested in other options. Cooperative partners could include private sector firms, universities or government laboratories.

6.13. Country: France

Organization: Thomson

Contact: Rene Berterottiere, Director of Research
Mr. Pierre Lepetit, Director Technology Cooperation

Location: 173 Boulevard Haussman
75379 Paris Cedex 8
Telephone: 45619600 Telex: 204780F

1. Overview:

The company is active in the following areas: network systems, flat panel displays, fibre optics, AI software and expert systems.

The primary areas of interest for Thomson were in the areas military programs and electronics. There was only limited discussion or interest expressed in the fields of consumer electronics and informatics. The company did not feel there would be any immediate need for cooperative research projects with Canadian companies.

6.14. **Country:** France

Organization: Ministry of Industry, Federal Government of France
Department of Services and Communications

Contact: Mr. Daniel Maitre, Chef de la Mission Internationale

Location: 32, rue Guersant
75840 Paris Cedex 17
Telephone: 643397F Telex: 45728662

1. Overview:

Discussions with Mr. Maitre focused on the role of the ministry to foster international collaboration. Currently, their mission is directed to the coordination of the existing European programs; EUREKA, ESPRIT and RACE. Funds are provided to French industry in each program for project support and management. The ministry provides the interface between the EEC secretariat and the French government. In the RACE program the leading organization is the DGT but the ministry is involved in administration and funding. Additional activities include conducting missions, establishing and maintaining bilateral contacts and administering a variety of special programs.

2. Research Activities:

Research and development is directed mainly to the areas of:

1) SPACE, through the European Space Agency CESA and CNES (the telecommunications space research centre);

2) Microelectronics;

3) Production processes, CAD/CAM. These latter areas are supported on a case by case basis as specific projects are identified.

A particular interest of the ministry is the support of small/medium enterprises. Research and development project funds are provided to companies or cooperative groups for product development and assessment. The criteria for securing funds in this FF 2 billion program are:

1) projects must be financially sound;

2) have long term interest and innovation potential;

3) there must be distinct market possibilities.

Financial support may be in the form of grants or loans which must be paid back to the ministry. The preference is for domestic companies to receive funds within the European programs but cooperation with other firms from non-EEC countries is not discouraged.

3. Cooperative Activities:

The Ministry would encourage joint ventures and activities with French and Canadian firms. These would be assessed on a case by case basis, either within the existing EEC programs or separately. Contacts for potential projects would be provided through one of the five areas:

1) SPACE;

2) Informatics;

3) Microelectronics;

4) Consumer Electronics;

5) Production Process CAD/CAM.

6.15. **Country:** France

Organization: French Association for New Media

Contact: Mr. Dalloz, General Secretary MICADO

Location: 18 Avenue Bugeaud, 75116, Paris
Telephone: 47044757 Telex: 642632 F

1. Overview:

Mr. Dalloz is head of the French Association for New Media, which promotes developments in graphics, video and audio technologies. The association is dedicated to the development and evolution of new technologies and to encouraging cooperative developments among firms nationally and internationally.

2. Research Activities:

Research has been conducted with Canada through the University of Montreal in the area of Image Synthesis and natural language man/machine interaction. These activities represent examples of broader collaborative efforts in the areas of graphics and advanced software. One suggested area of collaboration would allow Canadian expertise in new visual techniques and artificial intelligence to be combined with the image and speech processing expertise at the University of Grenoble.

Contacts have already been established between French industry and several Canadian companies including the National Film Board of Canada, NRG and the University of Montreal, to examine the potential of a joint project dealing with the development of CDROM for image synthesis and animation. Other specific contacts have been made with; Worpak, IDON, University of Waterloo and Vertigo Graphics.

3. Cooperative Activities:

In addition to fostering collaboration in specific areas the association disseminates information about new technologies, supports seminars and encourages participation in a wide variety of international conferences and meetings.

Mr. Dalloz indicated his willingness to act in a liaison function with French firms and agencies interested in collaboration with Canadian firms, agencies, research centres and government departments.

6.16. Country: France

Organization: Centre European de Recherche d'Images de Synthese: CERISE

Contact: Michel van Hauswaert, Director
Mr. Harry A. Elstermann

Location: 177, rue de Luxembourg
L-8077 Bertrange, Luxembourg
Telephone: 450545-1 Telex: MD400201F

1. Overview:

CERISE is an international centre set up in Luxembourg to further the development of video animation and advanced graphics. It is designed to provide facilities for the commercial production of video animation and to train students in the latest techniques in animation and production. CERISE was created as a Eureka project on the 30th of June 1986 with the main principals SESA in Renne and RTL-Productions. There are three sections in CERISE; education, research and production.

While there is no fundamental research conducted, it benefits from the activities carried out at SESA in Renne. The CERISE activities cover four areas: audio-visual production, experimentation, evaluation, research and development and education. The centre is linked on-line to all the major metropolitan areas of Europe.

2. Research Activities:

The main research activities are directed to the development of computer software for three dimensional graphics.

The main areas of activity are:

1) video animation;

2) graphics software;

3) high resolution television;

4) three dimensional graphics.

3. Cooperative Activities:

The centre is interested in establishing closer contacts with Canadian industry and government research centres. The most probable areas of cooperation would be for exchanges and joint training activities. The centre offers courses to students coming from any one of three areas:

1) technical schools;

2) universities (mathematics, artists);

3) info/graphics.

Courses are three weeks in duration with the training designed around a specific project having commercial possibilities.

The centre is also interested in acquiring state of the art technologies for use in training and commercial video animation production. Three-D animation and digital video technics are of particular interest. Their main topics of interest are: Video animation, graphics software, high resolution television, three-dimensional graphics.

6.17. Summary France

The policy and institutional framework for promoting and fostering basic research and development in France has a strong orientation to the informatics, microelectronics and space sectors. Much of the effort, as in other European countries, is directed to the EEC programs. France is one of the most active participants in these programs and has taken a leading role in their development. Much of the research activity in the country is conducted by several large firms such as Thomson, BULL, and the DGT, through its various CNET laboratories.

In addition the government supports several major research endeavors through INREA, CRIN and CNRS. These centres have generated numerous spin-off companies founded for the purpose of developing specific technological innovations. In many cases the government provides initial start-up capital with repayment required as products are developed and brought to the market place. These companies receive further support through indirect subsidies and participation in joint ventures and cooperative projects with government labs and universities.

CNET provides an enormous amount of R&D for its own purposes in the informatics and telecommunications field. Much of the activity is conducted in collaboration with other European firms within ESPRIT or RACE. The activities of BULL and other large firms also benefit from cooperation with government laboratories and university/polytechs. Quasi-government centres include LETI, a spin-off from the nuclear energy centre, where advanced research is being conducted on flat panels displays and electronic sensors.

Many of the companies active in software development are spin-offs from government laboratories. Their expertise is principally in the following areas:

1) artificial intelligence;

2) knowledge based systems;

3) parallel processing;

4) voice, image analysis;

5) pattern recognition;

6) encryption.

In most instances the companies contacted were receptive to cooperative programs and projects. Funds to support French firms in cooperative ventures are also available for selected technology areas.

The activities of CNET and large firms have been focused on the area of opto-electronics with some specific work oriented to: lasers, photo receivers, optical simulators and organic materials. There was significant complementarity with the programs outlined for the Heinrich Hertz Institute in Berlin, for example. The CNET labs are also active in microelectronics with submicron integrated circuits a major focus. At the same time, the centre is a world leader in bank card technology (smart cards) and encryption techniques.

3. Cooperative Activities:

Collaborative projects are possible for most areas particularly AI. Specific interest was expressed for image analysis pattern and voice recognition as well as voice synthesis. Related to these areas are the possibilities for simultaneous translation and automatic translation including lexicographic techniques. In many cases these possibilities would be most effectively pursued with university departments or government research centres.

AI research, knowledge based systems, expert systems, software development tools, and pattern recognition (speech, voice) were identified as having good potential for collaboration. This stemmed from a belief among the French representatives of Canadian expertise in these particular areas. In some cases there is experience with Canadian firms or agencies although this was still somewhat limited.

The Canadian Embassy, Technology Development Officer, Mr. Lafeuille, is particularly knowledgeable about the French informatics industry. The individual provided an excellent review of the situation and was instrumental in coordinating the visits with French government and industry personnel. It is expected that the TDO would be a very effective facilitator for coordinating potential cooperative projects between Canada and France.

7. Belgium

7.1. Introduction

Initial interviews were conducted in July 1987 with government officials and representatives of the Belgium Informatics Association. This provided an insight into the overall policy environment and programs for R&D.

Interviews for the indepth survey were arranged with the assistance of the Science Counsellor at the Canadian Embassy in Brussels. These were conducted in November/December 1987 and included:

1) Canadian Government Science Counsellor;

2) representatives from the Belgium government's Science and Technology Policy Group;

3) BIM-computer Group;

4) IMEC, Inter-university research facility (Catholic University of Leuven, University of Gent and University of Brussels);

5) K.U. Leuven Research and Development Centre;

6) Ministry of New Technologies and External Relations;

7) Ministry of New Technologies, Wallon Region[6].

7.2. Policy and Programs - Overview

The country's policy for science and technology is directed to the following objectives:

1) to reinforce the country's scientific and technological basis;

2) to counter the policies of other states if they affect the general competitiveness of the economy;

3) to expand international cooperation in the sector.

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6 Comments derived from this meeting are incorporated into the policy review section. Contact was made with:
Mr. Phillipe Deville,
Conseiller Informatique Ministry of New Technology and External Relations, Office of the Minister,
Avenue des Arts,
13 - 14 1040 Buxelles,
Telephone: 02 2115511 Telex: 62094.

One of the major research programs is the stimulation of top university centres in the areas of:

1) micro-electronics;

2) integrated optics;

3) robotics.

The government has also indicated the need for the creation of independent production units in various areas of IT, including:

1) Micro-electronics:
To support CAD for design of integrated circuits for production methods, solid state devices and integrated optics.

2) Software:
To support development of high level programming, expert systems and software workstations for production.

3) Office Automation:
Terminals and related communications equipment and videotex.

4) Telecommunications:
Extension and expansion of public switched services. Demonstration systems - digital networks, ISDN, Mobile telephony and fibre optics.

2. National Research Priorities:

Two other thrusts for technology development exist in Belgium and each has a high degree of government involvement. One stream is concerned with the telecommunications sector while the other deals with AI software. The former category is mainly industry oriented but there is a significant government involvement due to its role as the operator of the country's telecommunication services. Software activities are more precompetitive in nature and tend to be conducted at the universities.

7.3. Telecommunications

The telecommunications thrust is part of an overall upgrading of domestic telephone services is conducted mainly within the context of the European RACE program and promotes:

1) the creation of an advanced telecommunications infrastructure Integrated Broadband Communications (IBC);

2) creating a community-wide market for services and equipment;

3) improving the general competitiveness of European firms;

4) a common telecommunication infrastructure;

5) a comprehensive program of precompetitive R&D;

6) stimulation of equity partnerships.

The government of Belgium is committed to the need for the long range development of advanced technologies in telecommunication. This, they believe, will be accomplished through the implementation of domestic programs and the fostering of international cooperative linkages within the various European programs. Specific institutional and regulatory changes have also been proposed which are designed to increase competition and encourage the development of common standards for interconnection. Assessments are now being made for all aspects of the informatics sector in Belgium including satellite technologies, the cable industry and broadcasting.

The national investment plan for Belgium considers the need to:

1) ensure long term convergence and integrity of new and existing networks;

2) promote the introduction of digital technologies;

3) encourage the provision of open networks.

7.4. AI Software

The software sector in Belgium has received less support from the federal government than is the case for telecommunications. Discussions with the Head of the Industry Committee for Software indicated that while the government provides minimal direct investment to this sector it produces its own software through contracting with the various research institutes and university centres.

AI software research is conducted in 17 university research centres. However, unlike other countries, these have yet to develop strong links with industry, or to foster technology transfer, commercial development or spin-off ventures. The largest industry association is the Information Services Association with about 35 members. (It includes small domestic as well as large multi-nationals.)

7.5. Centres of Excellence for R&D University Centres

The following provides a brief review of the main areas of R&D at the University centres:

1) State University of Ghent:
Laboratory for electronics and measuring techniques (Professor Vanwormhoudt):
   a) thin film solar cells, based on Cds;
   b) hybrid micro-electronics, serigraphical layers;
   c) thermal analyses in micro-electronics;
   d) thin film transistors for analogous and digital circuits;

e) matrix screens with liquid crystals and electro-luminescent layers.

Laboratory for electromagnetism and acoustics (Professor Lagasse):
a) integrated circuits based on Ga As and InP substrates;
b) III-V-component simulations.

Laboratory for crystallography (Professor Cardon):
a) study of MIS and MES structures on GaAs and Si.

Laboratory for physical chemistry (Professor Gomes):
a) study of electrolyte semi-conductor transistors.

2) Catholic University of Leuven:
ESAT (Professor Van Overstraeten):
a) memory in NMOS and CMOS circuits;
b) VLSI technology;
c) study of Si02 and Si3N4 insulators;
d) silicon solar cells;
e) submicron lithography.

Applied mathematics and informatics section (Professor Teugels):
a) mathematical and theoretical aspects of VLSI;
b) coding theory.

Solid matter physics section (Professor Van Gerven):
a) metal semi-conductor multi-layers;
b) amorphous semi-conductors.

3) Free University of Brussels:
Artificial Intelligence unit (Professor Steels):
a) expert system for VLSI design.

Electronics unit (Professor Steenhaut):
a) sensors.

4) Antwerp University:
Professor Nagels' departments:
a) amorphous silicon.

General physics (Professor Amelinckx):
a) new materials in micro-electronics.

Physics:
a) quantum-mechanics studies in semi-conductors.

5) Limburg University Centre:
Material Physics (Professor Stals):
a) material research in micro-electronics.

6) Interuniversity Micro-electronics Centre IMEC:
Semi-conductor processes (Professor G. Declerck):
a) CCD's;
b) VLSI technology;
c) 0.7 um technology;

Invomec (Bourdeaud'hui):
a) intensive training course.

Material and packing (Professor Mertens):
a) photovoltaic materials;
b) doping profiles;
c) interconnection technology.

Design technologies (Professor De Man):
a) algorithms for VLSI design;
b) applications of artificial intelligence for VLSI.

7.6. Summary Policy and Programs

The university centers of excellence are expected to play a major role in Belgium initiatives for R&D in informatics and telecommunications. Greater emphasis has been placed on stimulating the use of these centres and encouraging their collaboration with industrial partners. In some cases technology transfer centres have been created while in others research centres are established.

Although the policy framework for R&D in Belgium is still being refined opportunities for cooperative and collaborative projects with Canadian firms are possible. Precompetitive activities are more likely to occur in conjunction with centres of excellence at various universities and to be oriented to computer software. Telecommunications projects are more likely to be applications oriented and to be led by industry rather than public sector organizations and universities.

This review emphasised the desire of the Belgium government to stimulate R&D ventures and illustrates the results of various regional programs to stimulate cooperative ventures. Regional and provincial government play a significant role in formulating economic policies and developing strategies for industrial stimulation. Information technology development and stimulation is a priority for the regional as well a national government.

An appraisal of the various areas of opportunity between Canada and Belgium indicated the following general possibilities:

1) Micro-electronics

a) Software
b) AI
c) Robotics

2) Telecommunications

a) Network Design
b) Silicon Chip Design
c) ISDN

8. Detailed Company/Firms/Agency Reviews/Belgium

8.1. Country: Belgium

Organization: BIM

Contact: Mr. Michel Vanden Bossche-Marquette, President

Location: Kwikstraat 4-B, 3078 Everberg
Telephone: (2) 7595925 Telex: 6351B

1. Overview:

BIM is a private company which had an annual turnover of approximately US$ 10 million in 1986 and net revenue of US$400,000. The company employs 60 people, the majority of whom are graduate scientists and engineers.

The principal areas of activity are:

1) manufacture of microsystems;

2) super computer design and development;

3) local area networks;

4) installation of fibre optic networks;

The main interest of the company is in the development of advanced microsystems and network design. Their long term objective is to create an advanced software factory.

2. Research Activities:

The company's R&D activities are directed towards AI software for use on SUN microsystems. BIM is developing a Prolog based natural language to serve as an interface for relational databases and as an advanced modelling tool for an intelligent spreadsheet.

Several cooperative research projects have been conducted leading to the current stage of development for their Prolog based systems. These have included firms and research centres in Belgium, France and Britain. Close ties have also been maintained with the Catholic University of Leuvan.

Future research will be directed to: parallel architecture, linguistic research for man/machine interface and knowledge based information retrieval systems. In the latter case efforts are being directed to the selection of various AI applications in areas such as:

1) biotechnology;

2) network management.

3. Cooperative Activities:

BIM has already established contacts with Canada through Sydney Software Development of Vancouver and the University of British Columbia for expert systems software. Cooperative projects would be most appealing in the areas of software development with particular emphasis on application specific expert systems and parallel processing. However, there seemed to be more interest in market development for microsystems, particularly in the United States, than software R&D for AI applications.

8.2. **Country:** Belgium

Organization: IMEC, Inter-University Micro-electronics Centre

Contact: J. Roggen Ph.D., Head Interconnection Technology Materials and Packaging Division
Hans Bracquene, Contract Research Administration
P. Pype, Technical Administrative Coordinator

Location: Kepeldreef 75 B 3030 Leuven - Belgium
Telephone: 016281211 Telex: 26152

1. Overview:

IMEC is the Inter-university Microelectronics Centre set up by the Flanders government in Belgium as part of a comprehensive program to promote education, research and applications of microelectronics. The centre combines the resources of the three Flemish universities, KUL, Ghent and Brussels, in a cooperative research environment designed to serve the universities, industry and government. Funding is derived 50% from the government and 50% from contract research carried out on behalf of industry.

Collaborative activities are conducted with Belgium universities and through ongoing scientific exchanges. Interaction with industry is facilitated through: joint research projects, training courses, seminars, manufacture of devices and design of custom chips.

IMEC is equipped to conduct fundamental research in the following areas:

1) development of design methodologies for VLSI systems;

2) the development of submicron processes and interconnecting techniques supporting VLSI production, optoelectronic components, sensors and solar cells;

3) the training of VLSI designers and processing engineers for industry.

The R&D facility includes:

1) a computer aided integrated circuit design laboratory;

2) a submicron processing laboratory;

3) a physics-chemical analysis laboratory;

4) automatic devices and circuit measurement;

5) mounting and testing equipment.

The laboratory houses over 3600 sq.m. of ultra clean processing area a 300 sq.m. computer room and a 6700 sq.m. administration area.

Affiliated with IMEC is the Limburg-Kempen centre. The main purpose of which is to strengthen the interaction between the research centre and industry. This is accomplished through information dissemination to industry as developments in new technologies occur. In addition, it has responsibility for:

1) ongoing identification of industrial research needs in the field of microelectronics;

2) identification of technologies which can lead to joint ventures and spinoff activities;

3) dissemination information to foreign investors regarding new developments at the research centre.

2. Research Activities:

Four areas of basic research were reviewed with IMEC. Each offers potential for Canadian firms:

1) Design Methodologies for VLSI Systems:
The goal of this research is the development of new techniques and methods for the design of complex custom VLSI chips beyond standard cell and gate array techniques (ASICS). Design methodologies are based on the application of complex systems in the field of digital signal processing (DSP). The results of these studies are formalized to provide the basis of the design for a number of prototype CAD tools supporting specific applications. The most recent advances involve the development of CATHEDRAL II which is an experimental third generation CAD system based on a high level behavioral description language SILAGE. Using this system the designer specifies a design in the SILAGE language. This is then interactively mapped into a network of parameterized modules which fit into an architectural strategy. The strategy is stored into the compiler and optimization of the mapping is done by algorithmic programs. New developments in this area focus on the use of AI based programming techniques and video oriented silicon compilation.

2) Advanced Semiconductor Processing (ASP):
The Advanced Semiconductor Processing division consists of 100 scientists working in three divisions. These include:
a) advanced deposition, doping and patterning techniques;
b) the characterization and use of new materials, modelling processes and devices;
c) the implementation of these steps in proven processes such as 1.25 micron CMOS or submicron GaAs processes.

Some of the achievements of the recent past include: development of the 1.25 micron CMOS process, work on submicron lithography silicide ion beam mixing, fundamental studies of oxide properties, the optimization of parameter extraction new device simulator (PRISM),

the successful fabrication of a number of silicon detectors and the implementation of a 1.5 micron GaAs MESFET process and the fabrication of MESFET on top of silicon.

3) Materials and Packaging:
The research work in this area includes:
a) silicon on insulator;
b) material development using laser or strip-heater recrystallization of deposited polysilicon silicon dioxide;
c) silicon materials;
d) amorphous silicon and related materials, and epitaxial growth of silicon;
e) molecular beam epitaxy of GaAs based materials.
f) bipolar device physics and development of advanced emitter base structures for silicon bipolar transistors and chemical sensors.

4) III-V Technology:
Optoelectronic and high speed microelectronics:
a) the fabrication of optoelectronic integrated circuits;
b) the integration of light emitting diodes into MESFET;
c) open tube zinc-diffusion techniques for application in GaAs LED's and lasers.

Other projects include the LPE-growth of InGaP lattices matched to GaAs for application in visible LED's and lasers. This lab is also investigating, as part of a RACE project, the feasibility of a number of technologies for use in broadband communications. This includes the interconnection of high speed devices and circuits both on-chip and off-chip. A selection of specific projects includes:
a) molecular beam epitaxy of III-V semiconductors;
b) liquid phase epitaxy;
c) metal organic chemical vapour deposition;
d) plasma enhanced chemical vapour deposition and etching of SiNx and SiOx;
e) reactive ion etching of GaAs;
f) photoluminescence, optical reflection and transmission measurement;
g) optical waveguide components, measurement devices and circuits;
h) asynchronuous time division techniques for integrated broadband communications.

3. Cooperative Activities:

IMEC is the leading R&D centre in Belgium and has developed extensive contacts throughout the European community in the areas of microelectronics, materials and optoelectronics. It is dedicated to the idea of cooperation and has several established mechanisms in place to undertake joint research projects. Collaboration with Canadian firms, universities and research agencies would be possible either in terms of a research project or through the placement of scientists in the centre. Participation by foreign firms would also be possible on a third party basis through programs such as ESPRIT and RACE.

8.3. **Country:** Belgium

Organization: K.U. Leuven Research and Development

Contact: H. Claes, Director

Location: Groot Begijnhof-Benedenstraat 59, B 3000 Leuven
Telephone: 016229220 Telex: 016239907

1. Overview:

In 1972 the Catholic University of Leuven created an R&D centre to provide services for the industrial and commercial exploitation research. One of the main objectives of the centre is to foster collaboration. This is accomplished in four ways:

1) Technology Broker:
Encouraging the establishment of research and development contracts for new products, production methods and technologies for small and medium sized companies and multinationals.

2) Patent Policy:
The centre has acquired over twenty patents for various industrial applications.

3) Spin-Offs:
Stimulation of start-up companies by means of technology transfer agreements.

4) Knowledge:
Specialized seminars and training programs for individual firms.

2. Research Activities

In the area of informatics and microelectronics the centre has expertise in:

1) visual inspection technology;

2) image processing;

3) data protection cryptography;

4) speech recognition;

5) natural language computing.

3. Cooperative Activities:

Project proposals and scientific exchanges would be welcome in each of the areas mentioned. The centre's main function is to assist in identifying university researchers and industrial partners for participation in various projects. Considerable experience has been gained in international collaboration and projects have been conducted with the University of Alberta in a biotechnology.

Several spin-off companies have resulted form the activities of the K.U.Leuven R&D centre.

1) SILVAR-LISCO, Palo Alto:
Develops integrated state-of-the-art computer aided engineering software products.

2) ICOS:
Develops, produces and markets visual inspection systems and graphic image processing systems.

3) CRYPTECH:
Develops and markets hardware and software for electronic data security.

9. United Kingdom

9.1. Introduction

The information in this section was obtained in two stages; the first involved meetings in the summer of 1987 with the Technology Development Officer and Science Counsellor at the Canadian Embassy in London, participation in the 1987 ALVEY conference at UMIST in Manchester and follow-up reviews of government publications and documents. The detailed survey was carried out during the November/December 1987 field visit. At that time contact was made with the following key individuals and organizations:

1) Infrastructure, Communications
ALVEY Directorate
Kingsgate House, London, U.K.

2) Plessey Research Ltd.
Allen Clarke Research Centre
Townsten, U.K.

3) Logica Ltd.
Cambridge, U.K.

4) Mullard Ltd.
Southampton, U.K.

5) Rutherford Appleton Laboratory
Didcot, Oxford, U.K.

6) Imperial College

9.2. Policy and R&D Environment

The British government has, over the past five years, been reviewing its high technology policies and at the same time emphasizing a new strategy of less direct government involvement. Their current policy is basically one of indirect support and the encouragement of collaboration and cooperation between firms in the high technology sector. One new aspect to this involves the establishment of Science Parks and the encouragement of Technical Universities. The basic objective of this strategy is to increase the opportunities for small and medium size firms to develop linkages with university centres and thereby to pursue projects of mutual interest. This strategy has, according to British officials, spawned numerous high technology projects and been responsible for the success of new Science Parks such as those in Cambridge.

9.3. ALVEY

One of the most dominant aspects of the IT sector over the past five years has been the ALVEY Program. This was developed by the British government in 1982 to provide an initiative for creating greater competitiveness in IT. The program

provided funds to industry and universities in support of collaborative research projects (precompetitive) in IT. ALVEY was instituted because of a recognized need to improve the country's capabilities in information technology, to develop the longer term technologies needed for the 1990's and to provide greater competitiveness in the informatics market worldwide.

The ALVEY program began in May 1983 with an initial budget of L350 million. The five year program was designed to match computer research initiatives abroad, particularly those in the U.S. and Japan. The principal research areas for ALVEY included:

1) very large scale integrated circuits, - VLSI;

2) software engineering;

3) intelligent knowledge based systems - KBS;

4) systems architecture;

5) man/machine interface - MMI.

The program consisted of about 200 industry-led cooperative projects combining two or three firms with one academic team working together on each project. About 100 firms were involved in actual research projects along with most of the major universities, colleges and Polytechs. Several research associations and government laboratories were also brought into the programs to act as partners with the industry and academic institutions.

In 1986 the Bide Report[7] addressed Information Technology and at the same time specified a national plan of action for the sector. The following observations were made of the ALVEY program's achievements:

1) ALVEY was successful in drawing together industry and universities in a much closer relationship.

2) The program has stimulated collaboration between companies, normally in competition, to attack common research problems.

3) There is a much stronger research base from which U.K. industry can be more competitive in the future.

The Bide Report emphasized the next stage of development for IT technology should be its exploitation and widespread adoption. In other words; applications should predominate over basic research. The report also revealed the importance of small companies to the IT sector and illustrated many of the problems experienced in securing funds and participating in collaborative ventures with larger firms (particularly those outside the U.K).

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[7]Information Technology, A Plan for Concerted Action The Report of the IT 86 Committee, HMSO, London, 1986.

The following recommendations were made:

1) More strenuous efforts should be made to take full advantage of European schemes for collaborative work in the IT field, i.e. ESPRIT, RACE.

2) IT suppliers need a U.K. home market from which to develop international markets.

3) An action plan is needed for collaborative IT applications, research for application needs; promotion of technology transfer; adoption of IT and development of IT skills.

4) Participation in European programs such as ESPRIT, EUREKA and RACE should be encouraged.

5) Close collaboration should be supported between universities, industry and government with the lead in future development expected to come from industry. Direct support from the government should be provided only where needed.

The report also indicated that while a strong linkage to European activities and markets was essential, a strong national program should still be emphasized. In this regard it recommended:

1) U.K. companies seek niches in the world market where they can exploit national expertise independently of and in some cases in competition with European firms. This may from time to time involve partnerships between U.K. companies and those outside Europe.

2) Small firms and universities should be encouraged to participate in various U.K. national programs with larger and stronger companies and thereby join European collaborations in a more cost effective way best suited to the national interests.

To stimulate future development in IT the government has been advised that upwards of CDN$1 billion would be needed. However, the government is expected to provide CDN$600 million, part of which would be used for furthering developments in the ESPRIT program.

Several possible projects for future development have been specified:

1) security and control services in domestic and commercial premises;

2) clerical data and process models for development of health care;

3) interactive distance learning as a teaching aid;

4) distance learning for senior management;

5) control of the manufacturing process in mechanical engineering;

6) a practical project support environment;

7) electronic funds transfer at point of sale (EFTPOS);

8) provable safe systems for railway signalling.

Related to these principal project areas are several sectors where future R&D is also likely to be supported:

1) communications: ASIC's, broadband services, visual communications, HDTV, mobile communications;

2) advanced information processors: hardware and software to acquire, adapt and use generic software;

3) workstations and display technologies;

4) IKBS, systems architecture;

5) speech, signal and image processing.

To encourage these programs, collaboration with external partners will be supported by the government. Its function will be to pursue opportunities through established programs such as ESPRIT and to find suitable partners when projects arise. Likewise, the EUREKA and RACE programs are expected to serve an important role in encouraging the participation of U.K. firms in a variety of research endeavors. It is recognized however that the initiative in these projects must come from industry, with government providing the linkage to other national governments, financial support and the removal of barriers to foreign markets.

9.4. R&D Results from ALVEY

The achievements of ALVEY were highlighted at a conference held at the University of Manchester, Institute of Technology (UMIST) in July 1987. The conference featured all of the major players in the program along with displays of their projects and results of the R&D initiatives.

The more general achievements of the program are considered to be:

1) the bringing together of the country's IT community;

2) the forming of close and harmonious working relationships between industrialists and academics;

3) the development of specific products;

4) training of post graduate research workers in "shortage areas";

5) creation of common strategies for the U.K.;

6) establishment of standards in languages and equipment;

7) creation of awareness of new technologies.

9.5. Evaluation of the British ALVEY Program[8]

A series of evaluations have been conducted on the ALVEY program during its five year term. The most recent assessment was made in late 1987, one year prior to the termination of the first five years of the program. In early 1988 the British government announced that major changes would be made in the forthcoming phase of the program. However, no specific details of those changes have to date, been made public.

Before reviewing the findings of the interim evaluation it is worthwhile to consider the objectives of the Programme. These were:

1) to increase the competitiveness of the U.K. IT suppliers;

2) to assure a measure of self reliance in key technological areas for commercial and defense purposes;

3) to strengthen the research and development base of the UK by rationalising and uniting fragmented resources, particularly by encouraging industry and academia to work together; and

4) to achieve specific technical targets in each of the enabling technology areas.

By mid 1987, 198 industrial and 115 academic projects had been approved. There were 115 firms taking part with a total of 421 participants. Sixty-eight universities and Polytechs participated along with 24 other research institutes. Considering the overall grant allocations, VLSI received the most funds with the majority being allocated mainly to large firms. In general, the program tended to favour larger size firms in all sectors. On average, each project had four partners, comprising two industrial and 1.9 academic partners per project. IKBS had the lowest number of partners (1.6,) which reflected the small number of firms active in this area.

Within each of the defined project areas there was a significant degree of achievement with respect to program goals and objectives. In VLSI for example, the technical target of having 1 micron silicon capability by 1989 is likely to be achieved. However, there seems to be a question as to whether the academic sector has made worthwhile gains other than improving its linkages with industry. Industry were believed to have achieved their objectives and to have benefited principally through the broadening of their R&D programs.

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[8]Evaluation of the ALVEY Programme, Interim Report, University of Oxford and Sussex University, HMSO London, 1987.

In the area of IKBS there have been significant improvements in the R&D base for AI research. There has also been an overall growth in the number of centres and top level scientists conducting basic research in industry and the academic environments.

The main shortcoming of ALVEY rests in the area of technology transfer. The central issue is whether the balance of effort between strengthening the IT community in the UK and supporting measures to effect the uptake of IKBS technologies in the market was correct. In general not enough support has been directed to the actual transfer process and as a result key developments have not filtered out from the centres of research activity to the broader industry.

Software activities were directed to improvements in the infrastructure, within the UK, for the provision of world class products in support of UK industry. The technological goals were:

1) to improve software performance reliability and user requirements;

2) increase software productivity.

In this area the major accomplishments were improvement and expansion of facilities. However, as noted previously, there have been very limited gains in technology transfer. Industry participants indicated that the program stimulated activities for R&D, which was very limited in the case of small firms, and typically only a small proportion of expenditures for larger firms. In general the research work tended to be extensions of existing company activities rather than the stimulation of entirely new activities.

MMI R&D incorporated four distinct subprograms: Human Interface, Image, Speech and Displays. The results to date show that the program has accelerated and expanded existing research and caused a switch in emphasis. This has been complimented with an increase in the interaction between industry and the academic community. Large scale demonstration projects were however, often delayed and suffered from the common problem of lack of technology transfer.

Some of the more relevant findings from these project were:

1) ALVEY has lead to a marked increase in the scale and extent of collaboration with industry and academic institutes;

2) The program had positive effects on the composition, scale and rates of progress on research activities.

3) A more positive attitude has emerged towards involvement in government support programs and the development of more global attitudes towards industrial strategies.

4) The large scale demonstration projects had somewhat less progress than planned and at the present time these need further support from industry and additional participants to carry them through to the next level of activity.

One of the most revealing and relevant findings from the ALVEY program is the recognition that national governments must reconcile the often conflicting strategies of addressing broad global objectives and those directed to specialization and niche markets. In the British case this led to ambivalence and uncertainty in policy formation. Coincidently there must, as well, be a clear strategy about the establishment of a consensus concerning effective compromises between the national interest and the interests of individual firms and institutions.

Another interesting finding was that ALVEY was generally more effective in expanding existing linkages than in developing totally new collaborations. The program however was successful as a catalyst for the exchange of information and setting the ground work for opportunities to emerge in the future.

The emphasis on precompetitive research was justified but there is now a feeling that this should be tied more closely with initiatives designed to support development and market stimulation. This latter point was raised in the Bide report which suggested that program extensions consider:

1) application schemes involving users, suppliers and academics;

2) a research scheme linked to an application scheme;

3) a stronger technology transfer element, education and training.

9.6. Future Directions for British R&D

Recommendations for further action have emphasised the need to develop closer ties with the international community, particularly in Europe. Specifically this would see increased participation in the ESPRIT 88 program. Such developments would provide the opportunity for broader access to expertise and sharing of resources but at the same time make it imperative that careful consideration be given to the potential for exploitation of research results. In this regard important decisions need to be made about choices for national program development and international strategies and cooperation.

Although industry is expected to play the leading role in developments of the country's IT strategy, the British government still has significant influence over developments in the IT sector. This is particularly the case where small firms are concerned. However, small firms often do not have the resources to devote to new ventures, collaboration or to attract credible partners. As a result, this sector was identified as one for which the government should provide direct support when and where needed. Large firms are also encouraged to assist smaller firms through developing consortia and joint ventures. That strategy is designed to help overcome the problems which plague most small innovative R&D firms in trying to advance their activities. This approach should be examined more closely since similar problems and the need for support structures and frameworks will be required as collaborative ventures are identified and pursued with Canadian firms.

One of the main trends in the U.K. is the movement of the government/industry initiatives away from the precompetitive R&D focus of ALVEY to product development. As an example the government announced in July 1987, after a two year study, the establishment of a national body to forecast the potential of new scientific and technological developments and to change national priorities as required. The centre is to be known as: The Centre for Exploitable Areas of Science and Technology.

Initial funding was set at CDN$10 million, with CDN$2 million coming from the government and the remainder from the country's 15 biggest industrial and financial concerns. The centre will:

1) monitor world-wide developments in R&D;

2) identify a portfolio of areas of scientific initiatives;

3) inform the government about investment decisions for U.K. industry over the long term.

9.7. U.K. Involvement with EUREKA, ESPRIT and RACE

A number of firms in the U.K. are actively involved in the European Community Programs of ESPRIT, EUREKA and RACE. The following provides a summary of a number of key projects and their participants:

1) EUREKA:

	Project	Company
a)	Communications:	
	Broadband interconnection	Plessey
	Integrated Home Systems	Thorne EMI
	Fibre Optics Transmission at 2.4 Gbits	Plessey
b)	Informatics:	
	Instrumentation and Control Systems	Manesty Machines
	Automated Dictionary (Mobidick)	Collins
	Advanced European Information Exchange	British Aerospace
	European Silicon Structure	British Aerospace
	Gatts Circuits	GEC
	Photolithographic Processes	Plasma Technology

Several U.K. firms will also be participating in the various projects identified as part of RACE[9] and ESPRIT. The specified projects are now in the definition phase and could therefore offer potential for a Canadian participation: (See section on European Community, EUREKA, ESPRIT and RACE).

2) RACE Projects and U.K. Participants:

Project	**Company**
Subscriber Premises Reference	GEC Information Systems GEC Telecommunications GEC ATEA STC PLC Thorn EMI
Integrated Video Coding	British Telecom BBC Plessey
Integrated Optical Communication and Mobile Terminal	GEC PLC GEC Research Ltd.
Technical and Economic Assessment of Low Cost Opto-Electronic Components	STC PLC
Technologies for Optical Switching in the IBCN	GEC PLC
Evaluation of Switching Techniques and Technologies for the IBCN	Plessey British Telecom
Software Programs for Research in Telecommunications	MARIE Advanced Electronics Ltd. British Telecom
Domestic Subscriber Premises Network Technology	Thorn EMI
Evaluatioon of Flat Panel Display Technologies	GEC PLC Thorn EMI MARIE Advanced Microelectrics
RACE Software Strategy Study	Imperial Software British Telecom PLC

[9]RACE (R&D in Advanced Communication technologies in Europe)

3) ESPRIT Projects and U.K. Participants:

Project	Company
High Level CAD for interactive layout and design	GEC General Electric
Advanced Mask Technology for VLSI Submicron Microelectronics Devices	Ferranti Electronics
Three Dimensional Algorithms for Robust & Efficient Semiconductor Simulators	Rutherford Appleton Laboratory
Optical Interconnect for VLSI and High Bit Rate IC's	GEC General Electric
Formal Methods for Asynchronous Systems	Advanced System Architecture
Genesis - A General Environment for Formal Systems Development	Imperial Software Technology
An Autonomous and Interactive Workbench to Aid Software Project Management	ICL International Computer Ltd.
Peacock - A Distribution Environment for the Development of Distributed Systems	Plessey Electronic Systems Ltd.
Automated Support for Software Engineering Technology (Asset)	Plessey Office Systems Ltd.
A Methodology for the Design of Knowledge-Based Systems	STC IDEC Ltd.
Integration of Symbolic and Numeric Learning Techniques with Applications	GEC General Electric Co.
Expert Systems Builder	Plessey Electronic Systems Ltd. Plessey Defense Systems

Knowledge Based Assistant for Electromyography	Logica U.K. Ltd.
A Methodology for the Development of Knowledge Based Systems	STD IDEC Ltd.
Functional Analysis of Office Requirements	STL-Standard Telecommunications Laboratory
Investigation into the Effective Use of Speech at the Man/Machine Interface	British Maritime Technology
Multipoint Interactive Audiovisual Communication (MIAC)	British Telecommunications PLC

10. Detailed Company/Firms/Agency Reviews/United Kingdom

10.1. Country: United Kingdom

Organization: ALVEY Directorate

Contact: Mr. Nigel Kay, Manager, Speech and Image Processing

Location: Kingsgate House, 55-74 Victoria Street
Telephone: 012158303

1. Overview:

The ALVEY spokesman reviewed the developments in the ALVEY program and indicated the nature of the forthcoming developments. These emphasized the fundamental shifts which are likely to occur over the next few years as the program becomes more applications oriented. The directorate has now been incorporated back into the Department of Trade and Industry under the direction of Mr. Timothy Walker. This move is expected to reinforce the interest in applications research and development.

New funding mechanism are being put in place which, it is hoped, will encourage greater participation by the private sector, particularly among SME's. While ALVEY will continue, there has also been a great deal of emphasis placed on coordinating its efforts with those of the European Economic Community. Another new development is the emphasis on support for centres of excellence. Speech analysis, for example, will be focused more on the National Physical Laboratory at Molton, while vision and pattern recognition will be the focus at the National Engineering Laboratory (NEL).

Within each of the designated ALVEY research areas, strategy papers have been developed, specifying proposed directions for future action. These papers have not as yet been accepted into a national policy for strategic development. However, the strategy papers have been used to form the basis for new directions in ALVEY. Recommendations have been made in:

1) infrastructure;

2) speech and signal processing;

3) IKBS strategies;

4) human interface;

5) man/machine interface;

6) distributed systems;

7) formal methods;

8) software engineering;

9) VLSI and CAD/CAM;

10) information architectures;

11) parallel processing;

12) system architecture.

2. Research Activities:

The proposed new R&D program will be heavily focused on IKBS and Intelligent Signal Processing. This will be supported by two related schemes:

1) systems support for IKBS and knowledge acquisition;

2) empirical cognitive studies.

A related area is Parallel architectures where the following will be pursued:

1) practical applications of ALVEY architectures: focusing on commercial applications;

2) experimentation and tools: assessing the effect of new architecture on approaches to development, tools, techniques and generating aids for users;

3) exploitation guidelines: providing rules derived from experimentation allowing future applications to exploit the potential for parallel architectures with a minimum of low-level knowledge;

4) integration: bringing together the results of architecture projects, both within and outside ALVEY and non-architecture work to provide solutions for "fifth generation" applications.

Other selected research activities of relevance to Canadian initiatives are:

1) VLSI Process Technology:
The ALVEY Very Large Scale Integration (VLSI) Program was a five-year national research effort in the areas of Silicon VLSI Technology, Computer Aided Design for VLSI (CAD), and VLSI Architectures. The program consisted of 85 projects, involving 32 separate companies, 35 academic institutions and 4 research establishments. It now has at least two of the six silicon VLSI processes already in pilot production, a number of new scientific instruments and processing equipments on the market, and a very wide usage in industry and academia of Alvey-researched CAD tools.

2) VLSI Processes:
This was a 1-Micron Ultra-High-Speed Bipolar Whole Process project aimed at restoring world state-of-the-art advanced bipolar processes. Initial applications are for wide bandwidth transmission circuits,

10,000-gate arrays, and a fast architecture processor. Preliminary design rules are now available, with production planned for 1988.

1.25-Micron Bulk CMOS Whole Process: A 2-micron variant of the original Alvey process is already in production with products now being shipped to customers. The 1.25-micron process is now in pilot production. The first batches of a technology pathfinder, a 16k x 1 SRAM have been fabricated and excellent device characteristics obtained. An access time of less than 15 ns has been measured.

3) VLSI Equipment:
Advanced Ion Etching: The aim was to produce a Reactive Ion Etching system giving two orders of magnitude increase in ionization density over existing systems. Plasma Technology (the developer) has already received an approach for licensing from a leading US manufacturer. The prototype is on test, and an initial batch of machines is now scheduled for construction.

4) VLSI Architecture:
Reconfigurable Processor Array (RPA): The aim is to achieve improvements in the speed of numerical processing by exploiting parallelism. The array processor chip set has been implemented and a prototype system is being built. A single-chip version is expected to be exploited through GEC or ICL.

5) MASCOT Design Support Environment:
The project is developing an enhanced software environment, including building in the expertise of experienced designers via an "Expert Systems" tool. The prototype will be used in house by the project collaborators.

6) Development of IKBS Software Tools:
The project will produce a set of IKBS-based tools to be used to help in the system design stage of data processing developments. The first prototype is now available, and the full toolset will be available in 1988.

7) Expert Systems for the Design of Spatial Arrangements:
The project tackles ways of representing spatial arrangements and for reasoning about these, with particular reference to ship layout. A spatial calculus has been developed and forms the foundation for an experimental system. A numerical design system which was developed in earlier research and which will be marketed through Strathclyde University has been incorporated in the system.

8) EMEX:
The aim is to develop Expert Systems to assist in the task of building econometric models for market specialists who know their markets but not the mathematics of the models. The first version is nearing completion. This system will be extended for use in management training. Test sites for commercial development of the system are under consideration.

9) PARLOG Development:
Parallel versions of PROLOG, the Logic programming language, are needed for concurrent processing, which will be required for most real IKBS applications. Work on three Alvey projects has resulted in the shipping of compilers to over 70 academic and industrial institutions, and has established a PARLOG research community.

10) Natural Language Toolkits:
These projects will provide a toolkit for the various teams attempting to tackle aspects of natural language understanding. The tools include a parser, a computational grammar of English, and a lexical analyzer. Versions of these tools are now available at Cambridge and Edinburgh, and the combined toolkit will be available in January 1988. It will be distributed by the Artificial Intelligence Applications Institute.

11) Speech and Image Processing:
The Image Processing work is now beginning to produce substantial results in the form of new algorithms for segmentation, image coding and object identification. Rapid progress is also being made in the design of new high-speed processing architectures and associated software. The main topics being addressed are speech recognition, speech synthesis and assessment techniques.

12) 3D Model-Based Vision from Stereo:
The aim of this project is to produce surface descriptions from stereo range data suitable for model based visual guidance of an automated assembly workstation. A system built in Sheffield and tested with a robot arm, is able to locate an object with sufficient accuracy to guide the robot arm to an appropriate grasp position. The commercialization of these techniques awaits implementation on fast hardware.

13) Knowledge-Based Segmentation of Remotely-Sensed Images:
A consortium has developed an automatic system for improved segmentation of remotely-sensed data for the land-use applications of environmental and agricultural monitoring, but it is also applicable to the remote-sensing community in general.

14) Displays:
Significant advances have been made in both circuit component technology and the properties of luminescent powders. These have resulted in improvements in the manufacturing yield, lifetime, speed, quality and size of displays. Small prototype displays have been developed in several projects.

15. Liquid-Crystal Display - Silicon Matrix:
The aim is to produce large (A4-size), flat, thin, colour screen with high information density. The display has a large-area integrated circuit directly fabricated onto ordinary glass instead of the usual silicon wafer. The ALVEY supported work has led to the discovery of a new process and circuit architecture which has been successfully

demonstrated with small colour prototype displays of up to 40,000 pixels.

16) Interactive Electro-luminescent Displays:
The project will produce an A4-size, electro-luminescent display using improved phosphor powder materials and an interactive, touch-sensitive input system. The hardware and software for an interactive half A-4 page display has been developed and a demonstrator built.

17) Ferro-electric Liquid-Crystal Display:
This involves development of a new type of display for high-resolution video images, which are not possible with conventional liquid-crystal displays. Considerable progress has been made with a display using ferro-electric liquid crystals. Small test devices have now demonstrated that large arrays can be switched at video rates.

3. Cooperative Activities:

The ALVEY program is now moving into a more well defined phase and one which will be increasingly applications driven. There is considerable scope for Canada either to link up with groups interested in exploiting the results of their initial R&D or in new initiatives. The ALVEY Directorate indicated their interest in receiving enquiries from Canadian firms in specified R&D areas. Inquiries should be made directly to the Directorate or through the Technology Officer or Science Counsellor at the Canadian Embassy in London.

10.2. **Country:** United Kingdom

Organization: Plessey Research Centre (Caswell Ltd.)
Allen Clark Research Centre

Contact: Dr. P. Clayton, Research Director

Location: Caswell, Towcester, Northants
Telephone: 032754755

1. Overview:

The Plessey Caswell lab is dedicated to:

1) the assembly and testing of integrated circuits;

2) 1 micron and submicron technologies;

3) optoelectronics devices;

4) lasers;

5) GaAs circuit design.

The research centre's new silicon processing facility is now fully operational and provides for 8,000 sq. ft. of ultra-clean space for research on 1 micrometer and bipolar processes. All silicon processing is concentrated in clean rooms using 125 mm wafers.

The Caswell facility is funded 50 percent by Plessey, 25 percent by the Ministry of Defense and 25 percent through collaborative projects such as those supported by ALVEY, ESPRIT and RACE. The centre is involved in 14 collaborative projects within the ESPRIT program, focused mainly on the investigation of silicon structures.
ALVEY projects range from basic techniques such as microlithography, dry etching, epitaxy, process modelling and silicon on insulator to whole process projects on 1 micron CMOS and 1 micron bipolar technologies. In the ESPRIT program, work includes multilevel metalisation for the production of a four-level 3 micron pitch system for use with 1 micron processes.

2. Research Activities:

The main research activities at the Caswell facility include:

1) Integrated circuits:
   a) a new wafer fabrication facility;
   b) bipolar and CMOS circuits with one micrometer size transistors;
   c) application specific silicon integrated circuits with 1.5 micron geometrics.

2) Optoelectronics research:
   a) high speed devices operating above 1 Ghz for trunk transmission systems;
   b) narrow line distributed feedback (DFD) lasers for coherent optical systems;
   c) optical switching;
   d) logic devices and integrated optoelectronic circuits covering III-V ferroelectric and organic materials.

3) GaAs (Gallium Arsenide):
   Research is directed to:

   a) integrated transmit-receive modules for phased array radar using GaAs;
   b) monolithic microwave integrated circuits;
   c) integrated circuit demonstrations in ring oscillators and high speed dividers;
   d) infrared detection and imaging on materials and structures leading to the next generation of technology for infrared imaging systems.

3. Cooperative Activities

At the present time the research staff at Plessey expressed limited interested in developing a program of collaborative research. The issue of collaboration through ESPRIT or RACE was discussed, however some confusion existed about the eligibility of non-EEC partners. This issue was clarified and the potential for such ventures acknowledged. The topics of greatest interest were: fibre optics, optical transmitter/receivers, lasers, Led's, integrated circuits, CMOS, VLSI, submicron silicon chips.

10.3. **Country:** United Kingdom

Organization: Logica Cambridge Ltd

Contact: Mr. Keith Southwell, Director of Operations

Location: Betjeman House
104 Hills Road, Cambridge
Telephone: 022366343 Telex: 27200

1. Overview:

Logica has over 3,000 employees worldwide and provides consultancy and support for custom and packaged software. One of its main areas of activity is AI and the company is involved in several different research themes in this area.

The Logica Cambridge labs have seventy staff dedicated to VLSI, Transputers, speech synthesis and natural language programming. Much of the work conducted at their Cambridge research centre is within the context of the ALVEY and ESPRIT programs.

2. Research Activities:

1) Parallel Architecture:
Logica is involved with seven partners in PARSIFAL a project to develop parallel architecture by simulation and measurement. It utilizes a powerful interconnected array of transputers and includes software tools to assist in development, debugging and performance analysis of large programs.

2) ISDN:
In cooperation with British Telecom, Logica is working to develop the first implementation of CCITT ISDN.

3) Expert Systems:
This project examines the use of advanced expert systems for fire risk assessment in the area of general insurance and equity selection for investment decisions.

4) VLSI and Advanced Architectures:
A high performance multiprocessor architecture has been developed for which Logica conducted the architectural design, hardware construction and design of a special programming language. Related developments include a Prolog-like language and a VLSI version of the processor.

5) Architectures for Lisp and Prolog:
The two leading languages for developing knowledge-based systems, Lisp and Prolog, have evolved in comparative isolation from one another. It is increasingly recognised that future systems will need to exploit the best features of both languages. Logica recently completed

a study with High Level Hardware Limited and academic collaborators under the Alvey program to investigate whether such systems could be developed without unacceptable performance compromises. Extensive measurements were made of existing Lisp and Prolog systems running on the High Level Hardware Orion computer. The study concluded that high performance mixed language systems can be developed and that microcoded implementation of the virtual machine can be extremely cost-effective.

6) VLSI-AI Technique:
Logica and Cambridge University are collaborating on the first phase of a research project to explore the application of Artificial Intelligence techniques to VLSI CAD. The project aims to develop ways of transforming a high level representation of the behaviour of a digital system into a design consisting of low level building blocks. The possibility is being explored of using a Knowledge Based System as an "intelligent assistant" to help the designer with the process of selecting and applying suitable transformations.

3. Cooperation Activities:

Logica are a diversified multinational software company active in many different collaborative and cooperative programs. They are receptive to Canadian collaborative opportunities in any or all of the several active research areas. As a private company they are most interested in applications oriented projects, particularly those which address knowledge-based systems, expert system software and parallel processing. The topics of interest include: AI, expert systems, KBS, speech and natural language processing, speech recognition, transputers, human computer interface.

10.4. **Country:** United Kingdom

Organization: Imperial College of Science and Technology

Contacts: Dr. David B. Thomas, Director of Industrial Liaison Imperial College
Mr. Roy McKean, Imperial Software Technology Director

Location: Room 539, Sherfield Building Imperial College
London SW7 2AZ
Telephone: 015895111

1. Overview:

Imperial College implemented its Technology Transfer and Industrial Liaison Centre in 1986. Its role is to strengthen the partnership between the college and industry.

The objectives of the Centre are:

1) to increase the number of research contracts;

2) to encourage scientific exchanges with different institutions around the world;

3) to facilitate the inflow of lecturers and professors from industry into the university;

4) to provide sponsorship of student research activities by industry.

Imperial College has participated in 34 different ALVEY projects. One of its main areas of interest was a collaborative venture with the University of Manchester and ICL for the development of a new range of main frame computer(s). This has led to the development of a new class of computers, known as transputers.

2. Research Activities:

The Centre has been actively pursuing the following:

1) New parallel processing machines;

2) Thin film low dimensional structures (LDS);

3) Molecular beam epitaxy which examines ultra-thin films, heterojunctions and super-lattices for a variety of narrow-gap semiconductor systems;

4) Properties of unusual combinations of III-V compounds, particularly those having small band gaps or where the band gap is modified by built in strain.

3. Cooperative Activities:

The Imperial College liaison group maintains close contacts with industry and has several spin-off companies including Imperial Software. This company has developed an expertise in AI software for parallel processing, and is active in several ALVEY projects. The company, itself, is a joint venture between Imperial College, Plessey and National Westminster Bank. Interest in collaboration with Canadian companies and institutes is quite keen, particularly in the areas of AI, sensors, semiconductors and transputers. Joint research projects, scientific exchanges and contract research are all potential areas of activity. The Centre has already participated with several of the more prominent informatics, software and telecommunications companies, including British Telecom, Plessey and ICL.

Imperial College offers a great deal of potential for collaboration, has excellent resources, experience with industry and is dedicated to the concept of liaisons with industry. Discussions with Dr. Thomas, the centre Director, supported the possibilities for Canadian co-venturing and the need to broaden the Centre's scope of operations beyond the U.K. The topics of specific interest were parallel processing and parallel language software.

10.5. **Country:** United Kingdom

Organization: Mullard/Philips

Contact: John G. Wilkes, Materials Development Manager

Location: Millbrook Industrial Estates
Southampton S09 7BH

1. Overview:

Mullard is one of the oldest electronics firms in Britain. They are now part of Philips Netherlands and are one of the company's main centres of research on silicon structures. This is directed to the examination of the various materials used in chip production, epitaxy and layer processing.

2. Research Activities:

Through Philips, the company is active in ALVEY and ESPRIT. In the latter case Mullard is participating in the European Megaproject which aims at the production of submicron semiconductors. This is a multi-country project involving most of the major European IT firms such as Philips and Siemens. Other areas of activity include: sensors, optoelectronic devices, infrared devices, space sensors, signal analysis integrated circuit design and manufacturing. (Limited information was provided on these areas due to Mr. Wilkes specialty in materials.)

3. Cooperative Activities:

The discussion with Mr. Wilkes touched on many areas of the company's activities. While very interesting and informative it suggested the company activities are determined to a large extent by the head office group of Philips. As such there is only limited autonomy to their activities and the possibilities for joint or cooperative ventures are somewhat limited. Companies interested in pursuing ventures with Mullard should make direct inquiries to the Philips Research Centre in Eindoven, Holland. The main topics of interest identified in this discussion were: silicon processors, integrated circuits, electronic devices, submicron technology.

10.6. **Country:** United Kingdom

Organization: Rutherford Appleton Laboratory (RAL)
Informatics Department

Contact: Professor G. Hopgood, Director AI Research

Location: Chilton, Oxfordshire
Telephone: 023521900

1. Overview:

Appleton Rutherford is part of the U.K. Science and Engineering Research Council (SERC). This is a public body responsible for basic and strategic research in pure and applied science. Its total budget in 1987 was C$700 million with about 2,700 staff and a further 6,500 supported on research grants in various universities.

The DIDCOT laboratory employs 1,400 staff and operates with an annual budget of CDN$120 million. The informatics department at Rutherford Appleton is composed of 120 staff and research personnel.

The department's activities include:

1) conducting research in software engineering, knowledge engineering and human computer interaction;

2) providing support for engineering researchers in universities and polytechnics through the Engineering Computing Facility;

3) providing technical and management support for the U.K. ALVEY program.

The centre conducts its own research using government funds, participates in the ALVEY and ESPRIT programs and undertakes contract research on behalf of industry. Industry research is generally conducted on a 50 percent cost sharing basis.

2. Research Activities:

1) Software Engineering:
Two specific research projects are currently being conducted:

a) theoretical studies and emerging computing graphics standards;
b) assessment of Knuth Bendix Techniques in Theorem Proving;

The first activity is an extension of an ALVEY project investigating the application of formal specification techniques to Graphical Kernel Systems (GKS) the first ISO standard for computer graphics programming and to assess their utility.

2) Knowledge Engineering:
The main areas of activity and interest include:

a) expert system architectures;
b) intelligent front ends;
c) knowledge acquisition;
d) knowledge representation.

Expert system architecture involves the analysis of problem-solving strategies to enable an appropriate matching of system architecture to various problems. Knowledge Acquisition has been directed towards "Expert Systems" in the financial domain and real-time control of complex experiments.

Human Computer Interaction research emphasizes user interface designs for powerful single user systems (SUS's) which have high quality displays and a pointing device. Current and future work is being conducted as part of ESPRIT II. The project is directed to the development of re-usable toolkits. It investigates architectures for knowledge based systems incorporating explicit and abstract representations to allow the re-use of knowledge.

Knowledge Elicitation and Acquisition research is being directed to two fundamental problems: material development and maintenance. Methods are being developed for consulting with the end-user and establishing the circumstances in which the system will be used and the role it will eventually play. Efforts are being directed to integrating knowledge into a system which performs a task different from that of the expert himself. This involves giving a greater role to the end user in the early stages of knowledge acquisition. Maintenance approaches are being expanded to account not only with the knowledge engineer's role in maintenance but also the expert's.

Acquisition techniques are being developed which integrate non-interview techniques with interview based methodology by:

a) integrating the expert with knowledge acquisition system;
b) integrating example based methods with the knowledge acquisition systems.

3) Transputers:
RAL is providing support for an ALVEY funded project which aims to develop an automated transformation system. Transformations of an original program can be defined which guarantee the new program has the same meaning as an original one. A prototype system has been written in Edinburgh Standard ML.

4) Integrated Optics:
Techniques are being developed at RAL to manufacture integrated optics based on titanium diffusion of waveguides in lithium niobate. Related activities are focusing on switch elements to more complex technologies such as three-arm directional couplers. New processing techniques have been developed to allow ion-beam micro-machining of on-chip mirrors.

3. Cooperative Activities:

These various and diverse research areas constitute only part of the RAL informatics activities. Collaboration with Canada has already been established through contacts with Simon Fraser University and University of Toronto in graphics standards and man/machine interface respectively.

The principal area of interest for collaboration are in KBS and transputers. Some potential exists for incorporating suitable Canadian scientists or firms within the proposed ESPRIT II projects. Other possibilities were also discussed in the area of scientific exchanges with universities or industry.

10.7. Additional Centres of Excellence and Research in Britain

During the field work conducted in November/December 1987 additional information regarding Centres of Excellence and Research Institutes in Britain were obtained. Visits were not made to these centres.

1) National Engineering Laboratory
NEL, East Kilbride
Glasgow, G750QU
Telephone: 03552 20222

Nigel Kay, Director Automation Centre

The British National Engineering Laboratory is part of the Department of Trade and Industry. The centre conducts research in several areas including automation, robotics and graphics. It aids in developing standard and gives technical advice to policy making bodies. It conducts long term research usually with funding obtained from the DTI's Research Requirements Board.

2) University of Edinburgh
Edinburgh Scotland

The University of Edinburgh recently instituted a school of information technology. This has three components: AI, Computer Science and Electrical Engineering. The AI initiatives are being directed to five major sections:

a) advanced robots;
b) automated reasoning;
c) education and training;
d) knowledge based planning systems/expert systems;
e) speech processing and natural language.

Two labs are operated:

a) The knowledge representation systems trial laboratory which investigates the applicability of knowledge representation systems such as ART, KEE, knowledge craft, loops and PopLOG.
b) Parallel Architectures Laboratory (PAL). This investigates new architectures such as the ALVEY parallel graph reduction computer and the University Intelligent Filestore.

In July 1984 the AI Applications Institute was created and it now functions as the technology transfer agency for the University's AI department. This "not-for-profit" institute has three main activities:

a) feasibility studies;
b) training;
c) product evaluation.

3) Turing Institute/University of Strathclyde
George House, 36 North Hanover Street
Glasgow G1 2AD Telephone: 041552 6400

The institute was set up in 1984 as an outgrowth of the ALVEY program. It was designed to apply AI and Intelligent Knowledge Based Systems (IKBS) on a self funded not for profit basis. The centre is government/industry funded but is closely linked to the University of Strathclyde and functions as its AI department.

Output from the centre in the recent past has been software tools and shells which are provided primarily to industry. The centre also operates a number of affiliate schemes, mainly oriented to providing access to databases. There are about 30,000 IT/AI documents, abstracted on a keyword basis, consisting of journals, proceedings, research reports, articles, and other medium. Training is provided in a short and long format consisting of formal lectures and self use software systems for student-specified projects.

The centre will also undertake research on behalf of industry, usually with a specific application deliverable as the principal goal. The centre is involved with two ALVEY projects and one ESPRIT project.

Collaboration with the institute would be most feasible through exchange of personnel. Canadians have already attended the institute under their "journeyman scheme".

10.8. Summary U.K.

The U.K. has been very active in the encouragement of new advances and developments in information technology embodied in various programs, policies and related government initiatives. The two most active of these are the ALVEY program and the participation in EEC ventures, such as RACE, ESPRIT and EUREKA. (ALVEY is now in its final stages with most projects due for completion within the next year).

Government policies and the plans which have been announced emphasize the need for industry to take the lead in joint ventures and collaboration, to encourage larger and smaller firms to work together for participation in the European programs, to develop export markets and to find foreign collaborative partners which offer benefits to U.K. industry. While Europe is seen as the principal focus of the U.K.'s efforts the government will support and encourage efforts with other partners, most notably those from North America.

Most of the efforts in the next few years will increasingly be directed to AI product development activities in order to bring the results of ALVEY to the market place. That will have some effect on the response to Canadian initiatives, particularly when a U.K. firm requires support from the British government. As well, many firms may wish to use an established program such as EUREKA and RACE to serve as the framework for their collaborative ventures. This would provide the advantage of:

1) having funds readily available;

2) providing a wide choice of additional partners;

3) establishing networks of research contacts;

4) accumulating a knowledge base of past research;

5) providing potential access to the European market;

6) establishing mechanisms for evaluating proposals;

7) providing a positive climate for collaborative ventures;

8) creating awareness of the benefits for cooperative projects.

Canadian firms wishing to participate in joint ventures should demonstrate the relative advantages they offer to European firms and where possible, consider the existing national and European programs as a mechanism for identifying joint venture partners.

Appendix 1
International Cooperation in Information Technology

Appendix 1

International Cooperation in Information Technology R&D

Project Description

The project seeks to identify opportunities for international cooperation in precompetitive R&D in Information Technology and help Canadian industry initiate and develop such cooperation.

The project relates to an initiative of the Department of Communications (DOC) in support of the Technology Inflow Program (TIP) of the Department of External Affairs and seeks to enhance Canadian research capabilities in Information technology by identifying and promoting mutually beneficial cooperative precompetitive R&D activities with Japan and Western Europe.

The project specifically seeks to:

1) collect information on current R&D activities in Japan and Western Europe, in areas of priority to Canadian industry;

2) identify potential partners in specific areas identified as promising for international IT R&D cooperation; and

3) facilitate initial contacts and follow-up activities between Canadian organization and their international counterparts.

Background

Information Technology, of which communications is a part, is a broad field touching virtually every facet of human activity. In human terms, information means knowledge; and technology means techniques and tools. Information, acquired by the senses, processed by the mind, and retained in memory, can be represented, conveyed and presented to other humans; processed to create new information; or imbedded in processes and materials to create services, tools and other goods for human use. These natural processes may also be accomplished using artifices of one sort or another such as: transducers (representation and presentation) or by computers (retention and processing). All are a part of information technology.

It is widely recognized that a stage in R&D critical to success yet amenable to cooperation is the precompetitive one where scientists exchange ideas, approaches and experience. Here, informed choices in developing technologies are made. Here, new products and business relationships are forged. International cooperation at this precompetitive R&D stage can lead to significant benefits.

ITRD 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

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

Discussion Guide Topics List

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

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 with 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)

R&D Survey - ITRD Database Topics Cross Reference

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					

Note: This exhibit shows the relationship between the topic/subtopics used in the original Canada Survey and ITRD database and those used as the discussion guide in Japan and Western Europe

Appendix 2
Pre-Survey European Itinerary
June 30 - July 16, 1987

Appendix 2

Pre-Survey European Itinerary
June 30 - July 16, 1987

France

June 30:

a) Canadian Embassy, Paris
Mr. D. Lefeuille

b) CNET, Research Lab, Paris
Mr. Vaillex, Director

c) Ministry: Department of Electronics and Informatics,
Programme Filiere Electronique
Mr. Claude Ouannes

July 1:

a) Ministry of Industry
Charge de Mission au Service Electronique,
Informatique, R&D
Mr. Gutovski

Netherlands

July 2:

a) Canadian Embassy The Hague
Mr. John Pearce, Commercial Counsellor

b) Mr. Chris Rowley, TDO

c) Ministry of Economic Affairs, Policy Division
The Hague
Mr. C.G. Hartman

d) Ministry of Economic Affairs, Technology Policy Branch
The Hague
Mr. H.H. Driesser

Belgium

July 3:

a) Mission of Canada to the European Communities, Brussels
Science Counsellor

b) Science Counsellor, Canadian Embassy
Mr. Jean Marion

c) The Belgium Computing and Software Engineering
Trade Association
Mr. Pierre Hap, Permanent Secretary

d) Science Policy Branch, Government of Belgium
Madame Guiette, Brussels

West Germany

July 7:

a) Embassy of Canada, Bonn
Dr. Chris Lukner, Technology Development Officer,
Bonn, West Germany????

b) Ministry of Research and Technology
Technology Transfer Program
Mr. Schoett

United Kingdom

July 9/10

a) Canadian Embassy, London
Mr. P. Whitby
Technology Development Officer

b) Mr. Mark Chappell, Science Counsellor

Netherlands

July 12:

a) SPIN, Informatics Program, Delft
Mr. H.L. Leudesdorff
Project Manager

b) Council for Informatics Technology, Netherlands
Mr. Schaake, Director

Belgium

July 14: Mission of Canada to European Community, EEC
Canadian Embassy, Brussels
Ms. Brigitte Leger

United Kingdom

July 15: ALVEY Conference, University of Manchester
Manchester

July 16: Canadian Embassy, London
Mr. Peter Whitby, TDO

Appendix 3

EUREKA Projects - Informatics - June 1987

Appendix 3

EUREKA Projects - Informatics - June 1987

PROJETS	PARTENAIRES	DURÉE (années)	COÛT (millions d'écus)
Systèmes de communication numérique large bande : développement de boîtiers d'interconnexion destinés aux commutateurs Rnis bande étroite.	CIT-Alcatel (F), Plessey (GB), Italtel (I).	5	160
IHS (Integrated Home Systems) : développement d'un système de communication pour le foyer (bus domotique).	Gec, Mullard, STC, Thorn (GB), Philips (H), Siemens (RFA), Electrolux (Suède), Thomson (F).	2	21,6
Nouvelles techniques de reproduction du son stéréophonique.	Bang & Olufsen (DK), Kef Electronics (GB), Acoustics Lab. (DK).	5	3,6
Mise au point de systèmes de transmission par fibres optiques à 2,4 Gbit/s.	Plessey (GB), Ericsson (S).	2,5	16
DAB (Digital Audio Broadcasting System) : élaboration d'un standard technique de radiodiffusion numérique.	Philips (H), Bosch-Blaupunkt (RFA) et sept autres partenaires allemands.	5	38,3
TVHD (Télévision haute définition) : introduction en Europe d'un système TVHD (production, distribution, consommation) prévoyant le renforcement de la norme Mac Paquets.	Thomson (F), Philips (H), Bosch-Fernseh (RFA).	6	180
ATIS (AIT Tourist Information System) : réalisation d'une base d'informations touristiques pour les clubs affiliés.	ANWB (H), OAMTC (A), TCS (CH).	5	7

(*) **Abréviations des pays.** A : Autriche – B : Belgique – CH : Suisse – DK : Danemark – E : Espagne – F : France – Fin : Finlande – G : Grèce – GB : Grande-Bretagne – H : Pays-Bas – I : Italie – Irl : Irlande – L : Luxembourg – N : Norvège – P : Portugal – RFA : Allemagne fédérale – S : Suède – Sc : Scandinavie.

Informatique et électronique

Eprom : étude, réalisation et industrialisation de mémoires non volatiles Eprom de 4 et 16 mégabits.	Thomson (F), SGS (I).	5	266,7
Jessi : développement d'une filière submicronique, réalisation de chaînes de fabrication de puces intégrant jusqu'à 100 millions de transistors (mémoires Dram 64 Mbits par exemple).	Thomson (F), MHS (F), SGS France (F), RTC (F), Philips (H), Siemens (RFA), Telefunken (RFA), Valvo (RFA) et des laboratoires universitaires.	10	4,8
Micro-encapsulation : formation d'une filiale commune pour le développement de systèmes d'instrumentation et de contrôle informatisé.	Manesty Machines (GB), Puumalainen Laboratories (Fin).	1	0,5
Eurovise : étude des applications de la visionique dans l'industrie européenne, traitement de l'image.	IIRS (Irl), Pera (GB).	3,5	1,6
Fastcat : développement d'un système d'aide à la traduction ; outils informatiques pour le traducteur.	Cos Computer Technologie (RFA), HTS Scandinavia (Sc), Special Systems Industry (H).	2	1,4
Fiabex : réalisation d'un système expert pour l'analyse de fiabilité des systèmes industriels.	CEP (F), Atkins (GB), Datamat (I), IGC (E).	2	64
Mobidick : développement d'un dictionnaire (français-hollandais-anglais) sur CD-Rom pour la traduction assistée par ordinateur et le traitement de texte.	Van Dale Lexicographie (H), ALPS (CH) ; intéressés : Dictionnaires Le Robert (F), Philips (H) et Collins (GB).	3	3,5
Apex (Advanced Program for European Information Exchange) : systèmes d'échange d'informations industrielles pour les industries aérospatiales.	Aérospatiale (F), Aeritalia (I), British Aerospace (GB), Casa (E).	5	30
Cerise (Centre européen des nouvelles technologies d'images de synthèse) : maîtrise des techniques informatiques et développement d'équipements européens pour l'image de synthèse.	Sesa (F), RTL Productions (L).	5	8,5
ES2 (European Silicon Structure) : infrastructure industrielle européenne pour la réalisation de circuits à la demande avec gravure directe.	Bull (F), Philips (H), British Aerospace (GB), Olivetti (I), NB : ces industriels participent au capital de la société ES2.	3	94
Circuits intégrés As-Ga : étude et développement de moyens de conception et de réalisation rapides de composants.	Thomson Semi-Conducteurs (F), GEC (GB).	3	60
Formentor : système expert en analyse de la menace et contrôle d'installations industrielles complexes.	Aérospatiale (F), Det Norsk Veritas (N).	5 (dont une phase de définition d'1 an) (10 MF)	30

Informatique et électronique (suite)

PROJETS	PARTENAIRES	DURÉE (années)	COÛT (millions écus)
East (Eurêka Advanced Software Technology) : développement d'ateliers de génie logiciel sur la base d'Unix System V et de la structure d'accueil Emeraude (PCTE).	SFGL (Sté française de logiciel) (F), Cri (DK), Nokia (Fi), Cir (CH), Solemia (I).	6	141
Paradi : intelligence artificielle appliquée au développement d'un système de gestion des fonctions d'étude, production et logistique.	Aérospatiale (F), Absy (B), Aeritalia (I), Matrici (E), Brown Boveri (CH), Ikoss (RFA).	6	141
Développement de thyristors GTO : gamme de composants d'électronique de puissance.	Thomson Semi-Conducteurs (F), GEC (GB).	2	20
Moses (Serveur multimédia) : systèmes multimédia permettant de traiter des données structurées (fichiers) et non structurées (images, plans, photos, voix...).	Bull (F), ICL (GB).	3	75
Machine "base de données" adaptée aux systèmes experts : gestion des bases de données relationnelles multimédia réparties avec langages proches des langages naturels.	In-Informatique (F), Entel (E).	6	20
ESF (European Software Factory) : ateliers de génie logiciel permettant d'accroître la productivité dans les domaines de l'informatique de gestion, des télécommunications et de l'informatique industrielle.	CAP Gemini Sogeti (F), Nixdorf (RFA).	10 (dont une phase de définition 18 mois) (25 MF)	327
Atelier logiciel pour le langage Ada : utilisation de composants disponibles pour les applications temps réel.	Alsys (F), Logica (GB).	2	4,3
Asic : conception et réalisation de circuits intégrés : développement, à partir de moyens de conception et de fabrication déjà en place, d'unités de réalisation de circuits en petite série.	Thomson Semi-Conducteurs (F), GEC (GB).	5	30
Réseaux locaux Fielbus : gamme de réseaux locaux industriels avec VLSI associés pour le contrôle temps réel des processus et des machines.	CGEE Alsthom (F), Fox Boro (GB), Valmet (Fi), Krohne (RFA), Carlo Gavazzi (I).	5	25,6
Processeur modulaire d'images : machine spécialisée très intégrée associant plusieurs modules de traitement spécifiques.	TRT (F), Contextvision (S).	4	7
Conception et fabrication d'une instrumentation adaptée à la technologie des semi-conducteurs grande puissance.	Asea (S), IMT (S), BBC (CH), CSEM (CH).	2	5
Desire : développement des technologies de photolithographie submicronique simple couche.	Imec (B), UCB (B), Plasma Technology (GB).	3	4
Projection ionique pour dessins inférieurs au dixième de microns.	IMS (A), Siemens (RFA).	3-5	5
Développement, production et commercialisation de compteurs à scintillation.	Nuclear Medical Electronics (GB), Somepal (P), Université Coimbra (P).	4	4
Système intégral de CAO 3D de protéines.	Bruker Analatyshe (RFA), MPI Biochemie (RFA), Carlsberg Lab (DK), CRI (DK).	5-10	16
Afficheur couleur universel et modulaire pour le contrôle de process.	Kone (Fin), HMW (RFA).	3	1
Transpolis/Transpotel : développement de centres de distribution équipés de systèmes de communication et de banques de données pour l'amélioration du transport aérien, maritime, ferroviaire et routier.	Butler (GB), Philips (H).	3	40
Développement d'outils logiciels Prolog.	BIM (B), Brown-Boweri (CH), IBM Deutschland (RFA).	3	2
Nouveau système de CAO.	Serete (F), Ewi (CH), Sereland (E).	3	17
Système expert pour la gestion des céréales dans une ferme.	Comput-a-crop (GB), Philips (H), Vicon (H).	3	0,6
Convertisseurs analogiques-numériques et corrélateurs de signaux.	Nuclear Medical Electronics (GB), Université de Coimbra (P).	2	0,4
Ordinateur vectoriel compact.	Matra (F), Norsk Data (N).	5	4,3
Oasis : sécurité des transferts d'information.	Cap Gemini Sogeti (F), Hasler (CH), BBC AG (CH), Nixdorf (RFA), ANT (RFA), Voest-Alpine (A) et des universités.	5	92
Développement de systèmes d'impression par jet d'encre.	Stork X-cel (H), Swedish Match (S).	3	13,9

Matériaux (suite)

PROJET	PARTENAIRES	DURÉE (années)	COUT (millions écus)
Membranes filtrantes.	Lyonnaise des Eaux, Degrémont (F), De Danske Sukkerfabriken (DK).	6	56
Silicium amorphe.	Solems (F), MBB (RFA).	5	53
Précurseurs pour céramiques.	Menotherm (A), Titaceram (B).	3	2
Carmat 2000, nouvelle conception d'une carrosserie automobile prenant en compte dès l'origine les matériaux nouveaux et permettant de baisser sensiblement les prix.	Peugeot SA (F), ICI (GB), BASF (RFA), DSM (H), Vitrotex, Italia (I), Cristaleria, Espanola (E).	5	60
Composites métalliques et céramiques pour automobiles : conception et réalisation, en pilote industriel, de pièces mettant en œuvre des matériaux et procédés de formage nouveaux.	Pechiney (F), Fiat (I).	5	15
Diane (Equipement mobile de neutroscopie) : équipement mobile de radioscopie neutronique, adapté aux contrôles non destructifs en milieu industriel.	Sodern (F), Dornier (RFA), Sener (E).	5	15
Turbine céramisée : réalisation de deux prototypes de turbines céramisées, l'une industrielle de 5 MW et l'autre, marine, de 2 MW.	SEP (F), Volvo (S), Alfa Romeo (I).	5	16
Moteur diesel céramisé : utilisation des céramiques composites Sic-Sic afin d'améliorer le rendement.	SEP (F), Man (RFA).	5	14
Etude de méthodes informatiques pour la conception de produits thermoplastiques moulés par injection.	Royal Institute of Technology (S), Centre for Industrial Research (N).	5	1,6

Robotique et productique

Famos : étude des ateliers flexibles.	CNRS (F), Taylor Hitec (GB), CNR (I), Schrack Elektronik AG (A), IPA (RFA), Ikerlan (E), Volvo (S).	10	2,2
25 kW CO_2 : conception et réalisation d'un module laser 25 kW CO_2 et de groupes modulaires pouvant atteindre 200 kW.	Consortium anglais mené par le Welding Institute (GB), Electronics SA (S), Svejsecentralen (DK).	4	7
Développement d'un laser CO (monoxyde de carbone).	Control Laser Ltd (GB), Austin Rover (GB), Wallis Electronics (GB), Advanced Production Automation (H), Laser PTI (S).	1 (phase de définition)	0,5
Etude des applications des lasers de haute puissance : soudage, traitement de surface...	Consortium allemand mené par DFVLR (RFA), Ecole polytechnique de Lausanne (CH).	3	7,5
Applications industrielles du traitement par faisceau d'électrons : fabrication de micro-émulsions, traitement de la cellulose...	Kvantek (S), Puumalainen Laboratories (Fin).	3	3,3
Usine du futur : développement de techniques pour la CIM, applications de l'intelligence artificielle (systèmes experts de conception d'ateliers flexibles, systèmes experts de planification...)	Atek NC-Systems (CH), Fides Treuhandgesellschaft (CH) et une dizaine de partenaires allemands.	13	17
IQ : développement d'automatismes « mécatroniques » intelligents et de systèmes de télécommande de véhicules à mécanismes hydrauliques.	Neles oy Lokimec (Fin), Hydrolux (Lux).	4	2,1
Soudage par faisceaux d'électrons à pression atmosphérique pour des aciers jusqu'à 100 mm d'épaisseur.	Espagne, Suède, Grande-Bretagne.	4	2,4
Navire de pêche des années 1990 : conception et réalisation de navires de pêche fortement automatisés et rentables. Développement en parallèle d'un système de contrôle acoustique de chalut.	Ifremer et Alma Marine (F), Ini-DCN et Percanova (E).	5	56
Hercule, robot pour le bâtiment : manipulateur de charges (robot grue) et robot multitâche de façade (échafaudage, porte-outils).	Compagnie générale des Eaux (F), Liebherr (RFA), Simon (GB).	5	22
Usine automatisée flexible de production d'équipements électroniques (Eurocim) : conception et réalisation d'un ensemble d'ateliers flexibles pour la fabrication de cartes de circuits	Eurosoft (F), Isel (E), CSEA (I).	5	30

Robotique et productique (suite)

PROJETS	PARTENAIRES	DURÉE (année)	COÛT (millions écus)
Robot de sécurité civile AMR (Advanced Mobile Robot) : robots de démonstration adaptés à l'environnement urbain et naturel, et destinés à la sécurité civile.	Matra-CEA (F), Casa (E), CSEM (CH), Aeritalia (I).	5	100
Capteurs automobiles : ligne de production de capteurs de silicium pour grande diffusion, dans l'automobile, la production et la sécurité.	Metravib (F), CSEM (CH).	5	27
Robot de surveillance Mithra : produits intégrables dans les systèmes associant une meilleure sécurité des hommes, des biens et de l'environnement.	Bossard Consultants (F), Elkron (I), EPFL (CH).	4;5	33,3
Atelier flexible optronique.	CGP, Cilas, Sesa, LDM/CGE (F), Groupe Fiat (I), SMH (CH).	5	70
Laser CO_2 de puissance.	Cilas (F), Rofin/Sinar, DFVLR (RFA).	6	50
Laser à solides.	Quantel, BMI, Sciaky, Sfena, Crismaltec (F), Noble-light (GB).	6	25
Laser excimères de puissance.	Cilas, Lam, CEA (F), KWU (RFA).	3	17
Robot pour le textile.	Lectra Systèmes (F), Efacec, Eid (P).	4	22
Eurofor : automatisation et informatisation des opérations de forage. Objectif : réduction d'un facteur 2 du coût du forage au mètre.	Alsthom (F), Foramac (GB), Massarenti (I), Subsea Technology (GB).	4	26

Appendix 4

ESPRIT Projects - June, 1987

Appendix 4

ESPRIT Projects - June, 1987

N°	TITRE	PARTICIPANTS
304	Conception de techniques et d'outils à l'appui de l'analyse et de la conception de systèmes cognitifs	Standard Telecommunication & Cables (UK), SCS (D), Univ. d'Amsterdam (NI), KBSC/Polytec. of the South Bank (UK)
26	Algorithmes avancés et architectures pour le traitement de la parole et de l'image	CSELT (I), AEG Telefunken (D), Gec (UK), Thomson-CSF (F), Univ. de Turin (I), Polytechnique de Turin (I), Hitec (Gr)
96	Réalisateur de systèmes experts (ESB)	Plessey Electronic Syst. (UK), CSELT (I), ST Lyngso A/S (Dk), Trinity College Dublin (Irl), Plymouth Polytechnic (UK), Riso National Labs (Dk), LAI Marseille (F), Tecsiel (I), Cimse (I)
107	Approche orientée logique des bases de connaissances et de données supportant l'interaction naturelle des utilisateurs (Lokc)	Bim (B), Fraunhofer Institut IAO (D), Scicon (UK), Univ. de Crète (Gr), Cranfield Inst. of Technology (UK), SCS (D), Inca (D), Tech. Univ. Munich (D)
256	Conception de systèmes cognitifs pour applications industrielles Influence du temps et modélisation	CISE (I), Framentec (F)
280	Aide intelligente aux utilisateurs de systèmes d'information	CRI A/S (Dk), Courseware Europe (NI), Dansk Datamatik Center (Dk), ICL (UK), Univ. de Leeds (UK), Univ. d'Amsterdam (NI)
311	Systèmes avancés de gestion des données et de la connaissance (ADKMS)	Nixdorf Computer AG (D), Bull SA (F), Olivetti (I), Univ. de Berlin (D), Univ. de Turin (I), Univ. de Bologne (I), Univ. de Dortmund (D)
316	Une architecture pour la solution interactive de problèmes grâce à l'utilisation de bases de données et de bases de connaissances	CSELT (I), CAP Sogeti (F), Cert (F), Philips (B), Polytechnic of Milan (I)
393	Accord : Construction et interrogation des bases de connaissances au moyen de textes énoncés en langage naturel et de graphiques	CGE-LDM (F), CII-HB (F), Triumph-Adler AG (D), Fraunhofer Inst. IAO (D), Univ. of Edinburgh (UK), Univ. de Suttgart (D)
415	Architectures et langages parallèles pour TAI - Une approche à base de VLSI	AEH Telefunken (D), CII-HB (F), CSELT (I), CWI Amsterdam (NI), Gec (UK), Univ. de Munich (D), Lifia (F), Nixdorf (D), Philips (NI), Stollman & Co (D), Univ. de Berlin (D)
419	Compréhension de l'image et du mouvement	Univ. de Gênes (I), Captec (Irl), Trinity College Dublin (Irl), Univ. de Nimègue (NI), Video Display System SRL (I)
440	Architectures à communication par messages et systèmes de description	Delphi SpA (I), Bell Telephone (B), Vrije Univ. Brussel (B)
527	Défaillance de communication lors d'un dialogue : techniques de détection et de réparation	Education Research Centre (Irl), Linguistic Institute of Ireland (Irl), Memory Computers PLC (Irl), Univ. of Leeds (UK), Univ. of Pisa (I), ITT Europe (UK)
530	Systèmes avancés de gestion des bases de connaissances	S & M (I), Bense KG (UK), Criss (F), Univ. de Pise (I), Univ. C.-Bernard, Lyon (F), Univ. de Dortmund (D)
532	Réalisation et affichage en temps réel d'un sketch en 2.5 D pour scènes animées	Univ. of Strathclyde (UK), Barr and Stroud Ltd (UK), Zeltron (I), Olivetti (I)
618	Delta 4 : une architecture de système distribué ouvert et sûr	CII-HB (F), IEI-CNR (I), Ferranti Electronics (Uk), Fraunhofer Inst. (D), GMD (D), Lase (F)
857	Dialogue basé sur graphiques et bases de connaissances, pour systèmes dynamiques	Cri A/S (Dk), Univ. de Kassel (D), Univ. of Strathclyde (UK), Univ. de Leuven (B), Brown Boveri (D)

Quelques projets Esprit dans le domaine du « traitement avancé de l'information » (suite)

N°	TITRE	PARTICIPANTS
874	Environnement intégré pour systèmes	Marl Advanced Microelectronics Jeumont Schneider (F), Univ. de Bologne (I), Telettra (I)
940	Analyse de la profondeur et du mouvement	Elsag (I), Gec (UK), Matra (F), Inria (F), ITMI (I), Noesis (F), Univ. de Cambridge (UK), Univ. de Gênes (I)
957	Mémoires de masse à haute densité pour stockage des connaissances et de l'information	Bull (F), BASF (D), Bogen Elektronik GmbH (D), Glaverbel (B), Leti (F), Simulog (F), Thomson CSF (F)
973	Environnements avancés pour la programmation logique (Alpes)	Cril (F), Bull (F), Enidata (I), LSI (F), Iasi (I), Univ. de Rome (I), LRI (F), Tum (D), Univ. d'Orléans (F)
1015	Intégration de l'intelligence artificielle – de l'interface vocale et du dialogue en langage naturel – application aux services de l'annuaire (Palabre)	Sesa (F), Cnet (F), British Telecom (UK), ERLI (F), CNRS-LIMSI (F), Polytechnic of Turin (I), SARIN (I)
1063	Intégration des techniques d'apprentissage symbolique et numérique	Cognitech (F), Univ. de Paris-Sud (F)
1085	Développement et application d'une machine multiprocesseurs à haute performance et bas prix	RSRE (UK), Apsis (F), Inmos (UK), Telmat SA (F), Thorn Emi (UK), Univ. de Southampton (UK)
1098	Une méthodologie pour le développement de KBS	Standard Telecommunications & Cables (UK), Polytechnic of the South Bank (UK), Scicon (UK), SCS (D), Univ. d'Amsterdam (NI)
1117	Système basé sur la connaissance, orienté utilisateur, pour l'utilisation de bases d'informations	CRAI (I), DDC (Dk), Philips (NI), Enidata (I), Univ. d'Anvers (B), Univ. de Rome (I)
1218	Base de données intégrée et système de gestion cognitif de la prochaine génération	Syseca Logiciel (F), Univ. de Kaiserslautern (D), Absy (B), Cril (F)
1219 (967)	Développement d'une machine associative parallèle pour le support de l'intelligence artificielle	Cimsa Sintra (F), CSELT (I), Gec (UK), Non Standard Logics (F), Thomson CSF (F)
1219 (1106)	Développements supplémentaires de Prolog et leur validation par des systèmes cognitifs dans des domaines techniques	Prologia (F), Gia (F), Git (D), Robert Bosch (D), Daimler Benz (D)

Appendix 5
RACE Definition Projects

Appendix 5

RACE Definition Projects

1) Subscriber Premises Reference Model.

2) IVICO Integrated Video Codec.

3) Multi/gabits Integrated Optical Communication and Mobile Terminal, Integrated Circuits Definition and Technologies.

4) Examination of an Integrated MCT/GAAS Technology for 1.3-1.5 UM PIN-FET Receivers.

5) System Techniques and Components Optimised for the Optical Subscriber Loop.

6) Technical and Economic Assessment of Low Cost Opto-Electric Components.

7) Low Bit Rate CODEC in IBC Terminal Equipment.

8) Technologies for Optical Switching in IBCN.

9) Evaluation of Switching Techniques and Technologies for the IBC.

10) Customer Access Connections.

11) "Sprint" Software Programme for Research in Telecommunications.

12) High Bit Rate Long Haul Optical Communications in Middle Infrared Range.

13) Assessment of Systems and Components For Optical Telecommunications (ASCOT).

14) Coherent Multi-Channel Techniques for Integrated Broadband Subscriber Communications.

15) Madras - Modular Approach to Definition of Race Subscriber Premises Network.

16) Lorine - Limited Rate Imagery Network Elements.

17) Domestic Subscriber Premises Network Technology.

18) Evaluation of Flat Panel Display Technologies.

19) Security Privacy and Reliability in IBC Communications: Architecture, Application and Technology.

20) RACE Software Strategy Study.

21) Polymeric Optical Switches.

22) IBC Networks using Asynchronous Time Division Techniques.

23) Development Production Testing and Operational Tools for Dedicated Telecom Ssoftware in IBC/ISDN Networks.

24) AI Application in IBC Network Configuration Maintenance Operation & Message Processing.

25) Connection of Mobile & Portable Services to the IBC Network.

26) Optical Components in Relation to Network Architecture in the IBC Network.

27) Monolithic Integration for Opto-electronic Functions for Coherent Communication Systems.

28) Methods for Piecewise Development and Construction of Telecommunication Systems.

29) Specification Environment for Communication Software - SPECS.

30) Home Network Systems.

Appendix 6

Netherlands' Key IT Organizations, Agencies, Institutes

Overview of activities, studies and policy intentions in technology and application areas

Technology/ application category	Information	Education	Scientific infrastructure research	Stimulation market-sector (R&D)	Government
1. Biotechnology	• *in preparation:* • 'Biotechnologie in Nederland' magazine commercialised • 'Biotechnology in the Netherlands' international brochure (parts 1 & 2)	• *in preparation:* • 2nd stage professional biotechnology training at Delft/Leiden universities as of 1986	• *in progress:* • Biotechnology IOP as of 1986 (1986 costs: EZ 10.1 m)	• *in progress:* • corporate biotechnology research projects stimulation subsidisation (1985, EZ 24.6m, 12 projects)	
2. Information technology (see INSP)	• *in preparation* • subsidisation scheme for counselling firms on information technology • national information campaign • public information foundation	regular education • *in preparation;* infrastructure, training and research measures • in-depth projects in basic and special education • NOVI project, broad introduction for 1st stage secondary education • projects in LBO and MBO • HBO locomotive projects • ISI project • *in preparation:* • broadening information technology • transfer activities to normal training & caring institutions Non-regular education • *in preparation:* • upgrading information workers • upgrading gov't managers • practical training centres production innovation • transit & transport training project • *in preparation:* • small & medium firms projects	• *in progress:* • strengthening CWI & GTIs • cadre strengthening • SPIN with speech-processing technology, flexible production automation and 5th-generation systems programmes • IC-technology IOP • THs microelectronics plan • *in preparation:* • SURF • SPIN programmes in various areas incl. artificial intelligence & software engineering	• *in progress:* • SABA subsidisation scheme • ASCI'85 subsidisation scheme • Flexible Production Automation demonstration scheme • development & supportive research as to information technology, sundry projects • promoting information technology applications, sundry projects, (incl. use in products) • databank publication experiments • studies & research on information infrastructure (e.g. Zegveld Cttee) • Limburg cable experiment • *in preparation:* • Information Technology Certification Institute • production innovation measures • branch-oriented software development	• *in progress:* • CCOI establishment • SPIN-OV programme • PTT privatisation • *in preparation:* • study of possible privatisation of computer centres

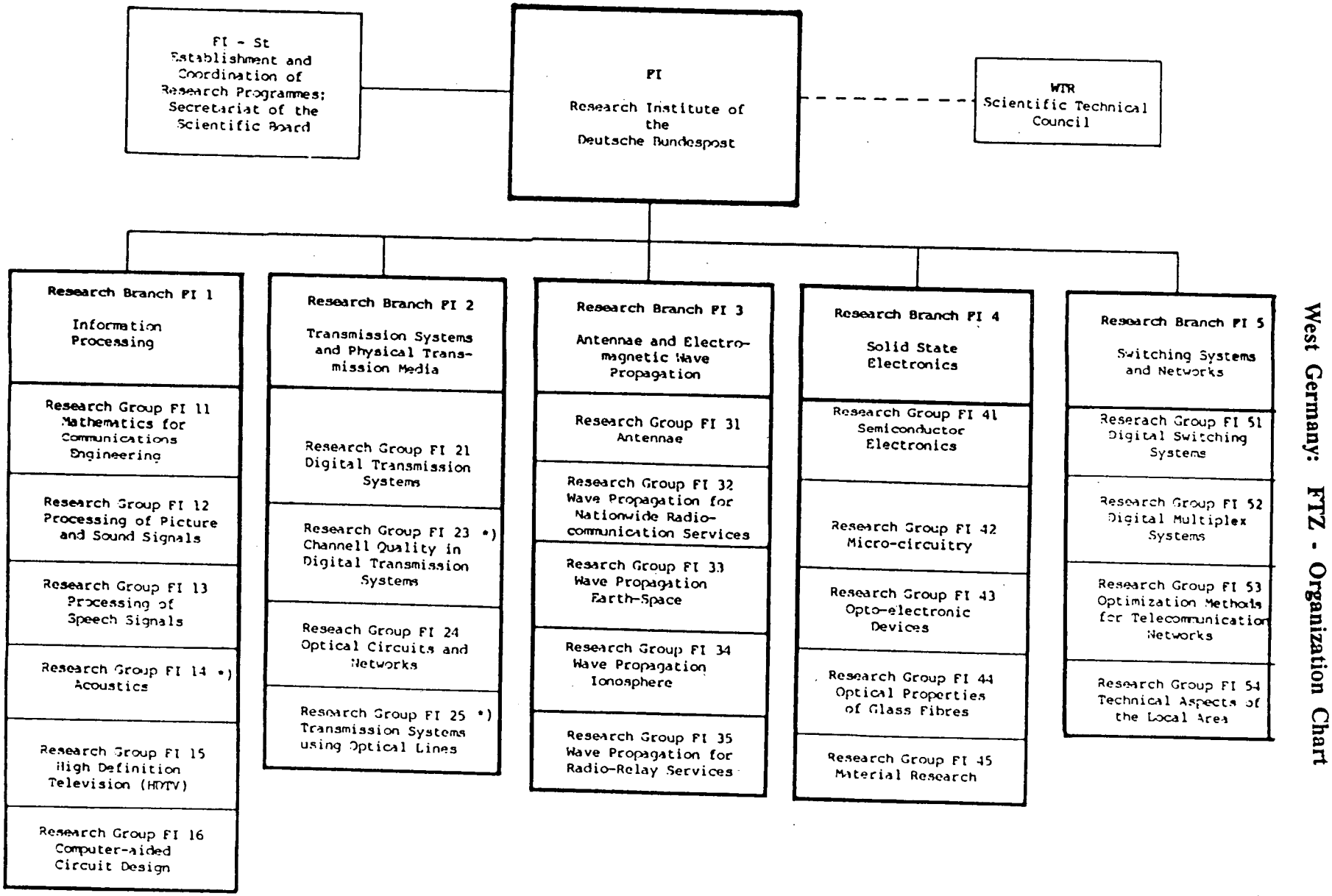
3. Materials technology	• feasibility study (Tebodin) database materials choice (ready summer 1986) (EZ) • Materials Policy Paper (ready spring 1986) (EZ & O&W) • programme information of firms (in preparation) (EZ & O&W)	• education & materials background study (ready spring 1986) • policy note on higher education technology and market sector (ready spring '86) (EZ & O&W)	° *in preparation:* Polymer Composites IOP 2nd stage 1986 ° *in progress:* Engineering Ceramics IOP 2nd stage 1986 ° *prelim. study:* • recycling IOP (ready spring'86) • Metals IOP		° *under study:* • possible programme for materials sector
4. Energy technology	° *in progress:* energy-saving demonstration projects • wind energy relative to IPW implementation		° *in progress:* • molten carbonatecell research programme since 1986 (EZ 10m) for 3 years ° *under study,* policy intention: • photovoltaic conversion of solar energy research	° *in progress:* • phosphoric acid fuel cell development & demonstration programme (EZ 2m p.a.) ° *IPW stimulation* programme 1986–90 (EZ 110m) for 5 yrs	
5. Construction	• 'Innovation also in Construction' booklet completed	° *in preparation:* • study better match of regular education to needs of construction industry	° *in progress:* • Construction IOP	° *in progress:* • demonstration projects ° *in preparation:* technology policy steering group	° *completed:* • inventory of knowledge economy problems
6. Defence					° *in preparation:* • Defence Technology Concept development ° *in progress:* • extending Codema scheme to technology projects • changing tasks & composition of Military Production Advisory Board
7. Agriculture & Fisheries a. National radio-activity measuring system	° *in progress:* • extra activities for farm sector & food, drink, tobacco industry	° *in progress:* • training & constant up-grading of analytical staff in government & industry	° *under study:* • long-term effects of Cesium, etc in soil and crops	° *in progress:* • installation of 20 more monitors with private firms	° *in preparation:* • qualification & quantitative expansion of measuring network
b. Acidification research			° *in progress:* • National Acidification Research Programme through 42 research projects	° *in progress:* • Participation through NRLO	° *in progress:* • L&V research in RIVM and other institutes

Technology/ application category	Information	Education	Scientific infrastructure research	Stimulation market-sector (R&D)	Government
c. Food irradiation	• *in progress:* • Information of industry by PROVO & RIKILT		• *in progress:* • irradiated products quality study (PROVO, RIKILT) • application research		
d. Agricultural biotechnology	• *in progress:* 'Biotechnologie Nederland' magazine • Brochures on Bio-technology IOP • transfer points	• *in progress:* • specialisation bio-technology discipline at Wageningen Agricultural University	• *in progress:* • Biotechnology IOP	• *In progress:* • EEC Framework Programme • Biotechnology IOP • *under study:* • Eureka	• *in progress:* • PCLB research coordination in IOP context
e. Manure surpluses	• *in progress:* • sundry activities through consultancies		• *in preparation and progress:* • animal feeds research • manure processing • manure sales	• *in progress:* • involvement & participation in NRLO context	• *in preparation:* • implementation of Fertilisers Act & Soil Protection Act
8. Maritime & Marine technologies			• background research programme (MARIN) • research programmes through CMO	• CMO research programmes	• *in progress:* • CMO assessment
9. Medical technology	• *in preparation:* • information about ongoing research activities	• *under study:* • 2nd stage of professional training in medical technology	• *under study:* • Medical Technology IOP • strenghthening medical technology exports action programme • canvassing medical technology investment (through setting up subsidiaries) in the Netherlands	• *in progress:* • continuation of a number of brokerage experiments • starting participation in Eureka • involving industry in WVC technology assessment project	• *in progress:* • measures to achieve streamlining of international prescriptions and standards
10. Environment	• *in progress:* • environmental technology project papers or monographs for 1986 continuous publication (EZ/VROM) • biannual environmental technology seminars (EZ/VROM) • switching scheme (EZ/VROM/C. of C.)	• *under study:* • 2nd stage environmental sciences professional training at IVM (Amsterdam), CML (Leiden), IVAM (Amsterdam, University) • appointment of 2–3 extraordinary professors for 2 days a week (VROM)	• *under study:* • study on starting Environmental Technology IOP	• *in progress:* • national research programmes on basis of environmental policy, IMPs and EEC directives (VROM/EZ) and medium-term membrane technology, environmental biotechnology & control technologies research programmes	• *under study:* • cleaning up toxic wastes from dumpsites through gov't-industry and scientif. infra-structure consultations

11. Space technology	• *under study* • information via Estec science park		• *in progress:* • participation in ESA scientific programme • participation in ESA R&D programmes (cf. Technology Policy Survey 1985–1986, p. 110–112) ZWO research programme (SRON) • National Space Programme (NIVIR)		• *under study:* • space effort policy intention 1985–95
12. Traffic & Transport			• *in progress:* • Shipbuilding CAD under CMO multi-year programme	• *in progress:* • joint Neth. industry participation in COST programme for shipping traffic management systems • sundry projects – SAR; – Cargonaut • *in preparation:* • European Carminat project • development of new generation of vehicles • Fokker 50 and 100 projects approaching completion as basic versions (funding via NIVR) • Through international development of Airbus A310; completed	• *completed:* • study of technological aspects of transit trade in the Netherlands: no follow-up activities expected
13. Public Works				Programme is being started up • *in preparation:* • studies on water purification, maritime information, tunnelling systems energy reservoir	
14. Fine chemicals		• stimulation subsidy 2nd stage polymer technology training	• *in progress:* • Carbohydrates IOP (EZ 12m, L&V 4m; 1986–92) • Catalysis IOP pilot projects being set up • *in preparation:* • study of Dutch position on heterocyclical chemistry	• *in progress:* • Stimulation subsidies to support corporate R&D effort to speed up products package shift towards specialties • *in preparation:* • in-depth study of crop protectants	• *under study:* • Possibility of programme for fine chemicals favoured sector

Appendix 7

West Germany: FTZ - Organization Chart



*) in Berlin

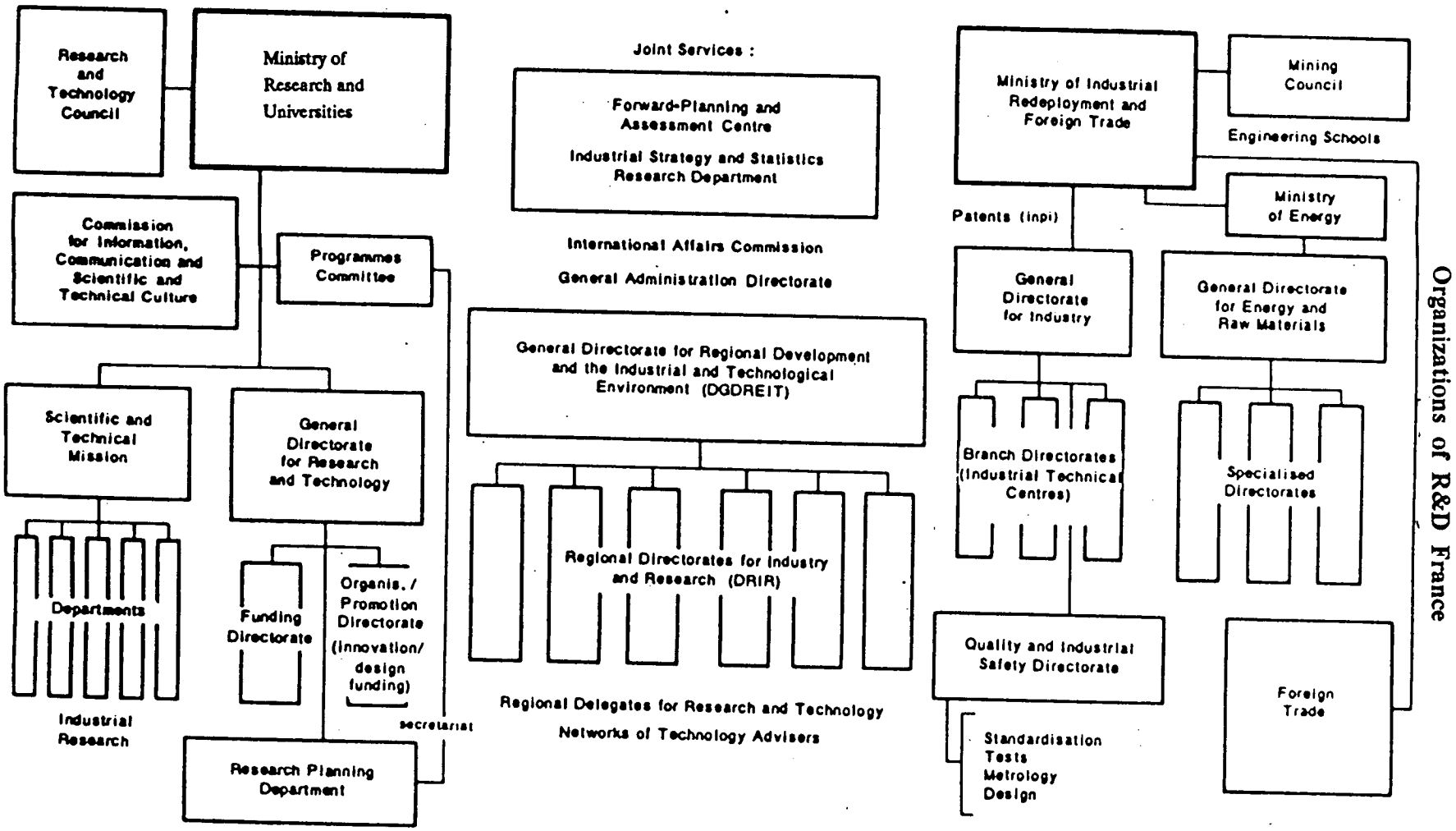
Appendix 7

West Germany: FTZ - Organization Chart

Appendix 8

Organizations of R&D France

ORGANISATION CHART
1985



Source : MRT.

Appendix 9

CNET Participation in EEC Programs in 1986

CNET PARTICIPATION IN EEC PROGRAMS IN 1986: Microelectronics, ESPRIT, RACE, and Conformance Testing

Microelectronics program (1983-1986) - Contract signed		Centers involved
CVT (1983-April 1986)	Design of integrated circuits for telecom applications (CAO - VLSI - Telecommunications)	CNS

ESPRIT (1984 tender) - Contracts signed		
SPECTRE (contract 554)	Submicrometer CMOS technology	CNS
SOI-3D (contract 245)	Insulating silicon 3D Integration	CNS
Optoelectronics (contract 263)	Devices for high-speed transmission in optical communications (contract 963 in 1985-1986)	PARIS B
Optoelectronics (contract 443)	Molecular engineering for optoelectronics	PARIS B
Displays (contract 491)	Thin film transistors for driving liquid crystal flat displays	LANNION B
Circuit design & testing (contract 271)	Testablility of VLSI circuits using electron beams	CNS
Image coding for videotex (contract 563)	Image coding algorithms for photographic mode videotex	CCETT
NOTA: CNET is prime contractor for contracts 554 and 443.		

ESPRIT Program (1985 tender)		
CVS (project 802)	Design of VLSI silicon integrated circuits (cont. of CVT/1983) (CAO - VLSI - SILICON)	CNS
Display (contract 833)	Thin-film transistor driven liquid crystal displays	LANNION B
Bipolar ICs (projects 971)	GaAs-GaAlAs bipolar integrated circuit technology	PARIS B
KNOSOS (contract 974)	Knowledge base environment: re-use of notions and components	LANNION A
ALABRE (contract 1015)	Integration of artificial intelligence, a vocal interface, and natural language dialogue - phone directory application	LANNION A
Office documents (contract 1024)	Management of an office document architecture	SEPT
Interactive Audiovisual Facilities (contract 1057)	Multipoint interactive audiovisual communications via the ISDN and 64 kbit/s networks	LANNION A
Software tools (contract 1265)	Demonstration of the SEDOS-ESTELLE tools (supplementary 1985 tender)	LANNION A

ESPRIT: 1986 Program		
Optoelectronics (contract 1270)	Project originally under BRITE, transferred to ESPRIT	LANNION B
Speech processing (contract 1541)	Project SAM: evaluation of speech synthesis and recognition	LANNION B

RACE Program (definition phase): Contracts		
1001/3012	High-definition television-TV and audio standards	CCETT
1013	HgCdTe technology for detectors	LANNION B
1016	Optoelectronic components (economic evaluation)	LANNION B PARIS A LANNION A
1024	Switching techniques (evaluation)	LANNION A
1029	High bit rate long haul optical links (infrared window)	PARIS B
1033	MADRAS (Modular subscriber installations, specifications)	CCETT
2000	LORINE (low bit rate images)	PARIS A
2003	Flat displays (technological evaluation)	PARIS B
2015	Security, confidentiality, reliability	SEPT
2031	Optical components - network architectures	LANNION B
2036	Optoelectronics (monolithic integration, coherent systems)	PARIS B
2039	SPECS - specification software	PARIS A
2042	Domestic networks	LANNION A CCETT

WAN-CTS: Wide Area Networks - OSI* Conformance Testing Services	
4 contracts were signed for conformance testing to check compliance of various OSI levels with standard protocols: — OSI levels 1 to 4 (physical, data link, network, transport) — teletex — electronic mail (MHS) — file downloading (FTAM) and level 5 "session". *Open Systems Interconnection	**PARIS A** CCETT SEPT LANNION A

1986 CNET PARTICIPATION IN COST ACTIONS

Action (period)		Topic	Centers involved
COST 202 bis	(1984-88)	Broadband digital local networks	LANNION A
COST 206	(1984-88)	High definition TV coding	CCETT
COST 207	(1984-88)	Communications with mobiles	PARIS A**
COST 209	(1984-88)	Speech recognition techniques	LANNION A
COST 210	(1984-88)	Propagation-related interference	PARIS B LANNION B
COST 211 bis	(1982-87)	Image signal coding	PARIS A** CCETT
COST 213	(1984-88)	Electronically steered antennas	PARIS LANNION B
COST 214 (cont. of COST 201)	(1985-88)	Multiservice network design	PARIS A**
COST 215 (cont. of COST 208)	(1985-90)	High speed transmission on optical fibers	LANNION B PARIS B
COST 216 (cont. of COST 208)	(1986-91)	Switching and routing via optical devices	LANNION B PARIS B
COST 219	(1986-89)	Telecommunications and aid to the handicapped	LANNION A
COORDINATION: TECHNICAL COMMITTEE FOR TELECOMS		Initiation and technical follow-up of COST actions for telecommunications. Coordination with other COST actions, the ESPRIT and RACE programs, and CEPT projects.	DICET

*COST: European Cooperation in Scientific and Technical Research.
**COST Actions 211 bis and 214 are currently chaired by CNET engineers Mrs. H. SEGUIN and Mr. ROBERTS, respectively. Mr. J. SOEIRO DE BRITO is Vice-Chairman of COST 206.

Appendix 10
Abbreviations

APPENDIX 10

ABBREVIATIONS

3D	= Three-dimensional, as in 3D pictures
5GCS	= see FGCS
Ag	= silver
AI	= Artificial Intelligence
ALVEY	= Industry/Government Program for Information Technology Research and Development in U.K.
ASIC	= Application Specific Integrated Circuits
ATM	= Automated Teller Machine, as in banking
ATR	= Advanced Technology Research Corp.
B	= Billion (1,000,000,000)
BMFT	= Ministry of Research and Technology, Bonn, W.Germany
BTSP	= Binary Time Spectrum Pattern
CAD	= Computer-Aided Design
CAE	= Computer-Aided Engineering
CAM	= Computer-Aided Manufacturing
CASE	= Computer-Aided Software Engineering
CATV	= Community Antenna Television, typical cable TV system
CCD	= Charge-Coupled Device or image sensor for video cameras
CD	= Compact Disk
CEPT	= Conference of European Post and Telecommunications
CHI	= Cooperative Hierarchical Inference
CNES	= Centre for Studies in Space
CNET	= Centre for Studies in Telecommunications
CoCr	= Cobalt Chromium

CPU = Central Processing Unit

CRT = Cathode Ray Tube

CS = Communications Satellite

CTV = Color Television

DAB = Digital Audio Broadcasting

DAT = Digital Audio Tape

DEMUX = Demultiplex, as in reassembling time sequence of signal samples to their proper channel as result of previously having been Multiplexed (see MUX)

DRAM = Dynamic Random Access Memory

DSP = Digital Signal Processing

EB = Electron Beam, as in EB lithography

EC = European Community

ECB = Electronically Controlled Birefringence

EDTV = Extended Definition Television

EEC = European Economic Community

EFT = Electronic Funds Transfer

EFTA = European Free Trade Association

EL = Electroluminescent, as in EL display

ESPRIT = European Program for Research and Development in Information Technology (mainly software)

EUREKA = European Program for Industry Stimulation of Research and Development

EWS = Electronic Work Station

FA = Factory Automation

FP = Flat Panel, as in FP Display

FAX = Facsimile

FGCS = Fifth Generation Computing System

G3 = Group 3 Facsimile

G4 = Group 4 Facsimile

GaAs = Gallium Arsenide

Gbps = Gigabits per second, or 1,000 Mbps

GKS = Graphical Kernel System

HDTV = High Definition Television

IBC = Integrated Broadband Communication

IBCN = Integrated Broadband Communication Network

IC = Integrated Circuit (see also LSI, VLSI, ULSI)

ISDN = Integrated Services Digital Network

ISP = International Standard Profile, relating to OSI

LAN = Local Area Network

LC = Liquid Crystal

LCD = Liquid Crystal Display

LED = Light Emitting Diode

LSI = Large Scale Integration, referring to ICs incorporating electronic circuitry on a large scale

MB = Megabytes (1,000,000 bytes)

Mbps = Megabits per second (1,000,000 bits per second)

MMI = Man-machine interface

M-TPC = Modified Time Polarity Control

MUX = Multiplex, as in dissassembling signals on multiple channels as a predetermined time sequence of signal samples (see DEMUX)

NAPLPS = North American Presentation Level Protocol Syntax, a joint USA/Canada standard for videotex/teletext displays

NL = Natural Language, as in Japanese, English, and French

NLP = Natural Language Processing, translating from one NL to another or using NL for a user-friendly input/output

OA = Office Automation

OASYS = Office Automation System

OCR = Optical Character Recognition

OSI = Open Systems Interconnection

PBX = Private Branch Exchange, a unit for local switching of calls by a telephone operator in a large office

PC = Personal Computer or Printed Circuit depending on the context

PCM = Pulse Code Modulation

PHIGS = Programmer's Hierarchical Interactive Graphics Standard

PIN = refers to PIN diode, a power diode where a silicon wafer of nearly equal p-type and n-type impurities is infused with extra p-type impurities from one side and extra n-type from the other to yield a lightly-doped intrinsic layer in the middle

Pixel = Picture Element

POS = Point Of Sale

RACE = Program for Research and Development in Advanced Communications-technologies in Europe

ROM = Read Only Memory

SAW = Software Analysis Workstation or Surface Acoustic Wave depending on context

SME = Small and Medium Size Enterprise

SMF = Single Mode Fiber, as in fiberoptics

SOI = Silicon on Insulator

SPIN = Support Program Informatics Development & Research

SQUID = Superconducting Quantum Interference Device, usually a superconducting ring with 1 or 2 Josephson junctions

SrS = Strontium Sulphur, as in bright EL Flat Panel displays

SrSe = Strontium Selenium

TbCo = Tibium Cobalt

TFEL = Thin Film Electroluminescent, as in TFEL FP displays

TFT = Thin Film Transistor

TFT-LCD = TFT-addressed Liquid Crystal Display

ULSI = Ultra Large Scale Integration (see IC, LSI, VLSI)

um = micrometer, one millionth of a meter

VLSI = Very Large Scale Integration (see IC, LSI, ULSI)

VRS = Video Response System

W = Watts

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