NETWORKS OF CENTRES OF EXCELLENCE

REPORT TO THE MINISTER

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NOVEMBER 1993

Canada

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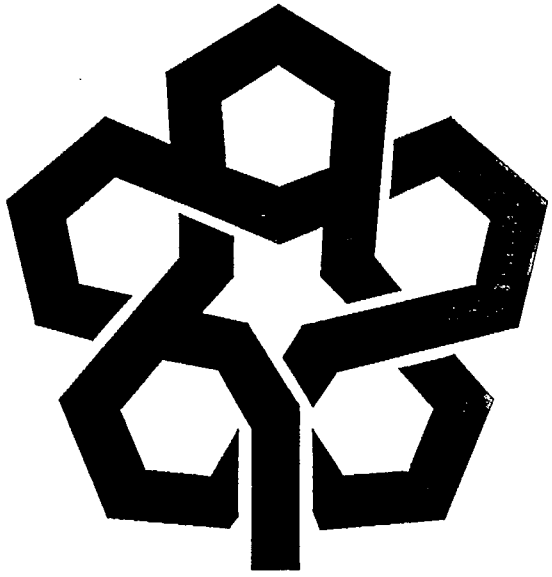

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NOVEMBER 1993

Government of Canada
Gouvernement du Canada

Natural Sciences and Engineering
Research Council of Canada

Medical Research
Council of Canada

Social Sciences and Humanities
Research Council of Canada

Industry Canada

Message from the Chair of the NCE Steering Committee

This has been a very challenging and rewarding year for the Networks of Centres of Excellence Program. Over the past year the networks have developed into well-integrated collaborative national research teams with participants from universities, industry and government working together on problems of importance to the Canadian economy. Interactions with colleagues from different sectors have enhanced and expanded the research horizons of the network participants. Science and technology partnerships, which include the provinces, are being forged through the networks program - a unifying factor in Canada, helping to mobilize resources to develop a stronger research infrastructure in all regions. The future of Canada depends on our ability to stimulate economic development through innovation. The networks provide an ideal environment for the training of the next generation of Canadians to meet the demands of a knowledge-based society.

The consolidation of the networks into identifiable R&D entities has raised the level of interest of the private sector in the networks, and substantially increased industry's investment, which is now more than $11 million in this third year of the program. The significant increases in the number of patents and invention disclosures over the past year indicates that the NCE program is having an impact on fostering greater awareness among the researchers of the potential benefit of their work for the Canadian economy and the importance of protecting intellectual property.

This has been a critical year for evaluation, both at the level of the NCE Program and of the individual networks. The interim program evaluation was carried out between July and December 1992, with the final report submitted to the NCE Steering Committee in February 1993. Although it was difficult to draw definitive conclusions about the NCE Program after only two years of operation, the evaluation clearly indicated that the program is functioning well and is on the right track.

This conclusion was also reached by the House of Commons Standing Committee on Industry, Science and Technology, Regional and Northern Development following hearings on the NCE Program during the months of February and March 1993. In its report the Committee noted that an impressive amount of scientific work of potential strategic importance to Canada has been achieved. The report concludes that "the most important initial product of the program -and this can be said of all fifteen networks - is a striking Canadian innovation in achieving nation-wide scientific collaboration" and recommends that the program be made permanent.

The progress of the individual networks was confirmed by their 33-month peer review committees. Over the period from April to October 1993, each of the networks was subjected to an in-depth evaluation that included a site visit. The members of the peer review committees were very positive about the NCE Program and praised the accomplishments of the networks. In particular, members from outside Canada who were involved in the peer review process were impressed by the research output of the networks. They were also impressed with the way in which the funding costs are distributed, with the federal government paying the direct costs of the research, industry contributing to the direct and indirect costs, and the provincial governments and universities providing the indirect costs and infrastructure, including the salaries for the principal researchers.

In making a commitment to fund a second four-year term for the NCE Program, Cabinet recognized the program's important contribution to changing the research culture in Canada and to focusing the collective efforts of our academic, government and industrial communities on problems of relevance to the Canadian economy. The linkages and interactions that are being established by this innovative program will help to position Canada at the forefront in the technology-intensive global marketplace.

The NCE Steering Committee is enthusiastic about the progress that the NCE Program and the networks have achieved over the past four years. We are approaching Phase II of this program with a great deal of optimism having gained considerable insight into the effectiveness of this model of research funding.

Peter Morand

Peter Morand
Chair, NCE Steering Committee
Networks of Centres of Excellence

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BREAKTHROUGHS

The research programs of the networks have now been underway for three years and an impressive amount of research of strategic importance to Canada is now being achieved. It has taken time to start up these multidisciplinary research programs and for results to show, but the outcome is now significant. We are observing a positive shift in the attitudes of the network researchers toward interdisciplinary and intersectorial research collaboration. During this past year, there has been a dramatic increase in the number of invention disclosures, patents filed and publications. The findings are not limited to research that can be commercialized, but also include contributions to improving the quality of life of Canadians. For example, the networks have made social and medical advances, and are providing information that is vital to economic and policy decisions. Other research results have already found application in industry. The following are only a few examples of these achievements:

Cost-effective and portable new version of an ionosonde

Researchers at the Canadian Network for Space Research have designed a new version of an ionosonde - a sophisticated instrument used to gather data on the effect of wind, sunspot activity and other conditions in the ionosphere, part of the Earth's upper atmosphere. Ionosondes are especially used to identify and establish radio frequencies for transoceanic and other long-distance communication links. This new Canadian Advanced Digital Ionosonde (CADI) is more compact, more flexible, and almost 90 percent cheaper than the earlier instruments.

The research provides a double spin-off. It gives the scientific community the opportunity to expand its network of ionosondes and thereby enhance the quality of its research. A large network of ionosondes enables research organizations to develop and share data on processes in the upper atmosphere on a much larger scale. At the same time, it is giving a small Canadian company a commercial opportunity. An industrial partner of the Network, Scientific Instrumentation Limited (SIL), of Saskatoon, has obtained an exclusive licence from the University of Western Ontario to produce a commercial version of the instrument for ground-based observations.

Fighting hamburger disease

A new drug that could prevent the harmful, and potentially deadly, "hamburger disease" has been devised by researchers with the Canadian Bacterial Disease Network (CBDN). The drug, SYNSORB-P, acts as a bait that ensnares and neutralizes potent bacterial toxins before they can do any damage. Pre-clinical trials are under way to determine the safety of the drug. Preliminary results are very encouraging, according to Dr. Glen Armstrong, of the University of Alberta, who helped invent the drug.

This invention is a novel therapeutic application of SYNSORBS, which were originally developed in the University of Alberta laboratory of Dr. Raymond Lemieux, and by a research team of the former Chembiomed Ltd., an Alberta high technology company and CBDN industrial partner. SYNSORBS are synthetic sugar molecules that bind proteins such as toxins and lock them within porous particles of single-celled organisms known as diatoms. Dr. Armstrong and his team, together with Dr. Murray Ratcliffe, then at Chembiomed, succeeded in pinpointing a SYNSORB sugar molecule and testing its ability to bind and block the harmful toxins that cause Hemolytic Uremic Syndrome (HUS). This discovery is now being pursued by the Alberta Research Council, owners of the technology.

High-performance concrete

A new bridge at Portneuf, Quebec, has been designed and built using concrete that offers greater strength and durability than ever before, thanks to a Canadian network's leading-edge research in high-performance concrete (HPC). This successful project is the outcome of a unique partnership involving the Network of Centres of Excellence on High-performance Concrete and over 20 building contractors, consulting engineers, material companies, owners and researchers in Quebec. They have linked up in a technology transfer endeavour called "Projet Voies Nouvelles du Béton", aimed at finding and developing new applications for high-performance concrete.

The bridge is the first of its kind in North America to be designed and built out of HPC, using the technology developed by the Network. HPC's high durability and strength makes it ideal for thinner structural design. Extra protective materials such as membrane and asphalt on the deck of the bridge have been eliminated to confirm research result on the strong performance of HPC under traffic conditions. Eliminating the need for protective materials will help lower costs for repairing and replacing Canada's costly infrastructure, and the durability of HPC will decrease the cost of maintenance over the life of the new structure.

Safer insecticides

Environmentally safe biological insecticides that have the potential to greatly reduce damage to crops are now within reach thanks to a recent discovery by Insect Biotech Canada (IBC) researchers. Working with a class of naturally occurring viruses called baculoviruses, Dr. Kostas Iatrou and his team at the University of Calgary have discovered a method to speed up the process by which they infect and kill their hosts. The commercial significance of this discovery is now being assessed by Cyanamid Canada Inc., one of the Network's industrial associates.

Dr. Iatrou's team is collaborating with insect physiologists at other Insect Biotech Canada centres to assess the system with different genes. This research may lead to more environmentally friendly insect pest controls and replacements for conventional broad-spectrum chemical insecticides, with their toxic legacy for many animals. The life cycle of these viruses is such that only insects attacking treated crops would be infected. In Canada and the rest of the world, up to one third of agricultural and forest products are lost to diseases, largely due to insect pests.

Helping paper to keep its colour

Researchers in the Mechanical and Chemimechanical Pulps Network have unravelled the complex chemistry responsible for one of the paper industry's most serious problems - paper that turns yellow only a few weeks after it is made. The new understanding achieved by the Network should provide the basis for improving low grade paper, and for helping Canadian manufacturers to increase their competitiveness by making mechanical pulp more suitable for an expanded range of higher-value grades of paper. An additional advantage of this new process is that it is environmentally friendly. Unlike chemical pulping processes that require chemicals to break wood down into its constituent fibres, mechanical pulping is largely a matter of grinding up the wood into basic components. It is cheaper and less polluting,but the problem of yellowing has limited its potential market until now.

Diagnostic lab of the 21st century

The diagnostic lab of the 21st century (or DL21C) is a joint venture of scientists from the Genetic Diseases Network at the Hospital for Sick Children, the Eye Research Institute of Canada (ERIC) and Pharmacia, a Swedish biotechnology company hoping to expand into Canada. The purpose is to use automated DNA sequencing technology to genetically screen individuals at risk for retinoblastoma, a cancerous tumour of the eye. A new facility has been established at ERIC utilizing their sophisticated computational and imaging capability, with Pharmacia providing technological support, and the Network contributing the expertise on retinoblastoma diagnosis and treatment.

Siblings of affected individuals are at greater risk than the general population for developing retinoblastoma. Currently, they are examined under general anaesthestic periodically for signs of tumour growth. By contrast, one-time genetic screening for the retinoblastoma gene could identify the subgroup carrying the gene, permitting follow-up examination of only those carrying the gene. The reduction in the number of diagnostic examinations would significantly decrease health care costs, reduce risks associated with repeated general anaesthesia, and permit more efficient treatment of retinoblastoma patients. The results of the DL21C pilot will have a direct impact on the application of genetic diagnosis to patient care in retinoblastoma as well as for other diseases.

Replacing dead brain cells

Until very recently, it has been thought that the adult mammalian brain cannot generate new nerve cells. As a result, brain damage caused by stroke, Alzheimer's disease, and Parkinson's disease has been permanent, with no known cure. However, scientists at the Neural Regeneration Network have now discovered an undifferentiated cell-type, called a"stem cell", in the central nervous system of the adult mouse. Under certain conditions, these stem cells can be made to develop into cells with different functions. Identification of the conditions which control growth and differentiation of these stem cells may lead to new approaches to cell replacement in injured or diseased nervous systems.

This discovery has resulted in several patents and companies are interested in access to this new technology. It has great economic potential, both in terms of its value to industry and with respect to the reduction of health care costs resulting from the rehabilitation of individuals with brain or spinal cord damage.

Balancing work and family responsibilities

In a 1993 survey of over 5,000 Canadian employees, it was found that 46% provide some form of eldercare, and over half of these also have childcare responsibilities. This national survey conducted by CARNET's Work and Eldercare Research Group found that employees with eldercare and/or childcare responsibilities reported: more stress, less job satisfaction, more work interference with family, more job opportunity costs associated with having to decline projects and promotions, more personal opportunity costs such as having to reduce leisure time and continuing education, and more absenteeism. The findings of the survey suggest that flexible work options and assistance programs tailored to the needs of workers would assist them with the challenges involved with harmonizing their job and family responsibilities. The aging of Canada's population means that a much larger proportion of the workforce will have eldercare responsibilities in the future. Further studies by CARNET will investigate programs, policies and management initiatives to help employees achieve a healthy balance between their work and family responsibilities.

INDUSTRIAL INVOLVEMENT

For the networks, linkages and networking include partnerships with industry. These partnerships take many different forms, from participating in the research program to providing guidance and direction to the research by participating on various committees and the Boards of Directors of the networks. There are 145 companies involved in the NCE research programs, along with 35 universities, 20 federal and provincial government departments and 33 other institutions (research institutes and hospitals for example).

The networks have now developed dynamic identities that are attracting the interest of industry. According to their 33-month Annual Reports, there has been a dramatic increase in industrial support in terms of cash and in-kind contributions to the networks relative to previous years. This is a clear indication that industry regards the networks as a valuable complement to their activities.

Figure 1 summarizes the increase in participation and support of the NCE program by industry.

	1990-91	1991-92	1992-93
No. of companies	109	145	145
Total cash contributions	$199,500	$553,500	$3,396,352
Total in-kind contributions	$3,511,955	$4,767,296	$7,671,353
Total industry contributions (cash and in-kind)	$3,511,955	$5,320,796	$11,067,705

Figure 1 - Industrial Support of the Networks

Involvement with the industry sector has also brought a noticeable change in the way academic researchers now consider the potential of their research for technology transfer to industry. The networks are focusing attention on the protection of intellectual property. The results are shown in the following table:

	1991-92	1992-93
Patent applications	15	58
Patents issued	4	8
Technology licenses	9	27
Invention disclosures	0	34
Copyrights	0	41

Figure 2 - Intellectual Property from the Networks

Many of the networks are actively expanding their industrial contacts to include small- and medium-sized industries (SMEs) whose needs are very different from the larger companies. SMEs tend to be more focused on the short term (two years or less). In recognition of this particular need, some networks have sought out mechanisms to interact with these companies. For example, Micronet has introduced a short-term R&D program. Working closely with a small company, Micronet matches a network researcher with the appropriate expertise to work on the company's problem. The company and Micronet each put in funds (up to $30,000 maximum) to support a Master's level one-year project. This enables the company to get help in solving its problem and provides a graduate student with valuable experience in an industrially relevant environment. This special initiative is carried out in parallel with Micronet's other research programs and does not interfere with the interests of its other industrial partners.

The networks rely on industry to provide guidance for the direction of their research programs. Over the last year, the networks actively sought additional input into their planning for Phase II of the NCE program. Networks held consultative workshops across the country with relevant industry, government and university representatives. Utilizing the industrial contacts of the local academic members of the networks, representatives of many different companies were brought into the planning process. A large number of these companies were not currently network participants. As a result of these consultations, the networks are revising their research strategies to better align them with the needs of industry.

The networks are continuing to expand their personnel exchange programs with industry. Faculty and students are spending more time in industry labs. This gives individuals from different sectors a better appreciation of other working environments. Industry has been sending more people to work in university laboratories. This is resulting in increased cooperation and genuine collaboration on joint projects.

For example, PRECARN benefits from the participation of IRIS researchers in its own research programs. The PRECARN projects build on the strengths of the IRIS researchers and also take advantage of the IRIS research program by including elements from network research in the PRECARN projects. This also involves an exchange of personnel.

TRAINING

The development of our next generation of researchers is a critical factor for Canada's future in a knowledge-based economy.

The networks report that 803 principal researchers in the networks are training over 1400 graduate students and more than 500 postdoctoral fellows in these highly interactive environments (see Figure 3); 65% of these trainees are directly supported by NCE funds.

	Network funds	Other sources	Total
Professionals*	228	151	379
Research Associates	230	151	381
Postdoctoral Fellows	346	191	537
Technicians	432	185	617
Graduate Students	955	526	1481
Summer Students	171	85	256
Other	68	23	91
Total	**2430**	**1312**	**3742**

Figure 3 - Personnel Involved in the Networks

The NCE program provides students with the opportunity to work with top Canadian researchers on targeted programs of national importance. Through special workshops and sessions organized by the networks, students are encouraged to present their work and to share information and experiences with other students and with other academic and industrial members of the network. In fact, most of the networks hold special poster sessions dedicated to the students and industrial members are invited to attend.

Most of the networks also publish directories of postdoctoral fellows and graduate students and their thesis topics which are circulated to the industrial members. Some networks provide mechanisms that allow graduate students to do some of their thesis research in industrial labs.

Industries such as Merck-Frosst and DuPont support the training of personnel through studentships and fellowships. Other industries provide recognition for students through awards for best papers at annual meetings.

* "Professionals" does not include the 803 network principal researchers.

Since the beginning of the program, there has been a steady increase in the numbers of graduate students working on NCE projects who have completed their degrees. Figure 4 summarizes these numbers.

	1990-91	1991-92	1992-93	Total
Ph.D.	12	49	102	163
Masters	22	113	257	392

Figure 4 - Degrees Completed

Personnel graduating from the networks continue to find employment in Canadian industry. The latest figures from the networks' 33-month Annual Reports indicate that, in the last year alone, 153 people have found employment in Canadian industry. Some networks, such as Micronet, report that of all of the students being hired by industry, 85% have remained in Canada.

The networks have also been instrumental in terms of retaining trainees within Canada, and attracting promising young Canadians back to Canada after completing post-doctoral training abroad. This is due to both the research opportunities provided by the networks, and the access to state-of-the-art equipment purchased through network funds.

NETWORKING AND COMMUNICATION

Networking is at the heart of the NCE program. It has already resulted in profound changes in our research culture. Networking has been producing more than interactions - it has been creating interactive environments that promote the formation of new collaborations, and an increased awareness of research carried out in other disciplines and sectors.

The networks organize a spectrum of activities in order to facilitate personal contact between researchers: annual (or semi-annual) meetings involving all network participants, project group meetings, seminars, and workshops. In addition to face-to-face contacts, networking is accomplished through a variety of electronic means. Most networks utilize fax and E-mail for instant communication between researchers and with their network administration. Some networks have introduced electronic communication systems between the centres involved in their network to facilitate communication and provide access to common data bases. CBDN has a Wide Area Network (WAN), and CARNET has its own electronic communication system called AGENET-L. CSNR has free access to the Canadian Space Agency's Data Analysis Network (DAN), to the CANOPUS electronic network and the NASA SPAN network. Inspiraplex is now using computer image transfer within and between centres of the network. PENCE and Inspiraplex have utilized videoconferencing for network meetings.

Network researchers, students, government and industrial partners are beginning to take full advantage of the opportunities for interaction provided at the annual meetings. Most networks combine formal research presentations with open forum discussions at these meetings, and debates frequently continue into the evening long after formal sessions have finished. Some networks, such as the High-performance Concrete Network, have scheduled meetings of the network's Boards of Directors and Industrial Advisory Committees during the annual meetings, in order to enable members to hear presentations on recent research results as well as to encourage informal interactions. The Neural Regeneration Network holds its Board of Directors meetings at different network sites across the country to encourage interaction between local network researchers and the Board members. The Mechanical and Chemimechanical Pulps Network's annual meetings are held in different cities and usually involve a mill visit as well as general business and technical discussions. In addition, the network holds a combined meeting annually in conjunction with the annual Technical Section meeting of the Canadian Pulp and Paper Association (CPPA). The occasion encourages networking and provides an opportunity for network participants to meet with technical people in the pulp and paper and related supply industries. A special workshop for network students is held the day before the CPPA meeting.

Project workshops and seminars provide additional opportunities for networking between senior researchers and students. These workshops also help to develop linkages among the corporate sector, the government sector and the research community. Micronet has held workshops at the facilities of its member companies. These have helped build stronger linkages between the university researchers and their industrial counterparts, with new contracts and collaborative research projects also initiated between the two sectors. Merck-Frosst has sponsored 2 workshops involving its researchers and those of Inspiraplex in the field of asthma. It has also hosted annual meetings of both Inspiraplex and the Canadian Genetics Diseases Network at its facility in Montreal.

There has been some networking between networks, especially through the sharing of core facilities. For example, the core facility for peptide and DNA synthesis and sequencing, located at Queen's University, provides service to both Insect Biotech Canada and the Neural Regeneration Network. The operation of the facility is overseen by both networks. Some networks have also been involved in networking outside Canada. For example, IBC actively networks internationally through exchanges of postdoctoral fellows between the Commonwealth Scientific and Industrial Research Organization (Australia) and the network. A similar new agreement has just been established with the Central Science Laboratory of the Ministry of Agriculture, Fisheries and Food in the UK in the field of hormones and receptors.

Communication within each network is necessary to keep all participants informed of the progress of the research and functioning as a team. There is also a need for the networks to communicate their results and accomplishments to a wider community: to industry - to attract new partners; to the research community - to help foster a new research culture that recognizes and supports collaboration; to peers outside the network - to demonstrate continued excellence; and to the public - to build awareness of the benefits of research. The networks have progressively increased their communication activities and many of them have now developed their own Communication Plan. All of the networks now publish a newsletter to promote linkages and to keep participants informed about progress in their R&D projects. For external audiences, most networks have produced a brochure or flyer describing their research goals, activities, and linkages with industry.

In the first two years of operation, the networks have received media coverage both locally and nationally. Most of the coverage comes from business and technical journals, but some of the networks have also been mentioned in The Globe & Mail, La Presse, the Ottawa Citizen and many other newspapers. As the research is now starting to produce results of interest to the public, the networks are becoming more pro-active in communicating with the press and other media. CBDN, the N.R. Network, IBC, CGDN, OPEN, as examples, have been keeping the media informed about their activities through press briefings and news releases. The N.R. Network holds regular press briefings in conjunction with its Board of Directors meetings. The media has the opportunity to meet researchers and business representatives and ask questions about the work under way. In addition, management and participants of many networks have been interviewed on local and national radio and television about their network's activities.

Some networks are developing and implementing strategies to bolster awareness among industry about opportunities for partnerships and technology transfer. For example, PENCE has commissioned an introductory report to industry which is intended to convey the unique structure and mandate of the network and to report on early successes and the excellence of the research program. CBDN has revised its information booklets aimed at introducing CBDN to industry and other target audiences. Student directories promote the network's students and help them to find work terms or permanent employment in industry. Micronet was one of the first networks to develop such a directory.

NETWORK MANAGEMENT

An effective network administrative structure is crucial to manage the complex spectrum of activities in this multidisciplinary, multisectorial program. The interim program evaluation study focuses on the management of the networks - specifically, to what extent does the operation of the network represent a significant shift from previous approaches to research. This study concluded that the majority of networks are being managed actively and effectively, both at the level of the Board of Directors, which provides ongoing advice and guidance on policy issues, and at the level of the Research Management Committee, which is responsible for reviewing progress in order to provide recommendations on research priorities and budget allocations. The membership of both the Board of Directors and the Research Management Committee is crucially important to the objective and effective management of the networks, representing the views of the stakeholders as well as the perspective of the external user community.

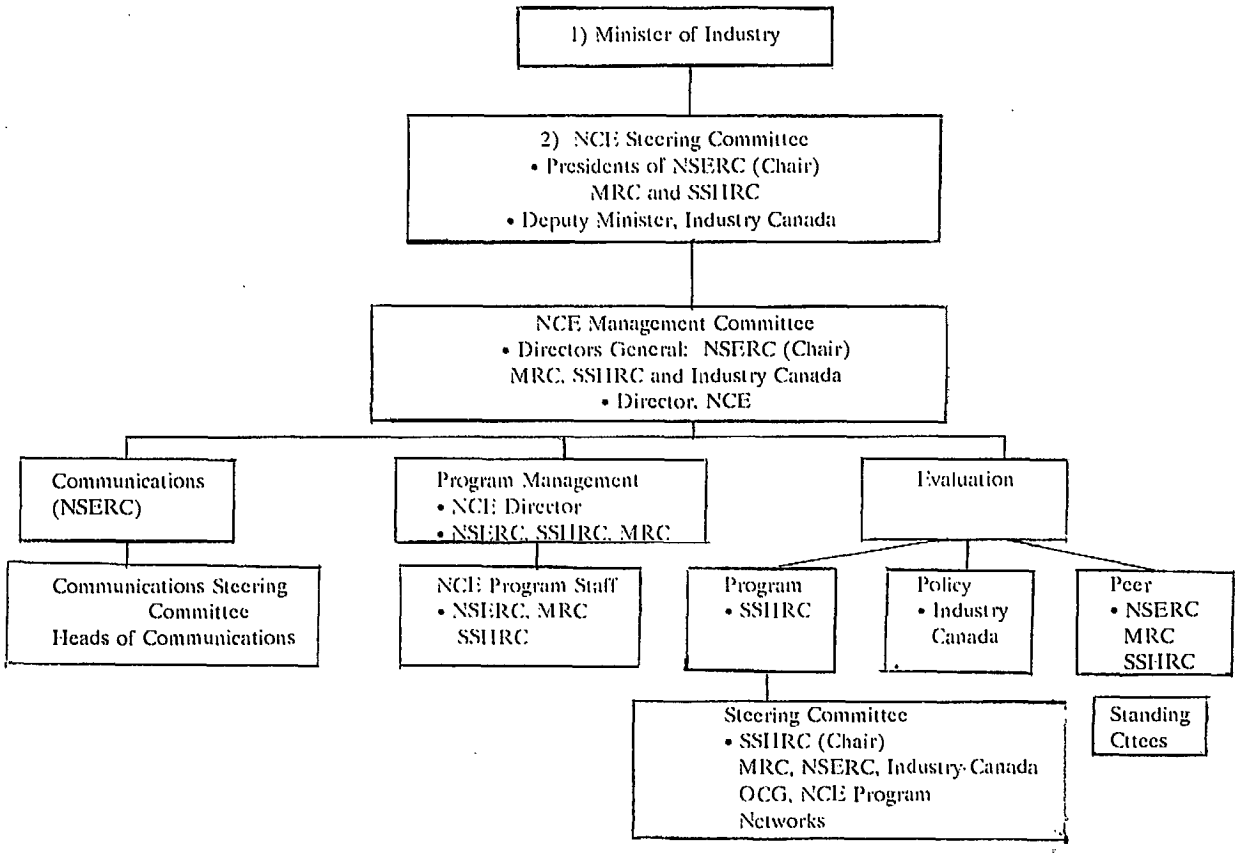
Since they were launched, the networks have introduced many changes to their research programs and budget allocations. Based on the research progress during the first two years of operation and the priorities established in consultation with industrial partners, most networks modified and focused their research programs. This resulted in decisions to terminate projects, in some instances necessitating the phasing out of researchers. New projects have been initiated, bringing in additional members to the network. In all cases where research projects were either terminated, or subjected to funding reductions, the networks adopted a phase-out policy to honour commitments to students. To ensure objectivity, in each network all project termination and resource reallocation recommendations of the Research Management Committee are subject to careful scrutiny by the Board of Directors prior to making any final decision. Further, all of the networks have implemented appeal procedures to address issues resulting from the phase-out of network researchers. The interim program evaluation considered the networks' flexibilty in reallocating both human and financial resources to be an advantage relative to conventional research institutions that are more restricted due to commitments to permanent personnel.

Each network has a full-time staff to provide administrative support. Their functions include the management of finances, intellectual property, technology diffusion, promoting interactions with academic, public and private sector organizations, as well as communications both inside the network and with external audiences. The network executive director plays a leadership role, and has managerial responsibility for all of these activities, assisted by the network's administrative support staff. As the network research programs accelerate, the importance of technology transfer and communications increases significantly. Several networks have created an industrial liaison position (e.g. CNSR, CEMAID, Wood-pulps); in other networks, this is the primary responsibility of the executive director (e.g. CBDN, IBC). The communications activities of the networks - including liaison with the media, preparation of newsletters, brochures, industry and annual reports - are co-ordinated by the executive director with the assistance of other staff and consultants.

In preparation for the submission of proposals for Phase II of the NCE Program, during the past year each of the networks initiated consultations with current stakeholders and a wider audience from the potential user community through workshops, discussions and interviews. The Boards of Directors played an important role in this strategic planning process, acting as facilitators to bring industry to the table to help the networks explore and define opportunities to respond to problems that relate to Canada's economy, productivity and well-being.

PROGRAM MANAGEMENT STRUCTURE

The management of this program involves a high degree of networking and cooperation that must occur amongst the Granting Councils and Industry Canada.



NCE STEERING COMMITTEE

The NCE Steering Committee is composed of the Presidents of the three Granting Councils and Deputy Minister of Industry Canada. The Committee has overall authority for the implementation of the NCE Program. It exercises executive authority, makes policy decisions within the framework of the objectives and design of the Program and reports to the Minister of Industry annually. It is chaired by the President of NSERC and meets as required at the call of the Chair.

NCE MANAGEMENT COMMITTEE

The NCE Management Committee is a coordinating mechanism composed of a representative at the Director General level from each of the three Granting Councils and Industry Canada, as well as the Director of the NCE Program. It is chaired by the NSERC Director General of Targeted Research. The NCE Management Committee oversees the operation and coordination of the program administration, communications and evaluation functions. The Committee reports to the NCE Steering Committee and refers policy matters, and those administrative issues in which there is not consensus, to the NCE Steering Committee.

1) Changed from Minister for Science on November 4, 1993
2) Name changed on August 6, 1993 to reflect the addition of ISC (now Industry Canada) to the Committee.

There are three main management functions shared by the granting councils:

1. Communications. This function is under the primary direction of the Chief of Communications at NSERC, but is a function that must be shared by the networks themselves. From the program perspective, the main focus is on assisting the networks in developing and implementing their communication strategies, coordinating the common communications activities of the networks and raising the profile of the program.

   A number of vehicles such as the NCE Seminar Series, press conferences and the brochure entitled "IMPACT" have been used to heighten the awareness of industry, federal departments and central agencies to the achievements of this program.

2. Program Management. The Director of the NCE program has responsibility for overall program integrity. There are five program officers: three at NSERC and one at each of MRC and SSHRC. These program officers are responsible for the administration of those networks under their respective Councils' purview.

3. Evaluation. There are three major components to the evaluation: the program evaluation under the leadership of SSHRC (the Director of Evaluation at SSHRC chairs the program Evaluation Steering Committee composed of representatives from the three Granting Councils, the Government Review Group [formerly the Office of the Comptroller General] and Industry Canada); the policy review under Industry Canada; and peer review which is on a network by network basis and conducted under the direction of the Granting Council with administrative responsibility for the network.

1. Communications

The focus of communications over the past 12 months has been on promoting achievements and progress in the networks. Two media conferences were held: one in Vancouver on October 15, to highlight advances in R&D via the networks in a key area for British Columbia - Forestry; and another in Montreal on March 30, featuring achievements in robotics, high-performance concrete, and microelectronics. Coverage from both conferences was widespread and included articles from business journals and national newspapers, and a feature on CBC's *Tomorrow, Today*.

The first issue of *IMPACT*, which profiles achievements by the Networks, was published in October, 1992. Four other issues of *IMPACT* were published and distributed in January, April, June, and October, 1993. The newsletter has a target audience of over 4,000 individuals and organizations, including leading R&D firms, key research institutes, professional associations, government departments and embassies. Two issues of the internal newsletter, *Liaison*, were distributed to NCE researchers and industrial affiliates.

The NCE exhibit was displayed at industrial and professional events promoting R&D and technology transfer. These include the PMAC (Pharmaceutical Manufacturers Association of Canada) Health Research Foundation Symposium (Ottawa), the Technology Carrefour (Montreal), and the media conferences in Vancouver and Montreal organized by NCE Communications. The exhibit was also featured at the series of six half day NCE seminars for Assistant Deputy Ministers and senior bureaucrats held in Ottawa during April, May and June, and at a press conference in Fredericton in August announcing funding for phase two of the NCE program. The *Powerful Partnerships* brochure continued to serve as a useful communications tool to promote the networks at conferences, exhibits and special events.

With the growing media coverage on the networks, news clips are gathered regularly from major newspapers across the country as well as business and science journals. These Media Clips are distributed at least every two months to the networks, council management and senior government officials.

Letters were sent in the fall by the Chair of the NCE Steering Committee to the Deputy Ministers of the federal and provincial science-based departments and agencies, bringing them up to date on the status of the program and asking for their support and cooperation to ensure continued success of the networks R & D activities. This initiative elicited considerable positive response and resulted in broader awareness of the program. Visibility is critical to the success of the program and the networks. The networks, the Granting Councils and Industry Canada have a joint role to play in this function.

2. Program Management

The program management has focused its attention on the following key areas in the last year (see overview of activities in Appendix II):

- Peer Review of network annual reports

  (See also Section 3. Evaluation) The 33-month reports from the networks were received over the period February to August 1993. These reports served as the basis for the two day site visits held at each of the networks over the period April to October 1993. The site visit committee for each network was an expansion of the Standing Peer Review Committee that evaluated the network at its nine and twenty-one month intervals. The site visit committees were composed of five to ten experts from industry, university and government. The breadth of expertise on the site visit committees reflects the breadth of activities in the networks. The purpose of the in-depth 33-month peer review was to determine if the network's fourth instalment should be paid, i.e. whether progress has been acceptable and in accordance with the network's and the program's stated objectives. These site visit reports provide information on the past record of each network and will be vital in judging the potential for success of the networks' Phase II Strategic Plans.

- Developing the NCE Phase II policies and guidelines

  The process of modifying and refining the policies and guidelines, including the program objectives, for Phase II of the NCE Program commenced in October 1992 with a discussion of future options for the NCE Program by the NSERC Council. The results of this discussion, the findings and the recommendations of the interim NCE Program evaluation (completed in December 1992), along with the 21-month peer evaluation reports of the Networks, and the input provided by the NCE Steering and Management Committees and the Granting Councils, served as the basis for discussions held by the Presidents' Advisory Committee. This committee, composed of two representatives selected from the Council membership of each of the three granting councils, was constituted to provide integrated comments and advice to the NCE Steering Committee on the program and its future evolution (see Appendix VII). This committee deliberated in January and presented its findings to the Council Presidents at the end of January.

On February 26, 1993, in a document entitled "Networks of Centres of Excellence - Phase II", the Chair of the Tri-Council Steering Committee presented to the Minister for Science and the Minister Responsible for Small Businesses the advice of the Granting Councils on the evolution of the NCE Program. Throughout this period, Industry & Science Canada conducted extensive in-house consultations regarding the future of the NCE Program. The results of these consultations, the interim program evaluation and the advice of the Tri-Council Steering Committee were the major sources of information input in developing the final policies and guidelines for round two and ultimately the Memorandum to Cabinet for Phase II of the NCE Program.

- Developing the selection process for round two

The policies and guidelines for Phase II of the NCE Program also included guidelines on the selection and evaluation criteria and the application review procedures. The review procedures require that the networks be evaluated in comparison with one another by a selection committee. The membership of this committee was discussed over the period June to October 1993 with membership appointment occurring between August and October 1993. The terms of reference for the NCE Selection Committee appear in Appendix VIII. The membership on this committee is included in Appendix IX. The NCE Selection Committee will meet December 15 to 17, 1993 to evaluate and priority rank the existing Networks of Centres of Excellence.

Promoting interactions between the networks

The networks chairs, managers and program leaders meeting with the NCE Steering and Management Committees (July 8, 1993, in Ottawa) provided an opportunity to brief the networks on the evolution of the NCE Program and the requirements for Phase II. In addition, this meeting provided an opportunity to exchange ideas, experiences, and insights with regards to the challenges of managing research in this complex environment.

- Communications activities

(See also Section 1. Communications). The program management staff from the Granting Councils and Industry Canada have addressed industry audiences (e.g. the Association of Consulting Engineers of Canada), international audiences (e.g. Academic-Industry Interaction conferences in Mexico in January 1993 and in New York in May 1993), visiting dignitaries and network groups (e.g. CITR, N.R. Network, IRIS, IBC, etc) to promote the program and its objectives.

- Guiding the networks in their development

As observers, the NCE staff attend meetings of the network Boards of Directors and key meetings of network committees, such as the science and budget committees, as well as the networks' annual meetings. Through these and other less formal interactions with the networks, program staff provide guidance to the networks and monitor their activities. Regular contact with the networks has resulted in the development of trust and confidence between the networks and the program administrators.

- Financial administration

See Appendix III for the program financial statement covering the period up to and including fiscal year 1993-94.

3. Evaluation

This program is being assessed from three perspectives: peer review, program evaluation and policy review. The results obtained from these reviews were integrated into the series of options for Phase II of the program that were presented to Cabinet in June 1993.

Peer Evaluation

The assessment of each network is conducted within the context of the program objectives and the network's own stated objectives, with recognition of the specific environment in which the network is functioning. The peer review is under the direction of the granting council with administrative responsibility for the network, but is coordinated at the level of the Program Directorate to insure consistency in approach among the three granting councils. As noted in Section 2 (Program Management), in-depth reviews involving 2-day site visits by peer review committees specific to each network, with the expertise to evaluate not only the research, but also the management, industrial interaction, technology transfer and business functions of the network were held throughout the summer and into the fall. As the result of these 33-month reviews, the fourth instalment for each of the 15 networks was paid. The NCE Selection Committee for Phase II has received copies of the 33-month reviews to use as input in the selection process for the next round of the program.

Program Evaluation

A workshop to review preliminary findings of the NCE Interim Evaluation with network leaders and program managers was held in October 1992. Several iterations of the report were presented over the following months, and in consultation with the Evaluation Steering committee, it was completed, submitted and approved by the Presidents of the Granting Councils in January of 1993.

The NCE Interim Evaluation helped to inform management of progress made to-date, and to facilitate the decision making process on the future of the program. Overall, the networks were found to be "on the right track" in terms of realizing the objectives of the program. Areas requiring more attention included the clarification of program objectives and measures to encourage the increased involvement of user organizations (industry and government) in the whole network process, especially in the planning and management of the research programs. Changes have been made in these areas and are reflected in the Policies and Guidelines for Phase II of the program.

With the Interim Evaluation successfully completed and accepted, the Tri-Council Evaluation Steering Committee was disbanded February 18, 1993.

To gain a more comprehensive economic perspective on the networks' accomplishments and potential, Industry Canada carried out extensive in-house consultations with their sector branches over the period November 1992 to February 1993. Two inter-departmental consultation meetings were held (March 1 and April 21) to secure the views of the science-based federal departments and agencies on the policies and guidelines of Phase II of the NCE Program. The information resulting from these consultations served as important input to the Memorandum to Cabinet approved in June 1993.

CHALLENGES

The networks are facing a number of challenges over the next two years:

- Maintaining critical mass in a time of uncertainty

  All of the networks (except CARNET) have completed extensive consultations within their research communities and in their relevant industrial sectors as the basis for their Phase II applications and strategic plans that were submitted on October 29, 1993. (Note: The Canadian Aging Research Network "CARNET" has decided not to participate in the competition for Phase II funding.) New directions and orientations, as the result of the evolution and evaluation of the networks (both by external sources such as the peer review by the Granting Councils and by internal sources such as evaluation and "futures" committees set up internally by the networks), have resulted in changes in projects and participants. At this time, because of the uncertainty associated with the competition for future funding of the network, the NCEs face a period of uncertainty until the Cabinet decision is made with respect to which networks are continued.

- Technology transfer

  The networks are making gains in sensitizing their researchers to the importance of the intellectual property content and application of their work. However, the costs of protecting intellectual property can be significant and, although the NCE funds can be used to pay for half, there is a problem in securing the financing. Finding and developing receptor capacity within industry in Canada, securing venture capital, negotiating multiparty intellectual property agreements, and establishing the most effective technology transfer process with industrial partners are other common issues. The expertise available in the area of technology transfer is not extensive and network directors are spending a significant amount of time on these efforts. In recognition of the importance of achieving the business objectives of the network, the Phase II policies and guidelines encourage the networks to hire a business/manager executive director with the expertise necessary to lead the network in terms of achieving its business goals. In addition, in Phase II the networks are encouraged to include specialists in marketing, technology management and communication, and others with relevant business skills within the network structure where feasible.

- Changing attitudes

  The networks are accelerating a change in attitude toward collaborative research that crosses sectorial and discipline boundaries. However, this change must be nurtured and encouraged to ensure that it is not transient but becomes embedded in the research culture.

- Increasing industry's role

  The networks are responding to the challenge of integrating industry into the active management of their research programs at all levels. Phase II further encourages the participation of industry in all aspects of the networks' activities. Changes to the Board of Directors' structure reinforces this point. The challenge remains however to bring industry to the table, with its competitors, and discuss priority research directions. The networks are beginning to make gains in this regard as industry's trust in the networks' abilities increases.

- Communicating

  The networks are beginning to develop expertise in communications; however, public visibility is not easy to attain. The networks have limited funds for communication and are learning to maximize their resources. However, in many cases their best resources, their researchers, still require encouragement and training in the communications area.

In addition to the above, the ongoing issues of building partnerships and collaborations, enhancing the level of research excellence and training, and increasing economic relevance and focus are demanding challenges the networks are facing on a daily basis.

TABLE OF APPENDICES

APPENDIX I

GLOSSARY OF ACRONYMS

NCE	-	Networks of Centres of Excellence
IC	-	Industry Canada (formerly Industry, Science & Technology Canada)
NSERC	-	Natural Sciences and Engineering Research Council
MRC	-	Medical Research Council
SSHRC	-	Social Sciences and Humanities Research Council
OCG	-	Office of the Comptroller General
S&T	-	Science and Technology
R&D	-	Research and Development
RPP	-	Research Partnerships Program
WAN	-	Wide-Area Network
DAN	-	Data Analysis Network
NMR	-	Nuclear Magnetic Resonance
BNR	-	Bell Northern Research
NTE	-	Northern Telecom Electronics
PAV	-	Proportional Assist Ventilation
AQFIM	-	Association québecoise des fabricants de l'industrie médicale
CMC	-	Canadian Microelectronics Corporation
BiCMOS	-	Bipolar Complementary Metal Oxide Semiconductor
MC	-	Memorandum to Cabinet
CARNET	-	Canadian Aging Research Network
CBDN	-	Canadian Bacterial Diseases Network
CEMAID	-	Centres of Excellence in Molecular and Interfacial Dynamics
CITR	-	Canadian Institute for Telecommunications Research
CNSR	-	Canadian Network for Space Research
CGDN	-	Canadian Genetic Diseases Network
IBC	-	Insect Biotech Canada
IRIS	-	Institute for Robotics and Intelligent Systems
Micronet	-	Microelectronic Devices, Circuits and Systems for Ultra Large Scale Integration (ULSI)
N.R. Network	-	N.R. Network (Neural Regeneration)
OPEN	-	Ocean Production Enhancement Network
PENCE	-	Protein Engineering Network of Centres of Excellence
Inspiraplex	-	Respiratory Health Network of Centres of Excellence

APPENDIX II

Overview of the Program Management activities since the last report to the Minister that covered the period ending October 18, 1992.

October 19-20, 1992	Future options for the NCE program discussed by NSERC Council.
October 26, 1992	NCE Management Committee meeting - approval in principle of Presidents' Advisory Committee to provide advice on the direction for Phase II.
November 19, 1992	The Prime Minister announces that the NCE Program will be made permanent.
December 2, 1992	The Minister of Finance reaffirmed the government's commitment to continue the program, and to fund new networks.
December 7, 1992	Tri-Council Steering committee Meeting - review of the preliminary results of the NCE Program interim evaluation report; approval of the membership on the Presidents' Advisory Committee and terms of reference for this committee (See appendix VI).
December 8, 1992	Council of Science and Technology Ministers meet - NCE is discussed.
January 13, 1993	NSERC Council discusses changes to the guiding principles for NCE in round two.
January 20, 1993	Presidents' Advisory Committee teleconference to discuss the directives and guiding principles for NCE for round two.
January 27, 1993	Council Presidents' teleconference to discuss the Presidents' Advisory Committee recommendations and modifications to the guiding principles for NCE in round two.
November 1992 to February 1993	Extensive in-house consultation on NCEs undertaken by ISC for the collection of perspectives on the networks and the future of the NCE program.
February 17, 1993	Tri-Council Steering Committee Meeting - approval of the final interim evaluation report on the NCE Program and the objectives, expectations and guiding principles for round two of the NCE.
February - August 1993	The 33-month network annual reports received.

February to March 1993	Standing Committee on Industry, Science and Technology, Regional and Northern Development of the House of Commons conducts its hearings on the NCE Program.
February 26, 1993	Chair of the Tri-Council Steering Committee formally transmits the Tri-Council's advice on the future of the NCE Program to the Minister for Science and the Minister Responsible for Small Businesses.
March 1, 1993	Interdepartmental consultation on the Memorandum to Cabinet.
March 16, 17, 18, 1993	NCE Program participates in Technology Carrefour in Montreal (industrial showcase)
March 30, 1993	Media briefing in Montreal on the NCE Program.
April - October 1993	33-month site visits of individual networks conducted.
April - May - June 1993	NCE Seminar Series, six seminars held in Ottawa to brief government officials on the progress achieved by the NCEs.
April 21, 1993	Interdepartmental consultation meeting on the Memorandum to Cabinet for renewal of the NCE Program.
June to October 1993	33-month site visits for individual networks held.
June to October 1993	Membership on the NCE Selection Committee discussed by the granting council Presidents and appointed.
June 1 - 10, 1993	The Memorandum to Cabinet for the second round of the NCE Program passes Cabinet committees.
June 22, 1993	Tri-Council Steering Committee Meeting to approve the program material for the NCE Program Phase II and to discuss the NCE Phase II Selection Committee membership.
July 8, 1993	Meeting of NCE Managers and Program Leaders with NCE Management and Chair of the Tri-Council Steering Committee. Briefing on Phase II of the NCE Program.
July 20, 1993	The Treasury Board submission securing the $125M for round two of the NCE Program, including the $0.25M for competition costs, is approved.
July 23, 1993	Letters sent to University Presidents by Chair of NCE Steering Committee advising them of Phase II of the NCE Program and seeking their support.

July 26, 1993	Letters sent to federal Deputy Ministers of Science-based departments and agencies by the Chair of the NCE steering Committee advising them about the status of Phase II of the NCE Program and seeking their support.
August 3, 1993	The Minister for Science and the Minister Responsible for Small Businesses announces the NCE budget of $125 million over four years.
August 6, 1993	NCE Steering Committee meeting - the terms of reference for the new "NCE Steering Committee" to replace the Tri-Council Steering Committee were approved. This new committee changes the status of ISC from an observer on the NCE steering committee to a full member of the committee.
August 27, 1993	The Prime Minister announces an increase to the NCE budget from $125M over four years to the average annual budget in Phase I, i.e. $48 M per year.
September 7, 1993	The Minister for Science and the Minister Responsible for Small Businesses announces details of the $197 M budget for Phase II of the NCE Program.
September 22, 1993	The Treasury Board submission increasing the Phase II budget to $197M over four years is approved.
September 27, 1993	NCE Program Officers' meeting regarding the process and timing for the competition for renewal of existing networks.
October 8, 1993	Letters sent to provincial Deputy Ministers of science-based departments and agencies updating them on the status of the NCE Phase II Program.
October 22, 1993	NCE Chairs, Program Leaders and Managers informed regarding the schedule for their presentations to the NCE Selection Committee.
October 29, 1993	Deadline for submission of NCE Phase II applications by existing networks.

Networks of Centres of Excellence – Fiscal Profiling by Network

NSERC ADMINISTERED NETWORKS

Network	Award	Effective Date	1988-89 PAID 1989-90	PAID 1990-91	PAID 1991-92	PAID 1992-93	Forecast** 1993-94	Forecast** 1994-95	Forecast** 1995-96
Bacterial Diseases (1/2)	$9,100,000	May 15	$50,000	$2,231,500	$2,320,500	$2,382,609	$2,115,391	$0	
Bétons à haute performance	$6,400,000	July 01	$100,000	$2,169,729	$1,258,650	$1,284,205	$1,270,911	$316,505	
Cdn. Inst. for Telecom. Res.	$14,700,000	July 01	$100,000	$2,632,000	$3,493,000	$3,781,250	$3,755,000	$938,750	
Cdn. Net. for Space Res.	$17,000,000	July 01	$100,000	$5,862,263	$3,805,304	$3,428,178	$3,033,475	$750,780	
CEMAID	$18,500,000	Nov 01	$100,000	$4,250,108	$3,747,130	$4,576,720	$3,707,309	$2,118,733	
Insect Biotech Canada	$9,158,000	July 01	$100,000	$2,063,800	$2,034,000	$2,194,900	$2,211,675	$553,625	
IRIS	$23,800,000	July 01	$100,000	$6,805,000	$5,945,000	$5,575,000	$5,375,000	$0	
Mechanical Wood-pulps	$14,600,000	Aug 01	$100,000	$3,512,200	$3,149,733	$3,379,367	$3,351,200	$1,107,500	
Micronet	$10,800,000	May 15	$100,000	$2,800,000	$2,700,000	$2,700,000	$2,700,000	$0	
OPEN	$23,000,000	June 15	$100,000	$6,314,400	$6,563,119	$6,155,977	$3,447,705	$418,799	
Protein Engineering (1/2)	$10,000,000	July 01	$50,000	$4,014,000	$1,820,000	$1,797,500	$1,847,500	$471,000	
TOTAL (Grants)	$157,058,000		$1,000,000	$42,475,000	$38,836,436	$37,255,706	$32,815,166	$6,675,692	
TOTAL (Admin. expenditures)	$4,683,000	88/89	$1,186,000	$605,000	$532,000	$390,000	$864,000	$0	
		89/90	$1,086,000						

MRC ADMINISTERED NETWORKS

Network	Award	Effective Date	PAID 89-90	PAID 90-91	PAID 1991-92	Forecast** 1992-93	Forecast** 1993-94	Forecast** 1994-95	Forecast** 1995-96
Bacterial Diseases (1/2)	$9,100,000	May 15	$50,000	$2,231,500	$2,320,500	$2,382,609	$2,115,391	$0	
Genetic Diseases Network	$17,500,000	Aug 01	$100,000	$3,712,512	$4,138,366	$3,975,070	$4,195,420	$1,378,832	
Neural Regeneration	$25,500,000	July 01	$100,000	$6,298,951	$6,000,317	$5,753,250	$5,878,049	$1,469,433	
Protein Engineering (1/2)	$10,000,000	July 01	$50,000	$4,014,000	$1,914,750	$1,703,250	$1,847,500	$470,500	
Inspiraplex	$12,300,000	May 01	$100,000	$3,617,803	$3,143,480	$2,778,803	$2,457,316	$202,598	
TOTAL (Grants)	$74,400,000		$400,000	$19,874,766	$17,517,413	$16,592,982	$16,493,676	$3,521,163	
TOTAL (Admin.)	$1,157,500		$57,000	$248,000	$204,700	$216,100	$288,100	$143,600	

SSHRC ADMINISTERED NETWORKS

Network	Award	Effective Date	PAID 89-90	PAID 90-91	PAID 1991-92	Forecast** 1992-93	Forecast** 1993-94	Forecast** 1994-95	Forecast** 1995-96
Cdn. Aging Research Network*	$1,000,000	Sept 01	$0	$0	$200,000	$200,000	$200,000	$200,000	$200,000
TOTAL (Grants)	$1,000,000		$0	$0	$200,000	$200,000	$200,000	$200,000	$200,000
TOTAL (Admin.)	$696,100		$51,500	$143,000	$109,300	$168,300	$190,700	$33,300	
ISTC (Admin.)	$1,025,400		$439,000	$182,000	$71,000	$61,000	$242,000	$30,400	
GRAND TOTAL 1990-91: GRANTS	$232,458,000		$1,400,000	$62,349,766	$54,553,849	$54,048,688	$49,508,842	$10,396,855	$200,000
ADMIN	$7,542,000		$1,733,500	$1,178,000	$917,000	$835,400	$1,584,800	$207,300	$0
	$240,000,000		$3,133,500	$63,527,766	$55,470,849	$54,884,088	$51,093,642	$10,604,155	$200,000

* $200,000 grant, but due to late signing of the agreement, not required in Fiscal 1990 -91.

$15,000 was transferred to SSHRC but is still shown in NSERC figures.

APPENDIX III

APPENDIX IV

REGIONAL DISTRIBUTION OF NCE FUNDS FOR 1992/93

REGION	TOTAL ($)	%
BC	10,175,825	19.5
PRAIRIES	7,222,130	13.8
ON	15,981,428	30.6
QC	13,567,304	26.0
ATL.	5,250,447	10.1
TOTAL	**52,197,134**	**100.0**

Note: Includes expenditures by some networks by operating year

Summary of Provincial Contributions for Phase I [1]

Province	Contribution
BC	$ 20.0M
AB	$ 4.0M
SK	$ 2.4M
MB	$ 1.5M
QC	$ 25.5M[2]
NS	$ 2.8M[3]

(1) Forecast figures
(2) Maximum commitment
(3) For Gene Probe Laboratory at Dalhousie University

APPENDIX VI

Industry Participation in NCE Research Programs (145)

AGTI - CBDN
Ainsworth Automation - IRIS
Alberta Occupational Health and Safety - CARNET
Alcan International Ltd. - IRIS
Allelix Biopharmaceutical Inc. -CGDN, Neural, PENCE
Alliance of Canadian Travel Associations - CARNET
Amersham Canada - CARNET
Applied Physics Specialties Ltd. - CNSR
ARCOR - CARNET
Asea Brown Boveri Inc. - IRIS
ASTRA Pharma - CBDN
Atomic Energy of Canada Ltd. - IRIS
Aztech Associates - Neural
Bank of Nova Scotia - CARNET
Bank of Montreal - CARNET
Barrier Free Design - CARNET
B.C. Hydro - IRIS
B.C. Advanced Systems Foundation - IRIS
Beckman Instruments - CBDN
Bell Northern Research - CITR, IRIS, Micronet
Biochem Pharma - CGDN
Biophotonics Inc. - CBDN
Biosignal Inc. - CBDN
Biostar Inc. - CBDN, Neural
Bristol Aerospace Ltd. - IRIS
CAE Electronics Ltd. - IRIS
Canadian Astronautics Limited (CAL) - CITR, CNSR
Canadian Bankers Association - CARNET
Canadian Institute of Travel Councellors of Manitoba - CARNET
Canadian Marconi - Micronet
Canadian Semiconducter Design Association - Micronet
Cedarlane Labs - Neural
Centre for Research on Human Development - CARNET
Clearwater Fine Food Inc. - OPEN
COM DEV Ltd. - CNSR
Connaught Laboratories Ltd. - PENCE
Corporate Health Consultants - CARNET
Creative Retirement - CARNET
Cyanamid Canada - IBC
DowElanco - IBC
DuPont Canada - IBC, Wood-pulps
Electrohome Electronics - CARNET
Engineering Interface - Inspiraplex
Entotech (Novo Nordisk) - IBC
Ernst & Young - IRIS
ETHOS - CARNET
Falconbridge Ltd. - IRIS
Fishery Products International Ltd. - OPEN
FMC Corporation - Agricultural Chemical Group - IBC
Furniture West - CARNET
Gandalf Technologies - CITR

Gennum Corporation - Micronet
Glenayre Electronics - Micronet
Glenwilliam Industrial Designer - Inspiraplex
Gly Can Inc - PENCE
H.A. Simons Ltd. - IRIS
Hatch Associates Ltd. - IRIS
HBT AGRA (Hardy BBT Ltd) - Concrete
Hemosol Inc. - PENCE
Hewlett-Packard (Canada) Ltd. - CITR, IRIS
Hoechst Canada Inc. - IBC
Husky Injection Moulding Systems - IRIS
Hydro-Québec - IRIS
Hypercube Inc. - PENCE
IBM Canada Ltd. - CITR
ICI - Zeneca Agro - IBC
ID Biomedical - CGDN
Imperial Oil - CARNET
Inco Ltd. - IRIS
Infrascan - Inspiraplex
Innomed Christie Group Ltd. - CARNET
Institute for Technology Development, Oxford, Miss. CARNET
International Ladies'Garment Workers' Union (New York) - CARNET
ITRES Research Ltd. - CARNET
John A. Bickley Associates Ltd. - Concrete
JWI Group - Wood-pulps
Kellogg's - CARNET
Kelly Temporary Services - CARNET
LAC Minerals - IRIS
London Research and Development Ltd. - CNSR
Lynwood Extended Care Centre - CARNET
MacDonald Dettwiler & Associates - IRIS
Mainstream Access Corporation - CARNET
Manalta Coal Ltd. - IRIS
Manitoba Fashion Institute - CARNET
Manitoba Hydro - CARNET
Manitoba Telephone System - CARNET
Matrox Electronic Systems - Micronet
McNeil Consumer Production - CARNET
MDS Health Group Ltd. - CARNET, CGDN
Merck and Co. Inc. - IBC
Merck Frosst - CGDN, Inspiraplex, PENCE
Micrologix Biotech Inc - CBDN
Minimed Technologies - Neural
Mitel - Micronet
MPB Technologies Inc. - IRIS
MPR Teltech Ltd. - CITR, IRIS, Micronet
Myrias Computer Technologies Inc. - CNSR
N.B. Power Commission - IRIS
National Sea Products - OPEN
Neurodyne Canada - Neural
Neurospheres - Neural
New York Business Group on Health, Inc. - CARNET
Newbridge Microsystems - Micronet
Newbridge Networks - CITR
Northern Telecom Electronics - Micronet

Clearwater Fine Foods Inc. - OPEN*
Connaught Laboratories Inc. - PENCE*
Corporate Health Consultants - CARNET*
Cyanamid Canada Inc. - IBC*
DowElanco Canada - IBC*
Ernst & Young - IRIS*
Fishery Products International Ltd. - OPEN*
Gandalf Technologies Inc. - CITR*
Gennum Corporation - Micronet*
H. A. Simons Ltd. - IRIS*
Hatch Associates Ltd. - IRIS*
Hewlett Packard (Canada) Ltd. - IRIS*
Hughes Network Systems - Micronet
Husky Injection Moulding Systems - IRIS*
Hydro-Québec - IRIS*
Hymac Ltd. - Wood-pulps
IBM Canada - CITR*
ICI Canada Inc. - CEMAID
Inco Ltd. - IRIS*
Itres Research Ltd. - CNSR*
KlasTek Ltd. - IRIS
Labatt Brewing Company Limited - CBDN
Levelton Associates Consulting Engineers - Concrete
MacDonald Dettwiler & Associates - IRIS*
MacMillan Bloedel Limited - Wood-pulps
Mitel Semiconductor - Micronet*
MPR Teltech Ltd. - CITR*, IRIS*
N.B. Power Commission - IRIS*
Ontario Hydro - IRIS*
National Sea Products - OPEN*
Northern Telecom Ltd. - Micronet*
PAPRICAN - PENCE*, Wood-pulps*
Parteq R & D Innovations - CGDN
Petro-Canada Resources - IRIS*
PMC-Sierra Inc. - Micronet*
PRECARN Associates - CNSR, IRIS*
SCIEX - CEMAID, CGDN
Seimac Ltd. - OPEN
Shell Canada - IRIS*
Spar Aerospace Ltd. - IRIS*
Stentor - CITR*
Syncrude Canada Ltd. - IRIS*
Telus Corporation - CITR
Tembec Inc. - Wood-pulps
Terracy Inc. - Neural
TransAlta Utilities Corporation - IRIS*
Xerox Research Centre of Canada - IRIS*

PRESIDENTS' ADVISORY COMMITTEE

Terms of Reference

The Committee will review the interim program evaluation report, the peer evaluation reports and any other relevant documents; and provide comments and advice to the Tri-Council Steering Committee on the conclusions drawn about the programs in these various studies. The report of the Committee will be part of the information used by the Presidents in their submission to the Minister regarding the future of the program.

Committee Membership

The membership will be approved by the Presidents of the three Granting Councils and will not exceed eight (8) members.

Networks of Centres of Excellence Phase II

Selection Committee

Terms of Reference

The Selection Committee will evaluate the 15 Networks of Centres of Excellence according to the selection criteria stated in the Phase II Policies and Guidelines, based on the following sources of input:

- strategic plan applications for Phase II funding
- site visit reports from the 33-month review process
- evaluation of the proposed strategic plans by site visit committee members
- external review reports
- presentation by network representative(s) to the Selection Committee

The Selection Committee will provide the NCE Steering Committee with a list of its recommended ranking of the 15 Networks of Centres of Excellence, in order of priority for funding in Phase II of the program, for formal transmittal to the Minister of Science [now Minister of Industry]. The report of the Selection Committee will be made public.

APPENDIX IX

Networks of Centres of Excellence Phase II

Selection Committee

Chair:

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APPENDIX X

SUMMARIES BY NETWORK

1. Canadian Aging Research Network (CARNET)
2. Canadian Bacterial Diseases Network (CBDN)
3. Canadian Genetic Diseases Network (CGDN)
4. Canadian Institute for Telecommunications Research (CITR)
5. Canadian Network for Space Research (CNSR)
6. Centre of Excellence for Molecular and Interfacial Dynamics (CEMAID)
7. Insect Biotech Canada (IBC)
8. Inspiraplex (Respiratory Health NCE)
9. Institute for Robotics and Intelligent Systems (IRIS)
10. Mechanical and Chemimechanical Wood-Pulps Network
11. Micronet
12. Network of Centres of Excellence on High-Performance Concrete
13. N.R. Network (Neural Regeneration)
14. The Ocean Production Enhancement Network (OPEN)
15. Protein Engineering NCE (PENCE)

CANADIAN AGING RESEARCH NETWORK (CARNET)

Scientific Leader:	Dr. Victor Marshall
Network Manager:	Ms. Wendy Green
Chair, Board of Directors:	Dr. Barry McPherson
Number of Scientists/Engineers:	23
Number of Participating Institutions:	10 universities 2 corporate partners 1 government liaison organization
Number of Industrial Affiliates:	5 corporate affiliates
Administrative Centre:	University of Toronto
Award:	$5 million over 5 fiscal years
Start-up date:	September 1990

RESEARCH: Within 40 years, it is predicted one Canadian in four will be over 65. The combination of an aging workforce and rising costs for health and social care could pose threats to our national economic competitiveness. The goal of this network is to investigate conditions that can help Canadians maintain their productivity and independence in their later years.

Network researchers investigate how workplace and home environments affect cognitive performance and work behaviour. Expected benefits include a better understanding of the problems faced by older workers and their employers, as well as the development of innovative workplace environments tailored to maintain workers productivity. A second study investigates new health care products and community-based services that provide a better quality of life for seniors and that reduce or delay the need for medical care or institutionalization. Still, other researchers look at family care-givers, the home and work stresses they face in taking on responsibility for an older relative, and how these can be mitigated. Finally, a program involving a national survey and eldercare studies in the corporate sector is investigating the management of an aging labour force.

The major research areas are:

- products and services (e.g., needs surveys);
- work and eldercare research;
- cognitive functions (including cognitive aging, productivity workplace participation, and promoting independence); and
- managing the aging Canadian labour force.

STATUS REPORT: CARNET's third year has been exciting, as they have moved beyond the design phase of the first year and the implementation phase of the second year to see the first research products developed. The two major surveys, the Work and Family Study and the Needs Survey are now complete. The release of the findings of the Work and Family Survey was extensively covered by the Canadian media. Over the past year, a considerable amount of researchers' time was dedicated to the production of industry-specific reports. The Work and Eldercare Research Group produced customized feedback reports for eight industries that participated in the Work and Family Study. Similarly, the Products and Services Research Group produced industry-specific reports to MDS, and for ARCOR. In addition, a series of Technical/Special Reports will be distributed to all of the initial industries that assisted with the formulation of questions, or otherwise had contact at the beginning of the Needs Survey. Membership to the network has expanded from 116 to 156 participants. The Site Visit Committee unanimously and strongly recommended that funding for CARNET be extended to the fourth and fifth years. It was impressed by the excellent research produced by the network. It highlighted the important training functions which CARNET has served for students at all levels. For instance, during the past year, one Ph.D. and four masters theses were completed by CARNET students.

CANADIAN AGING RESEARCH NETWORK (CARNET)

Universities

Concordia University
McMaster University
Trent University
Université de Montréal
University of Alberta
University of Guelph
University of Manitoba
University of Toronto
University of Victoria
University of Waterloo

* these organizations have a formal link to CARNET

Federal Government Departments & Other

Health & Welfare Can

Government Involvement

Atlantic Canada Economic Development
Dauphin and District Community Resource Council
Min. of Community and Social Services (ON)
Empl. and Immi. Can.
The Canada Council
Waterloo County Board of Education
Doctors Hospital
Guelph General Hospital
Numerous long-term care facilities in Ontario and Manitoba
The Manitoba Govt.
Ontario Workers Compensation Institute
Veterans Affairs
Community Help Centre, Roblin
Senior Services of Antler River,
Melita Senior Centre
New Horizons, Killarney
Resource Council of Caman

*** Corporate Affiliates**

The Good Samaritan Society
Lynnwood Extended Care Centre
Edmonton General Hosp
Alberta Occupational Health and Safety
Innomed Christie Group Ltd.

Industrial Partners

CHC (Corporate Health Consultants)
ARCOR (The Canadian Aging and Rehabilitation Product Dev. Corp.)

Industrial Participation

Sunlife of Canada
The Mutual Group
Amersham Canada
New York Business Group on Health, Inc.
International Ladies' Garment Workers' Union (New York)
Quebec Fashion Apparel Manufacturers' Guild
Toyota Motor Manufacturing
Kellogg's
McNeil Consumer Production
MDS
Imperial Oil
Bank of Nova Scotia
Creative Retirement
Alliance of Canadian Travel Associations
Canadian Bankers Association
Kelly Temporary Services
Barrier Free Design
Manitoba Hydro
Manitoba Telephone System
Ontario Hydro
William M. Mercer Ltd.
Bank of Montreal

Industrial Participation (continued)

Mainstream Access Corporation
Electrohome Electronics
Centre for Research on Human Development
ETHOS
Canadian Institute of Travel Counsellors of Manitoba
Therapeutic Applications, Buffalo
Institute for Technology Development, Oxford, Miss.
The Messanger Telephone System
Manitoba Fashion Institute
Furniture West

CANADIAN BACTERIAL DISEASES NETWORK (CBDN)

Scientific Director:	Dr. Robert Hancock, University of British Columbia
Managing Director:	Dr. Henry Geraedts
Chair, Board of Directors:	Mr. Eric Geddes, Advanced Technology Project, Number of
Scientists:	39 full/3 associate members
Number of Participating Institutions:	Seven universities, two government labs
Number of Industrial Affiliates:	Ten
Administrative Centre:	University of British Columbia
Award:	$18.2 million over four years
Start-up Date:	May 1990

RESEARCH: Bacteria often cause rapidly progressing, highly infectious diseases that exact human suffering as well as billions of dollars of losses worldwide in the agriculture, forestry and aquaculture industries. New technologies including monoclonal antibodies and genetic engineering offer considerable promise in turning the tables against these bacteria. This network studies bacterial attack and host response in very different biological systems (humans, animals, plants). Some of the projects involve strengthening the host's defences, others are aimed at developing models for human infections.

CBDN studies the causative agents of such diseases in humans as whoopping cough, gonorrhoea, toxic shock syndrome, lung infections in cystic fibrosis, bacterial meningitis, and hospital-derived infections. In addition, researchers investigate major bacterial pathogens affecting the aquaculture industry (such as bacterial kidney disease in fish), the causative agents of plant wilt and crown gall diseases, and shipping fever in cattle. Products that may result include vaccines, antibiotics, diagnostics, and novel reagents and biomedical technologies.

The eight major research thrusts of CBDN are: antibiotics, intracellular bacteria/adherence/macrophages, live attenuated and subcellular vaccines, diagnostics, aquaculture and food animal vaccines, toxins, Helicobacter, and sexually transmitted diseases.

STATUS REPORT: In April 1993, the 33-month evaluation of all the activities of the network took place. A Committee of outside experts formed by NSERC met with CBDN representatives to do this review, based on the 33-month report submitted by CBDN. The Peer Review Committee was impressed with the progress demonstrated in the various research projects and commented that the research program of CBDN was highly relevant to Canada in its development of new technologies, in production of new products and in the training of scientists for the future. In the Committee's opinion, the technology and biomaterials transfers are very impressive and industry support has increased. CBDN has currently concluded agreements with ten industrial partners, seven of which are small Canadian-owned firms, one a small foreign-owned joint venture partner and two multinationals. In addition, CBDN is currently negotiating agreements with the following firms: Biochem Immunochem, Microcide, Synphar Laboratories, ASTRA Hässle, Sanofi Diagnostics Pasteur, NOAB Immunoassays, and NZYM Ltd.

With regard to training, the Peer Review Committee noted that the number of trainees (postdocs, students and technical assistants) has grown from 131 to 226 since the first 9-month report. The committee believes that these new scientists will be unique among Canadian scientists as a result of their experience in networking, technology transfer and in working collaboratively with the academic, public and private sectors.

CANADIAN BACTERIAL DISEASES NETWORK (CBDN)

Universities

Université Laval
University of Alberta
Univ. of British Columbia
University of Calgary
University of Guelph
University of Victoria
VIDO, Saskatoon

Federal Government Departments & Other

LCDC, Health & Welfare
N.R.C. - Division of Biological Sciences

Industrial Partners

ASTRA Pharma
AGTI
Beckman Instruments
Biophotonics Inc.
Biosignal Inc.
Biostar
Micrologix Biotech Inc.
Synthetic Peptides Inc.
Syndel Laboratories
StressGen

CANADIAN GENETIC DISEASES NETWORK

Scientific Leader:	Dr. Michael Hayden
Network Manager:	Dr. David Shindler
Chair, Board of Directors:	Dr. Martin Hollenberg
Number of Scientists/Engineers:	39
Number of Participating Institutions:	8 universities, 2 industries, 6 hospitals
Number of Industrial Affiliates:	0
Administrative Centre:	University of British Columbia
Award:	$17,500,000 over 4 years
Start-up Date:	August 1, 1990

RESEARCH: This network is investigating the genes that directly cause or predispose us to disease. The goal is to determine the biological function of each of the relevant genes, and to discover how mutation in each gene causes disease. From the new knowledge, it may be possible to detect carriers of most of the common genetic diseases, and, for some, to devise a treatment or cure. This research could lead to commercial opportunities for Canada in the area of DNA diagnostics and therapeutics. The results could be fewer affected persons and reduced health care costs. Specific diseases focused on include cystic fibrosis, muscular dystrophy, Huntington's disease, cancer and heart disease.

Major research themes are:

- identification of disease-causing genes;
- study of the disease process;
- therapy.

STATUS REPORT: CGDN continues to make breakthroughs in research including, this year, the identification of an infectious disease susceptibility gene, significant progress towards the identification of the Wilson disease gene, a significant contribution towards the identification of the Huntington's disease gene and impressive advances in genetic technologies. The report of the recent 33-month site visit committee noted that "if there was a standard in this area involving a ratio of contributions to the size of the country and the available resources, the Canadian Network might well be at the top of such an international comparison".

Also this year, several new collaborative research projects began with industry, including Biochem Pharma, Pharmacia, Merck-Frosst and ID Biomedical, evidence that the networking with industry is beginning to pay off. The number of industrial partners, contributions from industry, IP disclosures and patents has continued to grow. Plans for the establishment of an Institute for Molecular Medicine at UBC, to which Merck Frosst is to contribute $15 million, have been solidified.

Nevertheless, since the receptor capacity for genetic research in Canada is limited, the Network has also set up a new company, NGI, to be at arms length from the Network, to which new technology can be transferred for further development, in partnership with existing industrial partners if there is interest. The Network engaged a consulting company to assist in identifying potential projects and formulating a business plan so capital funding can be sought. An interim Scientific Director has also been appointed.

CANADIAN GENETIC DISEASES NETWORK

Universities

McGill University
Queen's University
University of British Columbia
University of Calgary
University of Manitoba
University of Montreal
University of Ottawa
University of Toronto

Federal Government Departments & Other

Hospital for Sick Children
Montreal Children's Hospital Research Inst.
Montreal General Hosp.
Children's Hospital of Eastern Ontario
University Hospital, Vancouver
Hôpital Ste-Justine

Industrial Partners

MDS Health Group Ltd.
Merck Frosst

Industrial Collaborators

Allelix Biopharmaceuticals
Biochem Pharma
ID Biomedical
Sci-Ex
Pharmacia

CANADIAN INSTITUTE FOR TELECOMMUNICATIONS RESEARCH (CITR)

Scientific Leader:	Dr. Maier Blostein, McGill University
Network Manager:	Dr. Maier Blostein, President & CEO, CITR
Chair, Board of Directors:	Dr. John Elliott, BNR Ltd.
Number of Scientists/Engineers:	67
Number of Participating Institutions:	15 universities, two research centres
Number of Industrial Affiliates:	11
Administrative Centre:	CITR office (McGill University)
Award:	$14.7 million over four years
Start-up Date:	July 1990

RESEARCH: CITR is a co-ordinated effort to boost Canada's position in telecommunications services and manufacturing, especially in the 'network of the future', which will allow subscribers easy access to telecommunications services involving voice, data, images, or multimedia services from virtually anywhere.

The network focuses on broadband and wireless communications, two rapidly growing areas that present important emerging markets for telecommunications over the next decade. Broadband communications refers to high-speed communications that will permit a diverse array of affordable, high-bandwidth, multi-point, interactive, audio/data/video teleconferencing, information and entertainment services for both business and residential markets. These will be made possible through advances in photonic, microelectronic and software technologies and by the development of novel telecommunication network design techniques.

The companion study in wireless personal communications is concerned with providing subscribers access to telecommunications, information and entertainment services from wherever they may be located; at home, at work, at a remote location or in a moving plane, train or car. The critical technologies under investigation are low power radio systems that are tightly organized into microcells, cells or macrocells, and that are interconnected to the terrestrial network in a manner permitting easy access to a wide range of multi-point, multi-media services.

STATUS REPORT: The 33-month Peer Review Committee found that during the past three years of operation the network has taken significant steps towards meeting its long-term goal of helping Canada achieve world leadership in the development and exploitation of advanced telecommunications. The network has developed a cohesive vision through strong leadership and has the full support of the academics and industry. The network has surmounted the inevitable problems related to academics focusing their research on shorter-term, more applied aspects. The research program has been reoriented into five coherent thrusts that bears directly on the vision of the network of the future. Key linkages with major federal government laboratories and provincial research facilities have been established in order to closely coordinate effort. Industry representatives to both the Board and Program Committee are involved, integrated, and knowledgeable about CITR activities.

Industry involvement with CITR at all levels of interaction - from the Board down to individuals interacting with faculty and students - appears to have been strengthened over the past year.

The concerns and direction proposed by industry are clearly reflected in CITR's change in direction and research activities proposed. The industrial component of the Board's support to direct government funds to the current structure is firm and encouraging. The Board initiative in creating a strategic plan, before such a plan was required for Phase II, was appropriate and essential to refocus CITR to meet both the original goals of the program and to place CITR in a position for renewal. The first years of the program were primarily run as business as usual (individual research) but with an increasingly recognized need to change. This need is actually driven by changes in the roles of government, industry, and academia but is embodied artificially in the goals of the network. The funding and the desire to renew the funding provide a forcing-function for change.

CITR is considered to be a vital element in Canada's economic future, especially as it relates to telecommunications and information technology. Industry appears enthusiastic with CITR as well.

CANADIAN INSTITUTE FOR TELECOMMUNICATIONS RESEARCH (CITR)

Universities

Carleton University
Concordia University
École Polytechnique
INRS-Telecommunications
McGill University
McMaster University
Simon Fraser University
University of British Columbia
Université Laval
Université de Montréal
University of Ottawa
University of Toronto
University of Victoria
University of Waterloo

Federal Government Departments & Other

Communications Research Centre (CRC)
TR Labs
Telecommunications Research Institute of Ontario
Information Technology Research Centre

Industrial Affiliates

BNR Ltd.
NovAtel Communications Ltd.
MPR Teltech
Teleglobe Inc.
Gandalf Technologies
Spar Aerospace Ltd.
CAL Corporation
Newbridge Networks
Hewlett Packard Canada Ltd.
IBM Canada Ltd.
Stentor Resource Centre Inc.

CANADIAN NETWORK FOR SPACE RESEARCH (CNSR)

Scientific Leader:	Dr. Leroy Cogger, University of Calgary
Network Manager:	Dr. Dennis Green
Chair, Board of Directors:	Dr. Ian McDiarmid
Number of Scientists/Engineers:	38
Number of Participating Institutions:	Six universities, two federal departments, one Ontario Centre of Excellence, six companies
Number of Industrial Affiliates:	Three
Administrative Centre:	University of Calgary
Award:	$17.0 million over four years
Start-up Date:	July 1990

RESEARCH: The network seeks to integrate knowledge of processes in the atmospheric and near-Earth space environments, and to increase the competitiveness of its industrial participants through the transfer of technology, through the cooperative development of innovative instruments and also through personnel interchange. CNSR research thrusts include: the study of space plasmas, their harmful effects on space vehicles and structures, and the primary role they play in catastrophic, geomagnetically induced failure of electric power grids; intensive studies of middle and high atmospheric processes of direct relevance to global climatic change and ozone depletion, especially in the polar region. These network-sponsored, ground-based studies are closely coordinated with observations made by network researchers using instruments on board the recently launched UARS and Freja satellites; acquisition by industrial participants of advanced spacecraft instrumentation technologies which are relevant to anticipated space research needs and which offer possible applications in other markets.

CNSR research and development activities are organized into five closely related themes: Structure and dynamics of the middle atmosphere; Auroral processes; The polar atmospheric environment; The plasma environment in space; Space science instrumentation development.

STATUS REPORT: The 33-month Peer Review Committee in its evaluation of the 33-month Annual Report found that the CNSR has accomplished leading-edge fundamental research of importance to Canada. The establishment of the CNSR has resulted in the revitalization of all of space research in Canada and has caused a rebirth in several sub-disciplines; such as the study of the polar atmosphere. Canada's geographical location, which includes the north geomagnetic pole and the auroral zone, places the country in an ideal position to play a major role in space science research.

The challenge to the CNSR and its industrial members, and one well recognized by them, is to seek out, encourage, and stimulate commercial possibilities from the network's research and instrumentation. The specifically space-related markets are likely to continue to be limited and perhaps shrinking in scope. To this end, the network has developed some interesting initiatives to capitalize on the results of network research. One example is a new digital ionosonde designed to measure ionospheric drifts that was developed by researchers at the University of Western Ontario for a network project. Subsequently, one of the network's industrial partners, SIL, became interested in the instrument. The result was an agreement for a technology license that would allow SIL to commercialize the instrument.

CANADIAN NETWORK FOR SPACE RESEARCH (CNSR)

Universities

University of Alberta
University of Calgary
University of Saskatchewan
Trent University
University of Western Ontario
York University

Federal Government Department & Other

Atmos. Envir. Service
NRC - Herzburg Inst.
ISTS

Industries

Can. Astronautics Ltd.
COM DEV Ltd.
ITRES Research Ltd.
S.I.L.
SCI-TEC Instruments Inc.
SED Systems Inc.

Industrial Associates

Myrias Computer Technologies Inc.
Applied Physics Specialties Ltd.
London Research and Development Ltd.

CENTRE OF EXCELLENCE FOR MOLECULAR AND INTERFACIAL DYNAMICS (CEMAID)

Scientific Leader:	Dr. Dennis Salahub, University of Montreal
Network Manager:	Ms. Nancy Quattrocchi
Director, Industrial Development:	Mr. Marc Escaravage
Chair, Board of Directors:	Dr. Alain Caillé, University of Sherbrooke
Chair, Industrial Development Committee:	Dr. Steven Wallace, University of Toronto
Number of Scientists/Engineers:	48
Number of Participating Institutions:	15 universities
Administrative Centre:	University of Montreal
Award:	$18.5 million over four years
Start-up Date:	November 1990

RESEARCH: Chemical physics, the area at the boundary of chemistry and physics, seeks to understand the behaviour of atoms and molecules at surfaces. This is important to the development of complex instrumentation such as analytical instruments, lasers, spectrometers of all kinds and specialized monitoring, measurement and process control instruments.

Spectroscopy is one of three areas that the network focuses on, with researchers in optical, laser and mass spectroscopy combining their work. A second study area, reaction dynamics, is a key to understanding such important processes as ozone depletion, combustion and atmospheric pollution, as well as industrial technologies such as the fabrication of integrated circuits. The final study area - interfacial dynamics - is a new field that looks at the properties of surfaces and may be relevant for the fabrication of new materials.

STATUS REPORT: In their evaluation of CEMAID, the 33-month Peer Review Committee was very positive about the quality of research carried out by network participants. The CEMAID research program in the three broad discipline-based areas is now evolving into four group projects. In their site visit report the Peer Review Committee affirmed this transition, which will enhance the focus and integration of network research. It will also enable CEMAID to align their research at the frontiers of basic science with key technological areas which will ultimately benefit Canada through exploitation by existing Canadian companies or new commercial ventures.

The Peer Review Committee appreciated CEMAID's receptiveness to commercializing technological advances arising from network research through the creation of new companies. Nevertheless, they encouraged CEMAID to increase the participation of representatives of existing industry in the network to provide the perspective to guide research directions and strategies towards Canada's technology needs. They noted that these interactions will also increase the awareness in industry of the research carried out within the network, as well as contributing a longer-term perspective on new opportunities for industry.

The increased interaction in the network between experimentalists and theorists, as well as between chemists and physicists, was deemed to be a major benefit of the network approach which also enhances the training environment for CEMAID students. CEMAID currently supports about 200 trainees, with about an equal number working on network research projects through other sources of funding. CEMAID students completed 16 PhD and 12 MSc theses in the past year. In the 33-month period, 247 postdoctoral fellows, graduate students and research associates trained by CEMAID are now pursuing further studies or have taken up positions in the academic, government and industry sectors. About half of these have remained in Canada.

CENTRE OF EXCELLENCE FOR MOLECULAR AND INTERFACIAL DYNAMICS (CEMAID)

Universities	Federal Government Department & Other	Industries
Dalhousie University		
Université Laval		
McMaster University		
Queen's University		
University of British Columbia		
University of Guelph		
Université de Montréal		
University of New Brunswick		
University of Ottawa		
Univ. de Saskatchewan		
University of Sherbrooke		
University of Toronto		
University of Victoria		
University of Waterloo		
Univ. of Western Ontario		

INSECT BIOTECH CANADA (IBC)

Scientific Leader:	Dr. Stephen Tobe, U. of Toronto
Network Manager:	Dr. Bruce Hutchinson
Chair, Board of Directors:	Dr. J. Clare Rennie
Number of Scientists/Engineers:	28 full/4 associates
Number of Participating Institutions:	10 universities, three government labs and two industries
Number of Industrial Affiliates:	Ten signatory
Administrative Centre:	Queen's University
Award:	$9.158 million over four years
Start-up Date:	July 1990

RESEARCH: Insect pest control is important to Canadian agriculture and forestry. Agricultural crop losses due to insects range up to 35 percent, while, in forestry, insects are estimated to destroy up to 65 million cubic metres of timber annually, fully one-third of Canada's annual cut.

With demand growing for new, environmentally acceptable methods of pest control, integrated biological management strategies are expected to be the major wave of the future. The network's program focuses on developing new, acceptable methods of pest control through biotechnology. Researchers explore means to alter naturally occurring insect viruses to render them more effective and selective in their attack on insects. Studies are also conducted on the molecular basis of pesticide resistance in insects with the twin goals of minimizing resistance in pests and transferring protecting genes to beneficial species. Researchers also look at genes responsible for hormonal mechanisms that can be used in new insect pest control strategies. One early practical result of molecular biology studies on insects is the development of DNA techniques for identifying closely related pest species. Products arising from this research will be tested in collaboration with industry and government laboratories.

Major research thrusts of IBC are:

- molecular engineering of baculoviruses (which infect and could control the spruce budworm, among others);
- characterization and molecular biology of insect neuropeptides (a class of hormones that control essential processes in insects);
- molecular genetics of pesticide resistance;
- juvenile hormone (a unique insect hormone) and juvenoid insect growth regulators;
- cell and molecular biology of insects.

STATUS REPORT: This past year has seen many exciting results from the researchers in IBC which may lead to successful new methods of control in the near future. The following will provide some examples of the most promising results:

• Breakthrough - A fast acting baculovirus: a major problem facing researchers developing biological control products based on baculovirus is the length of time it takes to kill the insect. Researchers from IBC have developed a system which will activate a gene very early in the baculovirus infection cycle and turn on the production of harmful factors in less than 10 hours. This invention has the potential to be the basis for new commercially viable biological pesticides.

• Molecular markers - Identification by DNA: The design of molecular markers to rapidly identify Asian versus European gypsy moths from egg masses, larvae or parts of insects caught in pheromone traps has been an advance welcomed by pest control officials in Canada and the United States. A system to provide foolproof identification of egg masses on ships which unwittingly transport these stowaways, has been developed by IBC researchers so that it can now be done in days instead of weeks, saving costs to shipping companies of up to $10,000 per day in quarantine fees.

On the management side, Dr. Gerard Wyatt resigned from his position as Scientific Leader in anticipation of his retirement. Dr. Steve Tobe has replaced him in this position on November 1st, 1993.

The visit for the 33-month review of IBC took place at the beginning of July 1993. The Peer Review Committee noted the substantial progress accomplished by Insect Biotech Canada during the first three years of operation of the network. The Committee was very impressed with the strong linkages within the network between academia, industry and government. There is a strong evidence of common, deep commitment to have the network meet its goal. In the Committee's discussion with industry representatives, industry recognizes the unique and outstanding scholarship available in the network and are pleased with the progress to date. The user sector has been delighted with the flexibility of the academics to consider its needs and orient their research programs accordingly. It is the feeling of the Committee that there is a real potential for innovation from the current research studies in IBC, mostly because of the leadership shown by IBC management in creating and environment favourable to the commercial exploitation of the current research. As a result of this leadership, four new Industrial Affiliates have joined the network in the past year. IBC also filed three patent applications and made five invention disclosures to its industrial partners.

The collaboration between disciplines and the three sectors also provides a special environment for the training of students and staff. As an example, the network produces students uniquely trained in molecular biology and entomology, a combination which is highly needed in industry and government labs. The number of trainees has grown from 77 to 125 since the first year of operation of the network.

IBC is also involved in international collaborations. The collaboration between IBC and CSIRO, Australia, continues with the exchange of postdoctoral fellows and interaction on research programs. A new joint research agreement has been signed with the Central Science Laboratory of the United Kingdom Ministry of Agriculture, Fisheries and Food in the field of hormones and receptors. IBC management is currently discussing with the organizers of the "insect industry" project in Japan for a possible research collaboration.

INSECT BIOTECH CANADA (IBC)

Universities

Queen's University
Université Laval
University of British Columbia
University of Calgary
University of Guelph
University of New Brunswick
University of Ottawa
University of Toronto
University of Western Ontario
York University

Federal Government Departments & Other

Agriculture Canada Research Centre, London
NRC - Biotech Res. Inst.
Forestry Canada - Forest Pest Management Inst.

Industries

Industrial Associates (2)

Cyanamid Canada
DowElanco

Industrial Affiliates (7)

DuPont Canada
Entotech (Novo Nordisk)
FMC Corporation - Agricultural Chemical Gr.
Hoecsht Canada Inc.
I.C.I. Zeneca Agro
S.C. Johnson & Son, Inc.
Merck & Co. Inc.
Plant Genetic Systems
Rhône-Poulenc Agriculture Company
Uniroyal Chemical

INSPIRAPLEX (RESPIRATORY HEALTH NETWORK)

Scientific Leader:	Dr. Peter Macklem
Network Manager:	Ms. Anne Vezina
Chair, Board of Directors:	Mr. David Weinstein
Number of Scientists/Engineers:	60
Number of Participating Institutions:	9 universities, 9 industries, 17 hospitals 3 government departments/agencies
Number of Industrial Affiliates:	0
Administrative Centre:	McGill University
Award:	$12,300,000 over 4 years
Start-up Date:	May 1, 1990

RESEARCH: Inspiraplex focuses on diseases leading to airways obstruction and inhalational lung disease. Its research programs represent traditional medical approaches to disease, namely pathology and pathophysiology, diagnosis, treatment, prevention and rehabilitation. These approaches represent the network's research themes:

1. Structure and Function (pathology and pathophysiology);
2. Physiologic Diagnosis;
3. Viral Diagnosis;
4. Asthma treatment;
5. Cystic Fibrosis treatment;
6. Environmental Health (prevention) subdivided into subthemes investigating indoor air quality in office buildings in relation to the sick building syndrome, homes in relation to asthma in school children and farm buildings in relation to hypersensitivity pneumonia;
7. Rehabilitation which includes intensive care medicine.

Eighteen disciplines ranging from molecular genetics through physiology, cellular immunology and pharmacology to biomathematics, computer sciences and engineering participate in the network's inter-disciplinary research programs. The products are equally diverse and include viral-specific DNA probes for the rapid diagnosis of viral lung disease, the development of living human lung explants, quantitative dynamic 3 dimensional imaging of moving cells, sophisticated image analysis systems, a machine to assess diaphragmatic contractility, a new generation mechanical ventilator in which patients choose their own rate of breathing, a patient transport vehicle which eliminates backstrain and a new heating, ventilation and air conditioning system designed to alleviate the symptoms of the sick building syndrome.

STATUS REPORT: The Site Visit Committee concluded that Inspiraplex research, with minor exceptions, was of outstanding quality and showed great productivity. They were also impressed with the degree and result of networking within Inspiraplex, remarking that it does more than supplement the normal scientific meetings since it brings together workers from many fields - physiology, medicine, biochemistry, genetics, environmental medicine, cell biology, biophysics, rehabilitation medicine and engineering - who would not normally attend the same meetings, but who are now learning to work together towards a common goal.

The Site Visit Committee also noted that the Network, to date, had been able to bridge the "development gap" for at least two marketable products - a pulmonary assist ventilator, which represents a substantial improvement in technology and for which there will be a large market; and a patient transport vehicle,

which will benefit caregivers as well as their patients. Other products including computer software, diagnostics, medical devices and a ventilation system, are in various stages of development. Relationships with industry vary with the product. Sometimes industry is the licensee, sometimes a collaborative partner in research, and sometimes the Network serves as a beta test site for industrial products to the benefit of both industry and the research laboratory. In particular, the Network has developed a model relationship for collaborative research with Merck-Frosst scientists in the area of asthma.

INSPIRAPLEX (RESPIRATORY HEALTH NETWORK)

Universities	Federal Government Departments & Other	Industries
McGill University	St. Paul's Hospital	Engineering Interface
McMaster University	Vancouver General Hosp	Glenwilliam Industrial Designer
University of British Columbia	Royal Victoria Hospital	Infrascan
University of Calgary	Montreal General Hosp.	Merck Frosst
Université Laval	Mtl. Chest Hosp Cntr	Omega
Université de Montréal	Hôpital Laval	Puritan-Bennett
University of Manitoba	Hôpital Notre-Dame	Raytech Instruments
University of Saskatchewan	Hôpital Sacré-Coeur	Respironics
University of Toronto	Hôpital St. Luc	RHT-Infodat
	West Park Hospital	
	Research Institute of the Hospital for Sick Children	
	Foothills Hospital	
	Winnipeg Health Sciences Centre	
	St-Boniface Hospital	
	McMaster Health Sciences Centre	
	St-Joseph's Hospital	
	University of Sask Health Sciences Centre	
	Department of Health & Welfare	
	Department of Public Works	
	Centre de la recherche industrielle du Québec	

INSTITUTE FOR ROBOTICS AND INTELLIGENT SYSTEMS (IRIS)

Scientific Leader:	Dr. Pierre Bélanger, McGill University
Program Leader/Director:	Mr. Gordon MacNabb, PRECARN Associates
Network Manager:	Mr. Paul Johnston, PRECARN Associates
Chair, Board of Directors:	Mr. Roy Hoffman, CAE Electronics Inc.
Number of Scientists/Engineers:	130
Number of Participating Institutions:	18 universities, 31 industries, five government departments and three other institutes
Administrative Centre:	PRECARN Associates Inc.
Award:	$23.8 million over four years
Start-up Date:	July 1990

RESEARCH: The network is managed by PRECARN Associates Inc., a consortium of 39 companies and other organizations whose mission is to carry out advanced research and development in robotics and artificial intelligence (AI). Members of PRECARN include resource and energy companies, suppliers of AI and robotics products, and communications and aerospace companies. Also integrated into the network are the 14 AI and Robotics Fellows of the Canadian Institute for Advanced Research.

The research program of IRIS includes 24 projects arranged within three related areas of enquiry-computational perception, knowledge-based systems, and intelligent robotic devices-the essential elements of a system's ability to perceive, reason and act. The search for technical advances focuses on the development of artificial intelligence, expert systems and robotics technology for the resource and manufacturing industries. Specific niches for Canada are also being identified in robotic devices for use in difficult and hazardous environments.

STATUS REPORT: IRIS has moved into the phase of its research program whereby the full, coordinated research effort is underway. In some cases, the network has progressed into the next phase where results have been achieved and identified. Many researchers, through intense personal effort, have made numerous contacts with industries related to their projects. Notably, over 90% are Canadian companies and many are not members of PRECARN. This indicates a wider interest in the work of IRIS than just the PRECARN companies. The links to PRECARN companies are quite strong; many IRIS researchers are involved in PRECARN-sponsored research projects that take advantage of the built in links to the resident expertise of IRIS researchers. The network has applied for a total of 8 patents and has had a total of 7 patents issued. As well, there has been a total of 23 technology licenses granted to industry.

During the visit of the Peer Review Committee related to the 33-month Annual Report, the issue of receptor capacity was brought up. While this issue may be outside the influence of the committee and of IRIS or even of NSERC, nevertheless the lack of it is hampering Canada from reaping the rewards of its investment in IRIS. On several occasions the committee was told that the easiest industrial involvement to obtain was from Japan and the USA rather from Canada. This is, of course, a well-known phenomenon from many other programs. It is partly due to the nature of the general industrial growth scene in the different economies. It is also due to the specific nature of the industries in the fields covered by the IRIS program, where there are relatively few firms in the robotics and related fields in Canada.

While it is true that the high-technology industries have to look to the world for their market, no global firms have become the norm. It is regrettable that Canadian or Canadian-based firms fail to take

advantage of the Networks program. The Government should examine this situation to see if there are steps that could be taken to increase the take-up by indigenous firms. Certainly, there was every evidence that the researchers would have preferred to deal with Canadian rather than foreign firms.

INSTITUTE FOR ROBOTICS AND INTELLIGENT SYSTEMS (IRIS)

Universities

Concordia University
École Polytechnique
INRS-Telecom.
Laval University
McGill University
McMaster University
Queen's University
Simon Fraser University
Technical University of Nova Scotia
University of Alberta
University of British Columbia
University of Guelph
University of Saskatchewan
University of Toronto
University of Victoria
University of Waterloo
University of Western Ontario
York University

Federal Government Departments & Other

Alberta Research Council
Can. Inst. for Adv. Res.
Canadian Space Agency
Communications Can.
C.R.I.M.
Energy, Mines & Resources
National Defence
NRC-Inst. for Info. Tech.

Industries

Ainsworth Automation
Alcan International Ltd.
Asea Brown Boveri Inc.
Atomic Energy of Canada
B.C. Hydro
Bell Northern Research
Bristol Aerospace Ltd.
B.C. Adv. Sys. Foundation
CAE Electronics Ltd.
Ernst & Young
Falconbridge Ltd.
H.A. Simons Ltd.
Hatch Associates Ltd.
Hewlett-Packard (Canada) Ltd.
Husky Inject. Mould. Sys.
Hydro-Québec
Inco Ltd.
LAC Minerals
MacDonald Dettwiler & Associates
Manalta Coal Ltd.
MPB Technologies Inc.
MPR Teltech Ltd.
N.-B. Power Commission
Ontario Hydro
Petro-Canada Resources
Shell Canada
Spar Aerospace Ltd.
Syncrude Research
TransAlta Utilities Corp.
Virtual Prototypes Inc.
Xerox Res. Cntr.

MECHANICAL and CHEMIMECHANICAL WOOD-PULPS NETWORK

Scientific Leader & Managing Director:	Dr. Gordon Leary, PAPRICAN
Chair, Board of Directors:	Mr. Peter Wrist, PAPRICAN
Number of Scientists/Engineers:	40
Number of Participating Institutions:	Ten universities, one government laboratory, two industries and two PAPRICAN research centres
Administrative Centre:	PAPRICAN, Pointe Claire
Award:	$14.6 million over four years
Start-up Date:	August 1990

RESEARCH: The goal of this network is to develop the mechanical pulping process to the point where it can produce superior grade papers that will not yellow. The process relies primarily on the mechanical breakdown of wood fibres as opposed to the chemical separation used in various "kraft" processes. It accepts a much wider range of common northern tree species and allows Canada to take advantage of its inexpensive hydro power. Mechanical pulping has the additional attraction of being intrinsically much less wasteful of trees. Mills that use the process have lower start-up costs, and produce less effluent.

The researchers, who include chemical, mechanical and electrical engineers, and chemists look at all stages of pulping. Key among their objectives is an understanding of lignin, a highly complex polymer whose components are responsible for photochemical yellowing. Success in eliminating this problem could create a new, and more efficient paper industry, plus the opportunity to develop a unique Canadian processing technology. Major project areas are pulping; processing; control; bleaching; reversion.

STATUS REPORT: The 33-month Peer Review Committee noted that this network has benefited from industry involvement from its inception, with the original goals established in consultation with the Canadian pulp and paper industry. They agreed that the multidisciplinary approach of the network, along with the active interactions with industry, is ideally suited to improving the quality of paper produced from high-yield Canadian mechanical pulps, and enhancing the abilty of Canadian industry to profit from expanded world markets for value-added paper products.

The Peer Review Committee was very pleased with the research progress in this network, and approved of the balance between short and long-term projects in the research program. After 33-months of operation, some projects are now ready for on-site trials in industry, such as the refiner load system now being tested at the MacMillan-Bloedel Powell River mill. Other projects with longer time horizons are making major contributions to the fundamental understanding of critical processes, such as the elucidation of the photochemical yellowing reaction mechanism.

This network has expanded training opportunities for highly-qualified personnel by bringing together participants in universities and industry with internationally-recognized expertise in pulp and paper research with researchers who have never worked in this area. This synergy has produced an environment for both researchers and students that is particularly effective at bridging the gap between universities and industry, and has also increased the focus on pulp and paper research at participating universities with benefits to students at undergraduate and graduate levels. Network funds support 122 trainees, with about 50 financed from other sources. Last year network students completed 2 PhD and 11 Masters theses. Of the 21 network trainees who are now employed or are continuing their studies, half are working in Canadian industry.

MECHANICAL and CHEMIMECHANICAL WOOD-PULPS NETWORK

Universities	Federal Government Department & Other	Industries
Lakehead University	N.R.C.	PAPRICAN
McGill University		DuPont Canada
McMaster University		JWI Group
Mount Allison Univ.		
Queen's University		
Université du Québec à Trois-Rivières		
University of British Columbia		
University of Ottawa		
University of Toronto		
University of Western Ontario		

MICRONET

Scientific Leader:	Dr. André Salama, University of Toronto
Network Manager:	Dr. Zahir Parpia
Chair, Board of Directors:	Dr. Douglas Barber, Gennum Corporation
Number of Scientists/Engineers:	76
Participating Institutions:	16 universities
Number of Industrial Affiliates:	14 industries 2 Ontario Centres of Excellence 3 government laboratories
Administrative Centre:	University of Toronto
Award:	$10.8 million over four years
Start-up Date:	May 1990

RESEARCH: Ultra large scale integration (ULSI) describes the technological challenge of squeezing more than ten million functioning electronic components onto a microchip layer smaller than a fingernail and thinner than soap film. The technology is expected to become the mainstay of the next generation of telecommunications and computer systems. Micronet ties together efforts in devices, circuits and systems in a coordinated, vertically integrated, approach. The network's device research program deals with the complex design, modelling, and process techniques needed to fabricate the different types of microscopic devices on the chip. Circuit researchers take the device models and build efficiently designed, functioning circuit blocks. Finally, systems researchers smooth the way for ULSI applications in the areas of personal communication and information based systems. Efficient signal processing hardware, new networks and structures specifically for ULSI, and the ability to test for and repair faulty components are a few of the fundamental areas that are addressed.

STATUS REPORT: Progress on the achievement of the research objectives of the network continues to be at or ahead of the projected milestones. A large number of graduate students continues to find employment in Canada: over 85% over the graduates in the last year alone moved into the private and public sectors. In this past year, the network undertook a cross-Canada consultation process with small industry to begin a dialogue on how Micronet could help these companies. The result was the creation of a new initiative by the network specifically designed to assist small companies. This new program will match companies with Micronet researchers with expertise in the companies area of need. Using funds from the company and from Micronet, a one year Master's level project is to be set up with the company being the primary beneficiary of the results of the research. As well, these same small industries have been invited to sit on a new industrial advisory committee that will provide input to the Board of Directors in addition to that from the larger industrial members who are represented on other committees.

The nine and twenty-one month reviews were conducted based on the annual reports submitted to NSERC in conjunction with the NCE program reporting requirements. The twenty-one month review specifically pointed out that: "Canada was getting exceptional value for the amount invested in Micronet." The single most important result of the 33-month Peer Review Committee evaluation was a solid confirmation of this assessment, based on intense first hand interaction

and dialogue with the key researchers, the research leadership, the members of the Coordinating Committee and the Board of Directors. The single most important recommendation that came for that site visit was that Micronet continue to be funded and indeed be expanded in the next five year cycle to fully reap the increasing benefits to Canada from the impact of this program on research quality, relevance and productivity, as already demonstrated in the first thirty-three months.

Micronet is considered by industry as a source of information, improving the decision making process on the use of new products or processes. The courses and workshops are found to be very useful by all parties. The forum created by Micronet leads to collaboration among different companies. The companies get to know each other through Micronet meetings and start to see common problems. It leads to the definition of common applications to drive the network and also leads to collaboration between several companies. The interest of industry for the R & D results motivates the scientists at the universities. Micronet gives focus to the research of the participating universities. It monitors the research and makes changes whenever needed. For small companies, Micronet research is often the only source of R & D results. Industry helps in defining the applications, and by organizing projects they help in bringing the universities together around common projects. These pre-competitive projects are often followed by individual projects between one University and one company making use of NSERC's Research Partnerships Program.

MICRONET

Universities

Carleton University
Concordia University
École Polytechnique
INRS-Energie
McGill University
Queen's University
Simon Fraser University
TUNS
University of Alberta
University of British Columbia
University of Calgary
University of Manitoba
University of Toronto
University of Victoria
University of Waterloo
University of Windsor

Federal Government Departments & Other

Alberta Microelec. Cntr.
B.C. Adv. Systems Institute
Canadian Microelect. Corp.
Electronics Net. of Alberta
Inform. Tech. Res. Centre
N.R.C.
TRIO
TRIUMF

Industrial Affiliates

Bell Northern Research
Can Semicon Design Assoc
Canadian Marconi
Gennum Corporation
Glenayre Electronics
MacDonald Detwiler Assoc
Matrox Electronic Systems
Mitel
MPR Teltech
Newbridge Microsystems
Northern Telecom Elect.
NovAtel Communications
PMC-Sierra
Teleglobe Inc.

NETWORK OF CENTRES OF EXCELLENCE ON HIGH-PERFORMANCE CONCRETE

Scientific Leader:	Dr. Pierre-Claude Aitcin, Université de Sherbrooke
Network Manager:	Mr. Matthew Garriss
Chair, Board of Directors:	Mr. Philip Seabrook, Levelton Associates, Vancouver
Chair, Consulting Board:	Mr. Eric Fines, Canadian Portland Cement Association, Toronto
Number of Scientists/Engineers:	11
Number of Participating Institutions:	Seven universities, two industrial engineering firms
Administrative Centre:	University of Sherbrooke
Award:	$6.4 million over four years
Start-up Date:	July 1990

RESEARCH: For material scientists and engineers, concrete is a complex composite for which behavioral models and applications are still in their infancy. Recent developments in reinforcing agents provide a strong thrust for the development of new concretes that rank with other "high-tech" composite materials. Members of the High-performance Concrete Network are attempting to tailor the properties of concrete to specialized uses. The new knowledge should help Canadian consulting firms bid successfully on large international construction projects.

Researchers investigate the whole concrete-making process, from colloidal phenomena in fluid concrete through to problems in the design of large structures. The anticipated benefits of this research include more durable and corrosion-resistant concrete for highways and bridges, as well as better testing methods for the safe use of high-performance concrete in offshore platforms, tall buildings, hydro-electric dams, and structures used to store nuclear waste. There will also be contributions to the development of codes, designs, and other applications. There are four major research themes: development of a new generation of building materials; design of high-strength concrete structures; development of new products and techniques (including testing); contributions to national building codes and standards of practice.

STATUS REPORT: In their site visit report, the 33-month Peer Review Committee noted that the network has effectively demonstrated that high-performance concrete is a new material, rather than an improved version of standard concrete. The network approach successfully integrates the theoretical, experimental and practical aspects of materials and structural research, in an area relevant to the Canadian economy - cost reduction for renewal of deteriorating infrastructure. The Peer Review Committee was enthusiastic about the network demonstration projects undertaken in Quebec in collaboration with the provincial Ministry of Transport and municipal governments as well as industry participants. Over the past year the network constructed five demonstration bridges of high-performance concrete which showed initial cost savings of 5% over conventional concrete, not including savings over the lifetime of the structure.

The Peer Review Committee noted the benefits from industry involvement through two consulting engineers as principal investigators, as well as through the active participation of concrete producers and users on the Consulting Board. This participation will become increasingly important as research reaches the application stage, with more opportunities for private and public sector involvement. This interactive environment is ideal for training highly-qualified personnel, with about half the 165 trainees supported by network funds. In the past year, network students completed 5 PhD and 14 Masters theses. Of the 14 network trainees who have now taken up employment or are continuing their studies, 5 are working in Canadian companies.

NETWORK OF CENTRES OF EXCELLENCE ON HIGH-PERFORMANCE CONCRETE

Universities	Federal Government Departments & Other	Industries
University of Alberta		John A. Bickley Associates Ltd.
University of British Columbia		HBT AGRA
Université Laval		
McGill University		
University of Ottawa		
Université de Sherbrooke		
University of Toronto		

NEURAL REGENERATION NETWORK

Scientific Leader:	Dr. Albert Aguayo
Network Manager:	Mr. Warren Bull
Chair, Board of Directors:	Dr. Roger Gaudry
Number of Scientists/Engineers:	24 Principal Investigators; 100 Associates, 50 Trainees
Number of Participating Institutions:	14 universities, 9 industries
Number of Industrial Affiliates:	8
Administrative Centre:	McGill University
Award:	$25,500,000 over 4 years
Start-up Date:	November 1, 1990

RESEARCH: The objective of the research is to promote nervous system regeneration and recovery of functions lost as a result of trauma or disease. A major reason for the permanent disability caused by injuries to the brain and spinal cord by common neurological disorders such as Alzheimer's or Huntington's disease is that damaged nerve cells are not replaced, nor do they restore connections with their natural targets. Major advances have been made recently in uncovering a previously unsuspected potential of the nervous system to re-grow after injury. The field is expected to undergo a further explosion of knowledge with the application of new technologies in molecular biology and genetic engineering.

Research by the network will lead to a better understanding of the underlying causes of neurodegenerative disorders, which in turn would allow for the design of better drugs for the treatment of these diseases. Indirect benefits could be reduced health care costs and re-entry into the workforce by the disabled.

There are six major research themes:

- neuronal survival and protection;-"rescuing & protecting nerve cells"
- neurotrophic factors;- "food for nerve cells"
- growth inhibitory molecules;- "blocking the blockers"
- regrowth and reconnection in damaged nervous systems;- "rewiring the circuitry"
- new gene technology; and -"newest tool for brain repair"
- functional recovery- "electronic replacement parts"

STATUS REPORT: The Site Visit Committee, which reviewed the Network after three years of operation, rated the overall quality of the research and the ability of the investigators very highly and identified many projects with economic potential, including several in which Canadians were in a leading position.

There is, however, a limited receptor capacity for the products of neuroscience research in Canada. The network management has therefore spent a great deal of energy seeking to create a Neuroscience industry within Canada by bringing together its intellectual resources with venture capital and business and marketing skills. As a result of their efforts, the Royal Bank has committed itself to establishing a Neuroscience Fund, which is to total eventually $105 million (the Royal Bank has already contributed $30 million; MDS Ventures, $5 million) to support new ventures in this area in Canada. An initial venture has been formed with Allelix called Neuropharm Inc. Projects have been identified for the new company, a business plan is in the final stages of development and initial support will be sought from the fund. Similar additional ventures are in the planning stage. The Site Visit Committee thought this was an

innovative and bold initiative and, if successful, would represent a breakthrough and major achievement in this country, where risk capital has typically not been invested in knowledge-based industries. The Network has, however, also spun off some smaller enterprises - Transgénique, which produces transgenic animals for commercial purposes, and Aztech and Cedarlane Laboratories which market reagents. It has also incorporated a company, NeuroResearch Inc., to facilitate technology transfer and to enable it to deal more effectively with other corporate entities.

In terms of training activities, the Network has exceeded its initial objectives in terms of numbers. A directory of trainees has been prepared for distribution to industry to assist them in the identification of potential employees, an initiative that has since been copied by other Networks.

NEURAL REGENERATION NETWORK

Universities

Concordia University
Dalhousie University
McGill University
McMaster University
Queen's University
University of Alberta
University of British Columbia
University of Calgary
Université Laval
University of Manitoba
Université de Montréal
University of Ottawa
University of Saskatchewan
University of Toronto

Federal Government Departments & Other

Industries

Allelix
Aztech Associates
Biostar Inc.
Cedarlane Labs
MDS Health Group
Minimed Technologies
Neurodyne Canada
Neurospheres
Smith Kline Beecham
Transgénique

THE OCEAN PRODUCTION ENHANCEMENT NETWORK (OPEN)

Scientific Leader:	Dr. George Rose, DFO/Memorial U.
Network Manager:	Ms. Denise Cassidy
Chair, Board of Directors:	Dr. Robert Fournier, Dalhousie University
Number of Scientists/Engineers:	39
Number of Participating Institutions:	Eight universities, one government labs and three industries
Administrative Centre:	Dalhousie University
Award:	$23.0 million over four years
Start-up Date:	June 1990

RESEARCH: OPEN brings together fisheries biologists and oceanographers in an integrated research program. The initial focus of the program is on two species which are of great commercial value: the sea scallop and the Atlantic cod. Using these species as models, the scientists are investigating the processes which control the survival, growth, reproduction and distribution of fish and shellfish. The results of these investigations will be relevant to commercial fisheries. Other network scientists are developing new techniques in molecular genetics and new instrumentation for studying the oceans.

There are nine major project areas: larval scallops, juvenile scallops, adult scallops, cod/salmon recruitment, cod/salmon distribution, cod physiology, marine genetics, costal ocean dynamics, and marine technology-operational systems.

STATUS REPORT: The third year of operation of OPEN has been marked by significant progress and concrete achievements in many areas where networking efforts have clearly paid off. Here are some examples of these achievements:

- Joint efforts by ocean modellers and technologists within the Ocean Probe module and fisheries biologists of the Recruitment module have been crowned with success. For the first time it has become possible to sample continuously at sea the development of cod from egg to larvae within the same drifting water mass, thus allowing the examination of the temporal evolution of a given biological cohort and of the characteristics of the survivors.

- Experiments in the Dalhousie Aquatron laboratory suggest that temperature changes of less than 1C will influence cod oceanic distribution and affect the timing and extent of their migration.

- OPEN geneticists, using genomic cDNA clones, have established for the first time that contiguous populations of cod along the northeast coast of Newfoundland, and along the coast of Nova Scotia, are genetically different.

During this past year, Dr. Paul LeBlond resigned from his position as Scientific Leader so that he can devote some extra effort to his many other commitments, including his appointment to the Fisheries Resource Conservation Council. Dr. George Rose replaced him in September as Scientific Leader.

The Peer Review Committee, who did the 33-month review of OPEN last May, noted that the overall quality of science undertaken by OPEN is excellent. In its opinion, OPEN has stimulated the production of leading edge fundamental and long-term applied research of importance to Canada. The Committee was impressed by the fact that OPEN is developing world-class Canadian scientists trained to work in collaborative situations. A considerable fraction of the total OPEN funding has been committed to this. A total of 221 trainees (postdocs, graduate and undergraduate students, and technical staff) were part of the network in the past year.

Networking was considered effective between university and DFO scientists, and the Committee noted that highly profitable synergism has developed, unlikely to have arisen without the OPEN incentive. Particularly notable has been the networking between disciplines. However, in the Committee's opinion, networking with the private sector has not been extensive. This was considered partly because much of OPEN is directed towards management of the resource as a whole, precluding some kinds of contacts with individual parties in the private sector. The Committee recommended that development of university/industry partnerships should receive more attention in the future, particularly the communication with the private sector. It was noted that the main goals of OPEN are just starting to bear fruit, and thus consideration of a practical report series of publications is now opportune to attract the attention not only of the fishing and aquaculture industries, but also other sectors such as the oil and shipping industries.

While critical on few points, the Peer Review Committee was in general unanimously impressed by the breadth and quality of OPEN achievements.

THE OCEAN PRODUCTION ENHANCEMENT NETWORK (OPEN)

Universities	Federal Government Department & Other	Industries
Dalhousie University	Fisheries and Oceans (B.I.O. and N.W.A.F.C.)	National Sea Products
Laval University		Fishery Prod. Int. Ltd.
McGill University		Clearwater Fine Food Inc.
Memorial University		
Simon Fraser Univ.		
Univ. of British Columbia		
Université du Québec à Rimouski		
University of New Brunswick		

PROTEIN ENGINEERING NETWORK of CENTRES of EXCELLENCE (PENCE)

Scientific Leader:	Dr. Michael Smith
Network Manager:	Mr. Stephen Herst
Chair, Board of Directors:	Dr. Eric Geddes
Number of Scientists/Engineers:	41
Number of Participating Institutions:	4 universities; 8 industries; 2 government laboratories; 1 hospital
Number of Industrial Affiliates:	0
Administrative Centre:	University of British Columbia
Award:	$20,000,000 over 4 years
Start-up Date:	July 1, 1990

RESEARCH: Protein Engineering is directed at establishing the relationship between the molecular structure and the function of proteins by chemical and molecular biological synthesis of systematically modified proteins. As well as defining how the molecular structure of proteins determines their function as enzymes (catalysts), hormones and growth factors (extracellular messengers), receptors (on cell surfaces or as antibodies) or as structural molecules (in muscle and connective tissue), protein engineering has the potential to provide molecular insights into almost all aspects of biology. In the long term, it will lead to the design of new pharmaceuticals and of new proteins of potential industrial importance. As such, it provides an essential infrastructure to studies of bacterial and viral infection and of inherited defects. Improved proteins can be of enormous benefit in the treatment of infectious diseases. They can also be used in the food industry, and in a variety of industrial products including pulp and paper and in biomass conversion into fuels.

PENCE studies concentrate on developing new peptide hormones and vaccines, cell growth factors for the treatment of cancer and infectious diseases, improved diagnostic reagents, and enzymes that will be able to operate in the various conditions found in pulp and paper processes to reduce the amount of chlorine used. In addition to a program of fundamental studies on protein design, the network can setup collaborations for protein structure determination with scientists from other universities, research institutes and industries.

The five major research areas are:

- growth factors and receptors;
- new oxidation and reduction enzymes;
- enzymes that hydrolyze polysaccharides;
- proteases of disease, novel inhibitors with potential therapeutic value; and
- design of proteins, glycoproteins and peptide pharmaceuticals.

STATUS REPORT: The site visitors described PENCE science as "excellent" and "leading edge". Additional evidence of this, was the recent award of the 1993 Nobel Prize for Chemistry to its Scientific Director, Dr. Michael Smith.

The Network is clearly maturing as this year featured at least two instances of transfer of technology to industry partners - a pulp bleaching technology to PAPRICAN to be scaled up in several plants shortly, and the licensing of modified hemoglobin to Hemosol, a new start-up company in Toronto which will pursue a project to use modified hemoglobin as a carrier for drugs targetted for specific organs or tumours. In addition, a new collaborative research project was begun with Merck-Frosst, and a new

company, Glycan Inc., was spun off from the Network.

The number of trainees has now exceeded the original target and 8 of these have gone on to positions in industry. In addition, two young investigators were recruited back to Canada, largely on the basis of the facilities and opportunities available in the Network. These two investigators were known by members of the site visit committee to have received attractive offers from the US and Europe and the visitors were impressed that the Network was able to lure them back to Canada.

In its first year, PENCE had to adapt to changing priorities by its industrial partners, Connaught and PAPRICAN, and did so successfully. It is now faced with the shutdown of the Protein Structure Group at NRC and the Canadian research facilities of Syntex, both of which were integral to its research program. This is a major issue it will face for the renewal of the Network.

PROTEIN ENGINEERING NETWORK of CENTRES of EXCELLENCE (PENCE)

Universities	Federal Government Department & Other	Industries
McGill University	N.R.C. - Biotechnology Research Institute	Allelix Biopharmaceutical Inc.
University of Alberta	N.R.C. - Division of Biological Sciences	Connaught Laboratories Ltd.
University of British Columbia	Shriner's Hospital, Montreal	Gly Can Inc
University of Toronto		Hemosol Inc.
		Hypercube Inc.
		Merck-Frosst
		PAPRICAN
		Synthetic Peptides Inc.