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# *Evaluation of the Networks of Centres of Excellence Program*

## Evaluation report

Prepared for

The Interagency Evaluation Steering Committee
on behalf of the NCE Steering Committee
350 Albert Street
Ottawa, Ontario K1A 1H5

October 19, 2007

This evaluation study was conducted independently by R.A. Malatest and Associates Ltd. and Circum Network Inc. The contents of this report reflect the findings and conclusions of the evaluation study team, and not necessarily those of the Natural Sciences and Engineering Research Council of Canada, the Canadian Institutes of Health Research or the Social Sciences and Humanities Research Council of Canada.

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# *Executive summary*

The present evaluation study is the Networks of Centres of Excellence (NCE) Program's third in the past ten years. It is required as part of the renewal of the program's Terms and Conditions and it is conducted for the Interagency Evaluation Steering Committee on behalf of the NCE Steering Committee. It focuses on:

- ***Program rationale***: What is the niche of the NCE Program given the current national R&D funding environment? What specific needs are addressed by the program?;
- ***Program success***: To what extent have the expected outcomes of the NCE Program been realized? Specifically, with respect to collaboration/networking, partnerships, leading-edge research, research training, and transfer/exploitation of knowledge and technology; and
- ***Program design and cost-effectiveness***: Could similar outcomes/program impacts be achieved more cost-effectively with some other delivery mechanism? How effective is the structure of individual networks in meeting research and knowledge translation objectives?

### *The program*

The NCE Program was created in 1989 with a goal to "mobilize Canada's research talent in the academic, private and public sectors and apply it to the task of developing the economy and improving the quality of life of Canadians". The program connects groups of researchers across the country to collaborate on common research problems. The program is intended to "generat[e] practical applications from fundamental research programs, working in concert with industry".

The NCE Program invests in national research networks, with specific objectives to:

- stimulate internationally competitive, leading-edge fundamental and applied research in areas critical to Canadian economic and social development;
- develop and retain world-class researchers in areas essential to Canada's productivity and economic growth;
- create nation-wide multi-disciplinary and multisectoral research partnerships that integrate the research and development priorities of all participants; and
- accelerate the exchange of research results within the network and the use of this knowledge within Canada by organizations that can harness it for Canadian economic and social development.

The NCE Program logic is to bring together researchers and the receptor community into formal and informal partnerships; to incite researchers to tailor their action toward knowledge transfer; to motivate partners to contribute financially and otherwise to the development of knowledge and to addressing important shared issues; to demand that researchers focus their attention on concrete, nationally important problems; to increase multidisciplinary and intersectoral training of highly qualified personnel.

In 2006, there were 24 active NCE networks. In 2006-2007, $82.4M in NCE Program funding had been earmarked for networks; the flow-through, from each of the granting councils, is as follows for 2006-2007: NSERC contributes 50.6%; CIHR, 34.6%; and SSHRC, 14.8%. In 2004-2005, partners also contributed $66.6M.

***Evaluation schedule***

The Evaluation Planning Report was completed in May 2006. Its preparation involved representatives from NSERC, SSHRC, CIHR, the NCE Steering Committee, the NCE Management Committee, NCE selection committees, the NCE Program Secretariat, and Industry Canada. The contract to conduct the evaluation study was awarded in July 2006. The design of the study, including all questionnaires and guides, was completed in February 2007. Data collection took place between March and May 2007. Technical reports on the various components of the study were delivered in June and July. Consecutive drafts of the evaluation report were delivered starting in June 2007.

***Evaluation approach***

This evaluation study design is based on a balanced mixture of qualitative and comparative evidence from multiple sources. Both descriptive and comparative data were employed.

Qualitative evidence was collected in the context of eight case studies. Case studies were central to the evaluation methodology, in order to gain an in-depth knowledge of the nature and dynamic of the networks. The selection of case studies ensured coverage across the life span of a network and representation from networks with a focus on science and engineering, health and social sciences. A total of 54 key informant interviews were conducted in the development of the case studies. Eleven additional interviews were conducted with NCE Selection Committee members, granting agency representatives and Industry Canada.

Quantitative evidence was collected in surveys of 1,782 students, 3,183 researchers and 207 network partners. The evaluation design is strengthened by a comparison of relevant results obtained from researchers and students, some of whom were involved in the program and some who were not. Three categories of researchers were compared: (1) academic researchers funded by an NCE network (called Group 1); (2) academic researchers not funded by an NCE network but funded by another network-related program (Group 2); and (3) academic researchers not funded by a network-related program (Group 3). Three categories of students were also compared - the students of these three groups of researchers (also called, respectively, Groups 1, 2 and 3). Comparing data obtained from Groups 1 and 2 contributes to the demonstration of the impact of the NCE Program over and above that of other network-related granting council programs. Comparing information from Groups 2 and 3 parcels out the effects associated with the networking model itself, a model on which the NCE Program is based but which presents unique aspects under the NCE Program.

In addition, a cost-effectiveness analysis was conducted to assess the NCE model relative to alternatives. Alternative delivery models included network programs operated within the three granting councils, a national network program under an independent Secretariat, and the NCE-NI model where funding supports only networking efforts, not research. The cost-effectiveness analysis was based on existing documentation.

Notwithstanding the strength of the design and of the data collection, there were some limitations to the available data. Because of their idiosyncrasies, case studies are difficult to compare with one another. Some aspects of the measurement of research collaboration may have suffered from the differences in the reference group utilized. The absence of a unique researcher identifier made the matching of data from councils and the program difficult. Participation in the survey of partners was limited; this impaired the analysis of network structures. The program definition of a partner might differ from that of the organizations identified as such by the program. The absence of a list of students associated (or

not) with the program led to the use of snowball sampling, which cannot guarantee the representativity of the results.

All in all, because the evaluation design is strong and because there are multiple lines of evidence contributing to answering each evaluation issue, these limitations do not put into question the integrity of the evaluation findings. In the view of the evaluation team, the results are valid and reliable. Where the evidence is limited in some way, the report notes that fact and weighs the value of the findings.

***Findings: program continuation***

The evaluation supports the rationale for the continuation of the NCE Program.

The NCE Program assembles at least three characteristics that other granting council programs do not share or bring together to the same degree: the multi-disciplinary nature of networks, the strong emphasis placed on the training of highly qualified personnel in a multi disciplinary, multi-sectoral, networked environment, and the objective of solving real-world problems via research and knowledge transfer.

Moreover, the NCE Program distinguishes itself with a long-term funding commitment, a clearly national scope woven right into its fundamental network requirements and an emphasis on multidisciplinarity that cuts across the granting councils' mandates.

Informed stakeholders consider that the NCE Program ranks among the top vehicles of S&T commercialization and translation support for Canadian research and technological application.

While many of the positive outcomes of the NCE Program are shared with other network-related programs, it performs better than these programs in some key areas, such as the creation of structured networks, the establishment of intersectoral partnerships, and knowledge utilization — in particular, the commercialization of research findings. Clearly, there is an undisputed place for the NCE Program.

In addition, the Government of Canada's newly released S&T strategy has recently given the program a central role.

*Recommendation 1: since it occupies a unique position in addressing issues that are important to Canada in an integrated manner and in supporting knowledge transfer, maintain the NCE Program.*

***Findings: program funding***

The NCE Program has been able to achieve significant results with existing resources. In general, stakeholders have not criticized the level of funding provided to individual networks, although it is obvious to everyone that more could be done with more resources. This evaluation is not in a position to recommend adding to or subtracting from the current program funding. It can only conclude that the program produces significant incremental benefits to Canada and Canadians, and that it is managed in a cost-effective and efficient manner.

***Findings: excellence in research***

This evaluation did not attempt to gather new evidence concerning the excellence achieved by NCE networks in research. The reason for this is that the characterization of the level of excellence of the research is a complex endeavor that was beyond the resources of this evaluation. At the evaluation planning stage, it was felt that the expert panels who review submissions for new networks and for network renewals, and panels which perform mid-term reviews are in a better position to pass judgment on this issue. Nonetheless, experts interviewed as part of this evaluation held the research performed by NCE networks studied here in high regard.

Also, the evaluation found that the proportion of NCE researchers who belong to the Thompson Scientific Citation Database list of highly cited researchers is four times higher than the proportion of all Canadian researchers on the list (i.e., 1.5% versus 0.4%).

The evaluation describes how, over their life, networks are subjected to reviews on up to 10 different instances (four times by an expert panel, four times by the Steering Committee and twice by the Selection Committee). In our view, this is the strongest possible mechanism to ensure that networks are focused on excellence in research and deliver on their promises.

Between 2001 and 2006, expert panels have included a healthy 64% of non-Canadian members, thereby contributing to the independence and the rigor of the assessments and ensuring international benchmarking. In addition, 32% of selection committee members were non-Canadians.

### *Findings: HQP training*

The NCE Program offers more opportunities to students with regard to publications and conferences, ethical debates and exposure to real-life practices. Participation in the NCE Program also leads to a better fit between the field of study and employment.

According to researcher input, more recently formed NCE networks offer more frequent access to multi-disciplinary initiatives and ethical debates about research, but less exposure to real-life practices than older NCE networks. Access to multi-disciplinary initiatives is somewhat easier in health sciences than in natural sciences and engineering or in social sciences and humanities; access to ethical debates is easier in health sciences and in social sciences and humanities than in natural sciences and engineering.

All in all, the training objective of the NCE Program seems to have been achieved only in part. Within the HQP training aspect of the program, the emphasis on multi-disciplinarity is of particular concern considering the importance that this feature has in the logic of the program.

*Recommendation 2: the program should restate the importance of the HQP training objective and request that networks develop additional strategies designed specifically to bolster the multi-disciplinary and multi-sectoral components of HQP training.*

### *Findings: research collaboration and partnerships*

The NCE Program has been more successful than other network-related programs at facilitating the creation of formal structures: its networks have more organized strategies and tasks as well as stronger leadership and decision-making processes. At the individual level, the findings show that the NCE Program increases the likelihood of collaboration as well as the size of collaborative networks; however, it does not replace NCE researchers' closest research group in terms of the intensity of collaborations — nor does the program expect them to.

NCE networks have been successful at bringing together researchers, public sector and private sector representatives, and NGOs to contribute to the definition of key knowledge issues, the execution of research and the translation of research findings into actionable results. Partnership results are most evident where prior relationships existed among some partners

and in sectors where the NCE network can build on existing clusters of interests.

Globally, NCE networks have shown more collaboration results than application results. By design, the NCE model sees networking as a predecessor to application: through networking, the most productive avenues of research are identified; networking also contributes to the dissemination of knowledge stemming from the research. There is a risk with the NCE model that networking could become an end rather than a means. Restating the role of networking as a conduit to knowledge and then application is crucial.

The new policy directions outlined in *Mobilizing Science and Technology to Canada's Advantage*, the most recent S&T policy statement of the Government of Canada, and the new initiatives it contains (business-led research networks, Centres of Excellence in Commercialization and Research, tri-council private sector advisory board for the granting councils) should revive NCE results in terms of knowledge-transfer activities and knowledge utilization. More generally, and in order to impact on existing networks, the program should revisit its performance measurement scheme to emphasize the importance of knowledge transfer efforts by networks and knowledge utilization by the receptor community.

*Recommendation 3: revise performance measurement schemes to emphasize knowledge transfer and knowledge utilization as end results and networking as a means to that end.*

***Findings: knowledge and technology exchange and exploitation***

Networking and collaboration programs double the amount of knowledge transfer activities and increase significantly knowledge utilization according to researchers. This finding is true for NCEs as well as other network programs. When compared to the average government agency, there was vastly more research finding utilization among NCE public sector partners in 2006 than in the average government agency. Although the comparison is somewhat limited by the date of the study (the only available data on public sector use was collected in 1998[1]), the results suggest very good performance by the NCE Program in this regard. Network-related programs are particularly adept at affecting the creation of policies, standards and regulations, the modification of behavior and attitudes of target groups,

[1] Landry, Réjean, Mokar Lamari and Nabil Amara (2003) "The Extent and Determinants of the Utilization of University Research in Government Agencies" in *Public Administration Review*, vol. 63, no. 2, March/April 2003, pp. 192-205.

and improving the quality of life of Canadians. Areas where the NCE Program performs better than other network- and collaboration-related programs cluster around the commercialization of research results: patents and licenses, the formation of new companies and the improvement of the health of existing ones, and the creation of new products, services and processes.

These results are clearly positive for the NCE Program. However, while the NCE Program performs better than other networks-related programs in areas where commercialization is a possible outcome, where the expected outcomes are not related to commercialization — such as public policy, regulations, and changes to practices — this evaluation indicates that the NCE Program does not provide more benefits than other networks-related programs.

One possible reason for this is that the NCE Program was originally conceived and deployed with commercialization as a key intermediate purpose and as a vehicle toward improvements for Canada and Canadians. In some of the issue areas more recently tackled by NCE networks, this building principle does not apply as well (e.g., literacy, care of the elderly, stroke). While the program has made efforts to adapt to this reality, more needs to be done to allow all networks to burgeon to their full potential.

The performance measurement demanded of networks is an important program lever to steer networks toward the expected outcomes. It could be used to better demonstrate the value added of NCE networks in areas other than the traditional commercialization. It could also be used to improve HQP-related results, in particular those that relate to defining characteristics of the NCE networks: multi-disciplinarity, ethical issues, exposure to real-life experiences.

More generally, the performance measurement scheme should be revisited. The current system of performance measurement has the advantage of providing standardized metrics, which can be totaled and compared; however, it reaches this result at the expense of sensitivity to the particularities of each network. One side effect of this is that some networks may be left with few performance indicators relevant to them.

Networks deal with varied subject matters, using diverse strategies and a range of network compositions. The one thing that ties them all together is the NCE Program logic model (see page 8): all networks use networking, leading-edge research, nation-wide, multi-disciplinary and multi-sectoral research partnerships, as well as training strategies, to achieve accelerated exchanges with the receptor community and use of knowledge, the development of world-class researchers, the creation of functional

multi-regional interdisciplinary research teams and the development of a pool of highly qualified personnel. We recommend that the program adopts these eight outcomes as the reporting structure for each network and that each network be requested to produce its own list of custom indicators of performance within these categories. This may mean that such traditional metrics as patent applications would become much less important if networks elected to measure their performance via other means of knowledge transfer.

*Recommendation 4: rethink the performance reporting system around the program logic model so that each network can customize their performance indicators while respecting the overall program logic.*

***Findings: program management***

This evaluation did not collect enough evidence to comment on the relative pertinence of the NCE-NI (New Initiative) model as opposed to the traditional NCE funding structure. More work is already under way to assess the NCE-NI experience.

The capacity of networks to maintain themselves past the 14-year funding period is no longer part of the program expectations. Nonetheless, sustainability was presented as a challenge at the forefront of some key informant thoughts during interviews conducted for this evaluation. Logically, in order to achieve the ultimate program objectives, it would be expected that the research momentum is kept and that knowledge on the issue of interest of each network continues to accumulate.

Information gathered in this evaluation suggests that the rigidity of the 14-year funding period is an impediment to overall program performance. Meanwhile, there was no consensus regarding the appropriate duration of funding — suggesting that a one-size-fits-all approach to the duration of funding is not appropriate. Since the NCE Program possesses well-structured and well-functioning peer-review mechanisms, it would be possible to tailor the duration of funding to the specifics of each network.

*Recommendation 5: adapt the duration of the funding period to the particulars of each network, based on the level and excellence of research output, the level of application of the knowledge by the receptor community and the remaining salience of the issue that triggered the creation of the network.*

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# Abbreviations

BSE . . . . . Bovine spongiform encephalopathy
CBDN . . . . . Canadian Bacterial Diseases Network
CDRN . . . . . Canadian Design Research Network
CGDN . . . . . Canadian Genetic Diseases Network
CIHR . . . . . Canadian Institutes of Health Research
CLLRNet . . . . . Canadian Language and Literacy Network
CSN . . . . . Canadian Stroke Network
CSS . . . . . Canadian Stroke Strategy
EDGE . . . . . Emerging Dynamic Global Economies Network
FRP . . . . . Fiber reinforced polymers
HQP . . . . . Highly qualified personnel
HSFC . . . . . Heart and Stroke Foundation of Canada
ICR . . . . . Institute of Cancer Research
IHDCYH . . . . . Institute of Human Development, Child & Youth Health
IHSPR . . . . . Institute of Health Services and Policy Research
IIFC . International Institute for Fiber Reinforced Polymers in Construction
INMD . . . . . Institute of Nutrition, Metabolism and Diabetes
IP . . . . . Intellectual property
IRIS . . . . . Institute for Robotics and Intelligent Systems
IRAP . . . . . Industrial Research Assistance Program
ISHMII . . . . . International Society for Structural Health Monitoring and Intelligent Infrastructure
ISI . . . . . Institute of Scientific Information
ISIS . . . . . Intelligent Sensing for Innovative Structures
KTEE . . . . . Knowledge and Technology Exchange and Exploitation
MOU . . . . . Memorandum of Understanding
MWPN . . . . . Mechanical Wood Pulps Network
NCE . . . . . Networks of Centres of Excellence
NRC . . . . . National Research Council
NGO . . . . . Non-governmental organization
NSERC . . . . . Natural Sciences and Engineering Research Council

PAPIER . . . . . Pulp and Paper Network for Innovation in Education and Research
PAPTAC . . . . . Pulp and Paper Technical Association of Canada
PAPRICAN . . . . . Pulp and Paper Research Institute of Canada
R&D . . . . . Research and development
RCSN . . . . . Registry of the Canadian Stroke Network
RMC . . . . . Research Management Committee
RMF . . . . . Research Management Fund
S&T . . . . . Science and technology
SFM . . . . . Sustainable Forest Management Network
SHM . . . . . Structural health monitoring
SPIN . . . . . Summer Program in Neuroscience
SSHRC . . . . . Social Sciences and Humanities Research Council
TSE . . . . . Transmissible spongiform encephalopathies

# Chapter 1

# INTRODUCTION

The present evaluation study is the Networks of Centres of Excellence (NCE) Program's third in the past ten years. In preparing for the renewal of its Terms and Conditions, the program Directorate has identified a number of informational requirements that were not fulfilled through these earlier studies and warrant the present evaluation. In addition to meeting these informational needs, this evaluation also provides an opportunity to revisit some of the questions posed during the previous evaluation.

The mandate given to the evaluation team was "to address the evaluation issues and questions presented in the Evaluation Planning Report." (*Terms of Reference for the Evaluation of The Networks of Centres of Excellence Program*). These issues and questions are presented in the chapter dealing with the evaluation approach.

The Evaluation Planning Report was completed in May 2006. Its preparation involved representatives from NSERC, SSHRC, CIHR, the NCE Steering Committee, the NCE Management Committee, NCE selection committees, the NCE Program Secretariat, and Industry Canada. The contract to conduct the evaluation study was awarded in July 2006. The design of the study, including all questionnaires and guides, was completed in February 2007. Data collection took place between March

and May 2007. Technical reports on the various components of the study were delivered in June and July. Consecutive drafts of the evaluation report were delivered starting in June 2007.

Many individuals and organizations contributed to this evaluation — a diversity that is, in fact, representative of the complexity of the environment of the NCE Program. Researchers, partners, students and program managers, from universities, private companies, government and not-for-profit organizations invested time and effort to input into this evaluation via interviews, questionnaires, documents, etc..

This document is structured as follows. Chapter 2 presents a description of the program, including a brief overview of program activities, outputs and outcomes. Chapter 3 of this report describes the evaluation issues and the study approach and methodology. Chapters 4 to 6 deal with the study issues: program success, program cost-effectiveness and program rationale. Chapter 7 concludes the study with overall findings and recommendations.

# Chapter 2

# PROGRAM DESCRIPTION

***Program objectives***. The NCE Program was created in 1989 with a goal to "mobilize Canada's research talent in the academic, private and public sectors and apply it to the task of developing the economy and improving the quality of life of Canadians".[1] The program connects groups of researchers across the country to collaborate on common research problems. The program is intended to "generat[e] practical applications from fundamental research programs, working in concert with industry".[2]

The NCE Program invests in national research networks, with specific objectives to:

- stimulate internationally competitive, leading-edge fundamental and applied research in areas critical to Canadian economic and social development;
- develop and retain world-class researchers in areas essential to Canada's productivity and economic growth;

1 *NCE Program Guide*, Updated March 2003.

2 http://www.nce.gc.ca/pubs/reports/2021/eval/eval-1a_e.htm#1

- create nation-wide multi-disciplinary and multi-sectoral research partnerships that integrate the research and development priorities of all participants; and
- accelerate the exchange of research results within the network and the use of this knowledge within Canada by organizations that can harness it for Canadian economic and social development.

***Program theory***. The NCE Program is a major federal investment in the area of research and development (R&D), innovation, training and knowledge transfer. A literature review presented in Therrien (2006, 2) identifies three roles and benefits from government involvement in R&D activities: (1) contribution to the generation of knowledge; (2) training of highly skilled workers and researchers to support firms, public laboratories and universities; and, (3) facilitation of the transfer of knowledge and commercialization to generate spill-over to the entire economy. The NCE Program acts in all three areas.

Professor Landry of Université Laval and his associates have published several articles on the dynamic of knowledge utilization (Landry et al, 2001a, 2001b, 2002, 2003, 2006a, 2006b), which, arguably, corresponds to only one objective of the program but a key one in terms of outcomes and
in terms of the specificity of the NCE Program within a constellation of government programs. Although the factors impacting on the level of knowledge utilization vary according to the discipline and the receptor community, the following were found to be key success levers:

- the level of receptivity of the user community to the research and the intensity of users' acquisition efforts;
- the efforts expanded by researchers in the dissemination of their results;
- the adaptation of research products for users — ultimately, supply of idiosyncratic knowledge for a few users;
- the intensity of the linkages established between researchers and users;
- the importance of the research funding from private firms and government agencies; and,
- the focus of research projects on users' needs (the effect of this factor varied according to the field of study).

The authors conclude that the best model to represent the dynamics of knowledge utilization is the "interaction model".[1] In this model, research utilization is seen as a consequence of relationships established between researchers and users at various stages of knowledge production, dissemination and utilization. The model explains utilization by four families of factors: types of research and scientific disciplines, needs and organizational interests of users, dissemination and linkage mechanisms. They conclude that "knowledge utilization depends much more heavily on factors related to the behavior of the researchers and users' context than on the attributes of the research products" (Landry, 2001b, 347).

The NCE Program action is clearly in sync with these results. It brings together researchers and the receptor community into formal and informal partnerships; it incites researchers to tailor their action toward knowledge transfer; it motivates partners to contribute financially and otherwise to the development of knowledge and to addressing important shared issues; it demands that researchers focus their attention on concrete, nationally important problems.

***Factual overview***. In the 2004-2005 fiscal year, there were 21 NCE networks operating in Canada. These involved diverse fields working on a vast array of social and economic issues. There were five new networks formed in 2006 (NCE New Initiatives), 19 established networks with provisions to run at least until 2006, and 16 previously funded networks creating a total of 40 networks running since the start of the program.[2] The NCE Program also includes partnerships with more than 75 Canadian universities, over 250 government departments, more than 800 companies, and almost 400 other organizations.

Since 2005-2006, $82.4M in NCE Program funding has been earmarked for networks annually, plus an average of $66.6M in partners' contributions. In 2004-2005, the total resources available amounted to $149M.

1 As opposed to the science push model, the science pull model, and the dissemination model.

2 http://www.nce.gc.ca/nets_e.htm

The NCE Program is part of the Government of Canada's science and technology strategy to create better links between research and the creation of prosperity. The program is jointly administered by the Natural Sciences and Engineering Research Council (NSERC), the Canadian Institutes of Health Research (CIHR), and the Social Sciences and Humanities Research Council (SSHRC), in partnership with Industry Canada. The *Evaluation Planning Report* (pages 8 and 9) describes key stakeholders others than federal institutions as follows.

> Canadian universities themselves, as well as affiliated hospitals and research institutes, and some industry consortia, also invest significant resources for the development and maintenance of the Networks and, as such, are key players in delivering the NCE program.
>
> Primary targets are the individuals and organizations that the deliverers (the four funding partners) aim in order to mobilize to achieve the expected results. University faculty and students, as well as public and private sector partners, play a significant role in achieving these results. Organizations eligible to receive funds are universities, affiliated hospitals and research institutes, and post-secondary institutions having a research mandate. Researchers and organizations that receive NCE funds must meet the general eligibility requirements of one of the three federal granting agencies partnering in the program.
>
> Industries and organizations within the areas covered by NCE networks are important stakeholders that benefit from the research results generated by the networks and from hiring trained network graduates. In many instances, they are closely involved in commercializing new products, services or processes or in adopting new practices and policies, linked to NCE research. Globally, the NCE program also bears the potential for impact on the development of entirely new industrial sectors in Canada. Parliament is another stakeholder given the significant role played by the NCE program within the federal science and technology strategy as well as within the various activities of the Industry Canada portfolio. The Canadian public can also be considered as a stakeholder since the results are already known to have important impacts on the economy and on the quality of life of Canadians. Moreover, at the international level, many research results of the Program have impacted on the development of international standards,

policies and regulations, thus affecting individuals and organizations outside Canada. Other network stakeholders include collaborators, consultants, clients, suppliers, various levels of government and the written and electronic media that closely monitor the NCE program.

Exhibit 2.1 presents the program logic model for the NCE Program. The logic model illustrates the program's main activities, outputs, and intended outcomes and how these are logically linked. Individual elements of the program model are discussed in detail in the sections following the presentation of this model.

***Inputs***. Funding is given in seven-year cycles and networks may be given up to two cycles (up to 14 years except under the NCE-NI, where the limit is four years) of funding. Expenditures for various program years are presented in Exhibit 2.2 below. In recent years, the expenditures have reached $80 million annually. The flow-through, from each of the granting councils, is as follows for 2005-2006 and for 2006-2007: NSERC contributes 50.6%; CIHR, 34.6%; and SSHRC, 14.8%.

EXHIBIT 2.1 • Networks of Centres of Excellence Program Logic Model

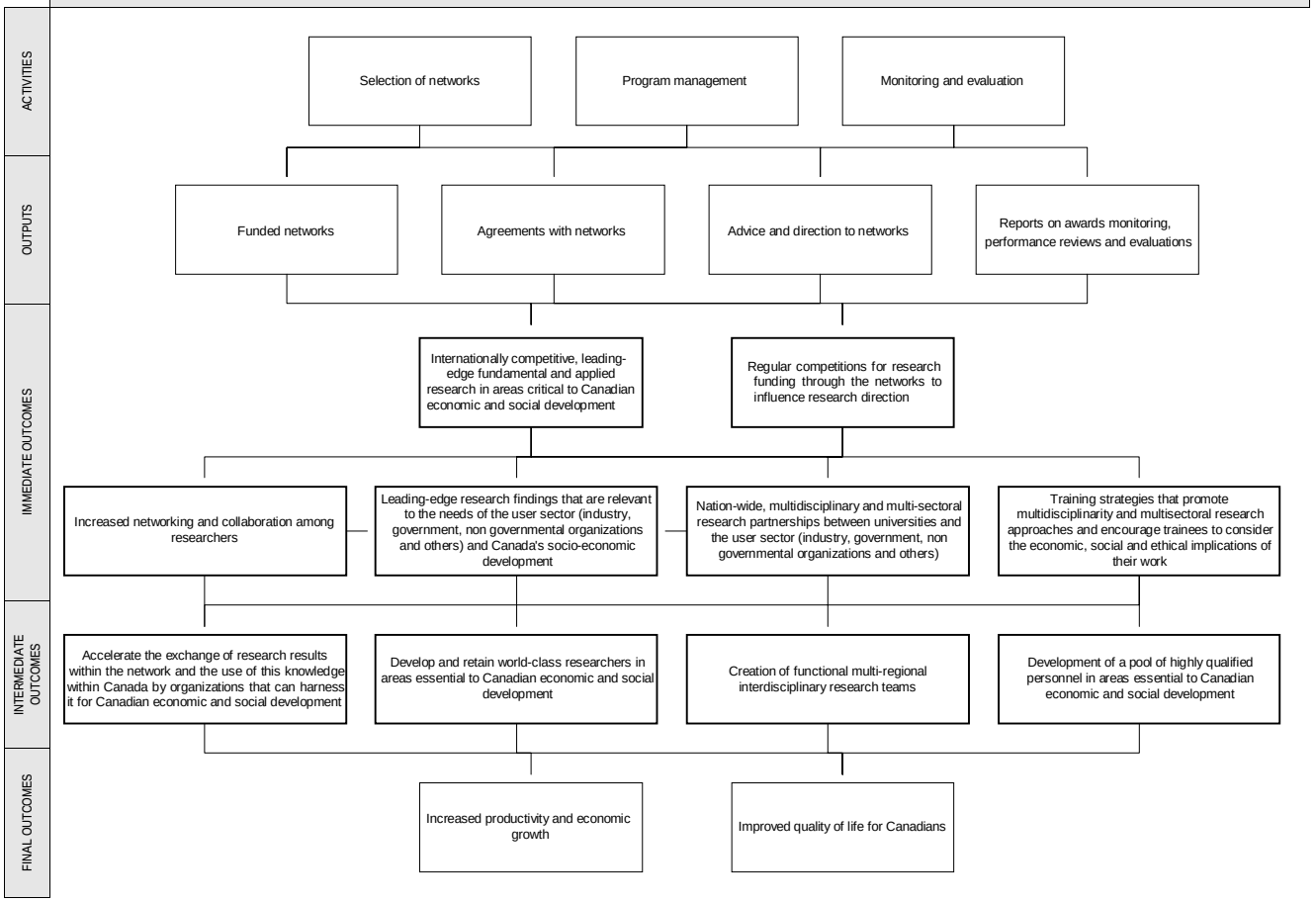
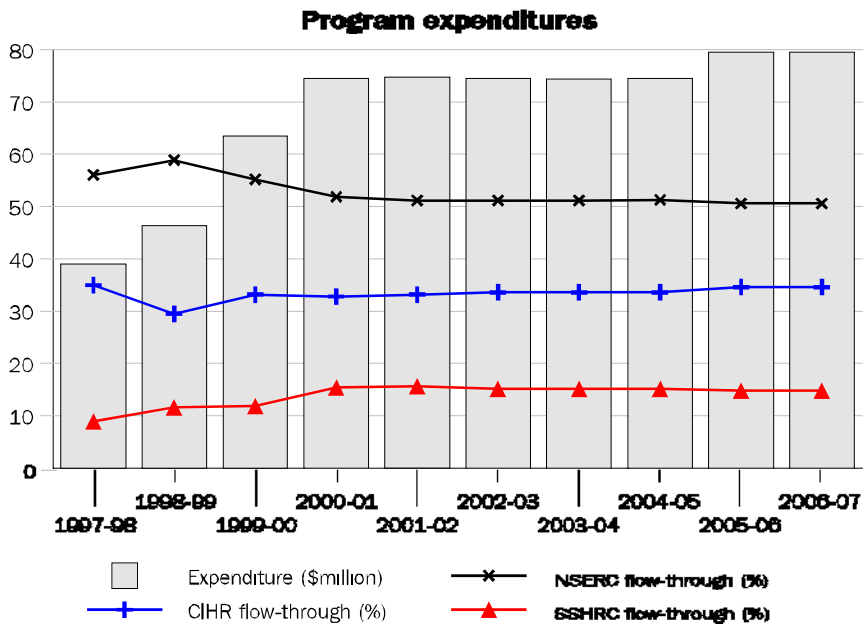


**EXHIBIT 2.2**




In addition to the budget allocation presented in Exhibit 2.2, a further $5M was provided for the 2004 BSE-TSE competition. According to the 2005-2006 NCE Annual Report (page 16), $70M was provided in this fiscal period from outside investments, of which $27M was from private sector companies (a 22% increase in partnership funding over 2003-2004). Including partner matching, a total of nearly $150M in network funding was provided to NCEs in the 2005-2006 fiscal period.

The 2005-2006 Annual Report also indicates that "the NCE Program's 1,663 researchers and 4,467 highly qualified personnel [were] involved in research relationships with 926 companies, 350 provincial and federal government departments and agencies, 64 hospitals, 202 universities, and 628 other organizations from Canada and world-wide."

The 2007 Budget[1] included new initiatives under the NCE umbrella.

1 *The Budget Plan 2007: Aspire to a Stronger, Safer, Better Canada*, March 19, 2007, http://www.budget.gc.ca/2007/pdf/bp2007e.pdf

> *Advantage Canada* committed to help strengthen the links between universities, colleges and the private sector through mechanisms such as business-led Networks of Centres of Excellence (NCE) in order to enhance the commercialization of Canadian ideas and knowledge. Through competitive awards, the NCE program fosters research partnerships between research institutions, government and industry. To ensure that new networks truly meet the needs of businesses, the NCE program will establish a private sector advisory board. Budget 2007 also dedicates $11 million in 2008–2009 to accelerate the creation of new networks, to be proposed and led by the private sector. The funding is expected to support up to five new networks, beginning in 2008–2009. (Budget 2007, page 205.)
>
> Budget 2007 provides $4.5 million over two years to the Networks of Centres of Excellence program to establish a new Industrial R&D Internship program. Modeled after the highly successful internship program developed by the Mathematics of Information Technology and Complex Systems (MITACS), an existing network, this initiative will partner graduate students and post-doctoral candidates with businesses to undertake applied research aimed at meeting the innovation needs of the host firm. By participating in these one-semester internships, businesses will benefit from the knowledge and skills brought by students, while interns will acquire hands-on research experience and greater exposure to research challenges and opportunities in the private sector. When fully in place, the new program will support up to 1,000 internships each year. (Budget 2007, page 205.)
>
> Centres of Excellence in Commercialization and Research . [...] This program will complement the research and science infrastructure funding available through the granting councils and the Canada Foundation for Innovation. Budget 2007 provides $195 million over the next two years to support competitions under this new program. (Budget 2007, pages 199-200.)

According to the program guide, organizations eligible to receive funds are "universities, affiliated hospitals and research institutes, and post-secondary institutions having a research mandate. Researchers and organizations that receive NCE funds must meet the general eligibility requirements of one of the three federal granting agencies partnering in

the program. An industry consortium may receive funds to administer a network."

***Activities***. The program comprises three activities: the selection of networks, program management, and monitoring and evaluation.

Five criteria are used to assess whether an NCE application will be funded:

- the excellence of the research program;
- development of highly qualified personnel (HQP);
- networking and partnerships;
- knowledge / technology exchange and exploitation (KTEE); and,
- management of the network.

Competitions are held regularly for renewal of existing networks and for new networks to be funded. Funding decisions are made based on a peer review process using expert panels and selection committees.

The second activity of the program is management of the research and network activities. The NCE Directorate is responsible for management of the NCE Program, with administrative support from NSERC. At the network level, management is provided by a Scientific Leader and a Network Manager, a Research Management Committee, a Board of Directors, or other committees depending on the network.

Monitoring and evaluation activities occur in the form of annual statistical and financial tables, annual corporate reports, mid-term review reports, and progress reports for renewal applications. The mid-term reviews are required for each network and are conducted at the midpoint of the funding cycle. The process involves a report produced by the network, which is followed by an evaluation panel that makes a recommendation to the NCE Selection Committee. The NCE Directorate compiles and analyzes statistics annually and reports to the NCE Management Committee on various trends. The NCE Management Committee may then make recommendations to improve or adjust the program, if necessary. Finally, evaluations are conducted every five years to determine if any changes are needed to the program, and to assess program performance.

***Outputs***. The activities described in the NCE logic model give rise to four main outputs – funded networks, agreements with networks, advice and direction to networks, and reports on awards monitoring, performance reviews and evaluations.

Network funding is administered through the NCE Directorate and payment of grants is authorized by the Steering Committee. Further payments are approved on an annual basis and are subject to satisfactory progress, compliance with policies and the availability of funds. Eligible and ineligible expenses are available on the program Web site.

Agreements with networks are an output of the NCE Program, which precede funding. Funding agreements are signed by representatives of at least one of the granting agencies involved in the program, the designated representative of the host institution and the network's Scientific Director. These agreements define the terms and conditions for funding under the NCE Program, as well as the governance structure of the network. In addition to funding agreements, Network Agreements are signed by participating institutions that receive NCE funds. The Network Agreements set out the operating rules of the network, and define the rights and obligations of investigators and participating institutions.

Existing networks are active in a wide spectrum of fields including, but not limited to, obesity, care of the elderly, allergies, literacy, photonics, geomatics, forestry, stroke, genetic diseases, and microelectronics (more details in Exhibit 3.3).

Advice and direction is given to networks through the NCE Directorate, concerning the networks' development and on-going activities. Staff within the directorate assists in solving technical, administrative or financial issues. The directorate may also provide advice or aid networks with adherence to or understanding of NCE guidelines and program requirements, as well as procedures for negotiating Internal Agreements.

Finally, reporting and review includes several components. Networks submit annual statistical and financial tables. Mid-term reviews are also implemented, which form a basis for decisions for continued funding. Finally, networks submit annual corporate reports, which may involve

statistical tables, financial statements or statements of funding, corporate reports, or reports on administrative activities, including conflicts of interest and environmental appraisal.

***Immediate outcomes***. The NCE Program has six intended immediate outcomes. These are specifically:

- Regular competitions for research funding within networks to influence research direction. The program Web site outlines five separate competitions that have occurred since 2003, which have focused on specific issues to provide this research direction.[1]

- Internationally competitive, leading-edge fundamental and applied research in areas critical to Canadian economic and social development and Canadians' quality of life. According to the NCE Programs Terms and Conditions (2005), the excellence, focus and coherence of the research program is a central concern in assessing applications.

According to the program logic model, the production of competitions and leading-edge research results in the following subsequent outputs:

- Increased networking and collaboration among researchers, including multi-disciplinary collaboration. According to the Evaluation Planning Report (2006), research is to be carried out in a way that involves a high degree of networking and collaboration among researchers.

- Leading-edge research findings relevant to the needs of industry, the health sector, government and non-governmental organizations and Canada's socio-economic and social development, as well as Canadians' quality of life. Research is intended to strengthen the Canadian industrial base, enhance productivity, and contribute to long-term economic growth, health benefits and social benefits. As well, network research is intended to aid in the implementation of effective public policy.

[1] http://www.nce.gc.ca/comp_e.htm

- Nation-wide, multidisciplinary and multisectoral research partnerships between universities, industry, the health sector, government and non-governmental organizations. The program is designed to create nation-wide multi-sectoral research partnerships that integrate the research and development priorities of all participants. The intention of the partnerships is to accelerate the exchange of research results within the network and the use of this knowledge within Canada by organizations that can harness research for Canadian economic and social development and Canadians' quality of life.

- High-quality, multi-disciplinary and multi-sectoral research training. Participation in networks is expected to benefit students and other HQP through access to network scientists, collaborative activities supported by networks, and activity participation in knowledge transfer in conjunction with partners.

***Intermediate outcomes***. Multi-disciplinary collaboration and networking, leading-edge research, multi-sectoral partnerships and advanced research training contribute to the production of the program intermediate outcomes: the rapid exchange of research results within the network, the transfer and exploitation of findings and research knowledge by industry, the health sector, government, non-governmental organizations and other user sectors, the development and retention of world-class researchers,
the creation of multi-regional interdisciplinary research teams and the development of highly qualified personnel.

While the ties between the immediate outcomes and the intermediate outcomes involve more than simple one-on-one relationships, it is possible to simplify the logic of the program in the following manner:

- improved collaboration among researchers leads to the rapid exchange of research results and to the solidification of multi-regional research teams;
- multi-sectoral partnerships contribute to the transfer and translation of knowledge from researchers to the receptor communities;
- facilitation of leading-edge research;
- participation in the attraction and retention of world-class researchers;

- planned research training strategies support the development of highly qualified personnel.

***Final outcomes***. There are two long-term goals of the program. These are increased productivity and economic growth, and improved quality of life for Canadians. They flow logically from the contributions that leading-edge multi-disciplinary research teams make to solving real-life industrial, social and public policy problems, and from the facilitation of knowledge transfer that strong, tight partnerships produce.

Both of the goals outlined above are consistent with the federal Science and Technology strategy, which has set out to accomplish three outcomes. As outlined in program goals, these are "Sustainable job creation and economic growth, improved quality of life, and advancement of knowledge".[1] Issued in May 2007, the new S&T strategy clearly supports the NCE goals.[2]

1 *NCE Program Guide*, Updated March 2003.

2 *Advantage Canada: An Economic Plan to Eliminate Canada's Net Debt and Further Reduce Taxes*, <http://www.fin.gc.ca/news06/06-069e.html> and particularly chapter 4, "Investing for Sustainable Growth," <http://www.fin.gc.ca/ec2006/plan/plc4e.html>:
"Policy Commitment. Canada's New Government will support research excellence and help to better align Canada's post-secondary research capacity with the needs of businesses by: • Targeting new investments in R&D, including those through the granting councils, to areas where Canada has the potential to be a world leader, such as energy, environmental technologies and health sciences; • Introducing competitive funding, potentially via the Canada Foundation for Innovation, that levers investment by the private sector and other levels of government in large-scale, national scientific projects and commercialization partnerships. • Strengthening the links between universities, colleges and the private sector through mechanisms such as business-led Networks of Centres of Excellence to enhance the commercialization of Canadian ideas and knowledge."

# Chapter 3

# EVALUATION APPROACH

This chapter explains the evaluation approach and methodology. The evaluation study is based on a combination of qualitative evidence gathered from case studies, documentation and key informant interviews and quantitative information in the form of survey research and a cost-effectiveness analysis.

## 3.1 Evaluation issues

The issues and questions for the present evaluation were identified during an evaluation planning process, which resulted in the *Networks of Centres of Excellence Program Evaluation Planning Report* of May 17, 2006. The objective of the present evaluation is to answer the following questions, identified through the evaluation planning process:

***Rationale***

1. What is the niche of the NCE Program given the current national R&D funding environment? What specific needs are addressed by the program?

***Program success***

2. To what extent have the expected outcomes of the NCE Program been realized? Specifically, with respect to:
   - Collaboration/networking
   - Partnerships
   - Leading-edge research
   - Research training
   - Transfer/exploitation of knowledge and technology

***Program cost-effectiveness and design issues***

3. Could similar outcomes/program impacts be achieved more cost-effectively with some other delivery mechanism?

4. How effective is the structure of individual networks in meeting research and knowledge translation objectives?

Exhibit 3.1 describes how each evaluation method documented in the rest of this chapter contributes to each evaluation issue.

**EXHIBIT 3.1**
**Links between evaluation issues and evaluation methods**

| Issue | Case studies | Network analysis | Document review | Key informants | Survey of researchers | Survey of students | Cost-effective-ness analysis |
|---|---|---|---|---|---|---|---|
| Rationale | | | Y | Y | Y | | |
| Collaboration | Y | | Y | | Y | | |
| Partnerships | Y | Y | Y | | | | |
| Leading-edge research | Y | | Y | | Y | | |
| Research training | Y | | Y | | Y | Y | |
| Knowledge transfer | Y | Y | Y | | Y | | |
| Cost-effectiveness | | | Y | | | | Y |
| Structures | Y | Y | Y | Y | | | |

## 3.2 Evaluation design

This evaluation study design is based on a balanced mixture of qualitative and comparative evidence from multiple sources. Both descriptive and comparative data were employed.

### *Descriptive data*

Descriptive data were assembled using case studies, existing documentation, administrative data bases, key informant interviews and a survey of NCE network partners. Using these descriptive data, we can develop profiles (for example, the documentation of network activities) and we can report perceptions of program impacts and effects. As is often the case in program evaluation, descriptive data offer rich contextual information but limited definitive evidence of program effects.

### *Comparative data*

Program impacts and effects are more convincingly demonstrated using comparative data. This evaluation study benefits from the comparison of responses from three categories of researchers: (1) academic researchers funded by an NCE network (called Group 1), (2) academic researchers not funded by an NCE network but funded by another network-related program (Group 2), and (3) academic researchers not funded by a network-related program (Group 3). As shown in Exhibit 3.2, the average funding received from granting councils by each group of researchers between 2003 and 2005, while not equal, was roughly similar — making their research budgets relatively equivalent. This equivalence in resources available for research is important, since the difference in research wealth cannot be used to explain differences in activities and outcomes that may be found among groups.

**EXHIBIT 3.2**
**Description of the three groups of researchers surveyed**

| Group | Definition | Label | Average funding from granting councils between 2003 and 2005 |
|---|---|---|---|
| #1 | Academic researchers funded by an NCE network between 2001 and 2005 | "NCE researchers" | $179,000 |
| #2 | Academic researchers not funded by an NCE network but funded by another network-related program between 2001 and 2005 | "Networked researchers" | $159,000 |
| #3 | Academic researchers not funded by a network-related program between 2001 and 2005 | "Non-networked researchers" | $147,000 |

Comparing data obtained from groups 1 and 2 contributes to the demonstration of the impact of the NCE Program over and above that of other network-related granting council programs. It allows us to determine

whether the NCE model and the NCE context is associated with more positive results than these other programs.

Comparing information from groups 2 and 3 parcels out the effects associated with the networking model itself, a model on which the NCE Program is based but which was taken further under the NCE Program. Therefore, together, the analysis of the results in the three groups of researchers allows us to document the impacts that are network-related from the impacts that are NCE-specific.

The respondents involved in the student survey were invited by researchers who completed the researcher survey. The questionnaire was designed so that the group membership of the inviting researcher was attributed to the student. Therefore, three groups of students are available for analysis: Group 1 includes students referred by NCE researchers, Group 2 was invited by non-NCE networked researchers, and Group 3 students studied with non-networked researchers. This composition of groups allowed for the same comparisons that were described above with regard to researchers.

***Statistical tests***

In making comparisons among groups of researchers or students, it is important to base conclusions on statistical tests which distinguish the statistically supported inferences from the results that may be due to mere chance. Throughout this report, statistical significance is tested using a $chi^2$ for percentage data, a T test for means where two values are compared, and an F test for means where more than two groups are compared.

All tables in the report present the statistical tests graphically. Where the comparison is between two groups, a plus sign (+) indicates that the value for one group is statistically larger than that for the other group; a minus sign (–) indicates a significant negative difference; and $^{ns}$ indicates that the difference between the two groups is not statistically significant. Where the comparison is among more than two groups, two stars indicate that the differences among groups are significant at the 0.01 level; one star

corresponds to a 0.05 level of significance; a dash means that the differences did not reach a 0.05 level of significance.

## 3.3 Case studies

Case studies were central to the evaluation methodology. Indeed, each NCE has a history and a life of its own and can be best understood by first developing in-depth knowledge of its nature and dynamic. Moreover, case studies are an excellent tool to investigate complex patterns of program effects.

The evaluation study included eight case studies of NCE networks. The selection of case studies ensured coverage across the life span of a network and representation from networks with a focus on science and engineering, health and social sciences. The cases selected are depicted in ***boldface*** in Exhibit 3.3, which also provides information on the disciplinary focus of the networks and on their age.

Case studies used a variety of approaches:

- an extensive document review to profile the history of the network and its accomplishments, and to contribute to the implementation of the survey of researchers and partners;
- key informant interviews to discuss the effectiveness of the structure and alternatives to program design; these key informants were with network administrators and key participants;
- a self-administered survey of researchers and partners to feed data to the analysis of collaboration and to document knowledge dissemination. Research users (internal to the network) were surveyed as to the use made of research results; this is the same survey described in section 3.6.
- a self-administered survey of students, present and past, to collect data on the unique aspects of the NCE model, support to students and employment outcomes; this is the same survey described in section 3.7.

## EXHIBIT 3.3 • Selection of cases

| Starting year | Health, Human Development and Biotechnology | Natural Resources and Environment | Engineering and Manufacturing, Advanced Technologies |
|---|---|---|---|
| 2006<br>NCE-NI<br>(4-year horizon) | • ***Canadian Design Research Network, Simon Fraser University***<br>• Canadian Obesity Network, McMaster University<br>• ***Emerging Dynamic Global Economies, University of Ottawa***<br>• National Initiative for the Care of the Elderly, University of Toronto<br>• Promoting Relationships and Eliminating Violence Network, Queen's University | | |
| 2003-2005<br>NCE<br>(7+7-year horizon) | • PrioNet Canada (2005-2010), University of British Columbia<br>• Allergy, Genes and Environment Network (2004-2009), McMaster University<br>• Advanced Foods and Materials Network (2003-2008), University of Guelph | • ArcticNet (2003-2008), Université Laval | |
| 1998-2000<br>NCE<br>(7+7-year horizon) | • ***Canadian Language and Literacy Research Network (2000-2008), University of Western Ontario***<br>• Stem Cell Network (2000-2008), University of Ottawa<br>• ***Canadian Stroke Network (1999-2009), University of Ottawa***<br>• Canadian Network for Vaccines and Immunotherapeutics (1999-2006), Université de Montréal<br>• Canadian Arthritis Network (1998-2009), Mount Sinai Hospital | • Canadian Water Network (2000-2008), University of Waterloo<br>• AquaNet — Network in Aquaculture (1999-2006), Memorial University of Newfoundland | • AUTO21 Network of Centres of Excellence (2000-2008), University of Windsor<br>• Canadian Institute for Photonic Innovations (1999-2009), Université Laval<br>• Geomatics for Informed Decisions Network (1998-2009), Université Laval<br>• Mathematics of Information Technology and Complex Systems — Mitacs (1998-2009), Simon Fraser University |
| 1995-1998<br>NCE<br>(7+7-year horizon) | • Health Evidence Application and Linkage Network (1995-2002), McMaster University | • ***Sustainable Forest Management Network (1995-2009), University of Alberta*** | • ***Intelligent Sensing for Innovative Structures (1995-2009), University of Manitoba***<br>• TeleLearning Network of Centres of Excellence (1995-2002), Simon Fraser University |
| 1989<br>NCE<br>(7+7-year horizon) | • Canadian Genetic Diseases Network (1989-2007), University of British Columbia | | • Institute for Robotics and Intelligent Systems (1989-2006), Precarn Inc., Ottawa |
| Inactive | ***Canadian Bacterial Diseases Network (1989-2005), University of Calgary***<br>Microelectronic Devices, Circuits and Systems (1989-2005), University of Toronto<br>Protein Engineering Network (1989-2005), University of Alberta<br>***Mechanical Wood-Pulps Network (1989-2004), Pulp and Paper Research Institute of Canada, Pointe-Claire***<br>Canadian Institute for Telecommunications Research (1989-2003), McGill University<br>Concrete Canada (1989-1998), University of Sherbrooke<br>NeuroScience Network (1989-1998), Montreal General Hospital<br>Respiratory Health Network of Centres of Excellence (1989-1998), Montreal Chest Hospital Centre<br>Canadian Ageing Research Network (1989-1994), University of Toronto<br>Canadian Network for Space Research (1989-1994), University of Calgary<br>Centres of Excellence in Molecular and Interfacial Dynamics (1989-1994), Université de Montréal<br>Insect Biotech Canada - Biotechnology for Insect Pest Management (1989-1994), Queen's University<br>Ocean Production Enhancement Network (1989-1994), Dalhousie University | | |

## 3.4 Review of documentation and administrative data

The project team reviewed relevant program-related documents for case studies. This included application and renewal forms, mid-term reviews, network annual reports, network annual statistical and financial tables, etc. Administrative data on the cost to administer the NCE Program were also necessary in order to complete the cost-benefit analysis.

The document review fed directly into the individual case studies. It also informed the analysis of the positioning of the NCE Program in the constellation of federal programs aimed at supporting knowledge development, network creation, HQP training and knowledge transfer. Documentation not directly related to the case study analysis was also reviewed, including the Industry Canada study of innovation programs (2006) and Atkinson-Grosjean's *Public Science, private interests* (2006).

Administrative data currently available were useful in the preparation of the case studies. Some informants were critical of the pertinence of some of the data collected by the program, however. For example, a count of patents and licenses may not be relevant to some networks that are not oriented towards this type of action. Section 5.6 of this report provides additional information on administrative data.

## 3.5 Interviews

The case studies produced 54 key informant interviews. Eleven additional interviews were conducted with NCE Selection Committee members, granting agency representatives and Industry Canada. They aimed at identifying unique aspects of the NCE Program, cost effectiveness, the effectiveness of the network structure and possible improvements to the program design. In total, some 65 individuals contributed to the interviews.

## 3.6 Survey of partners and network researchers

The evaluation study included a survey of network partners and of network researchers; all networks were included in these surveys. The survey of network partners and researchers provided case-study-based information but also extended beyond the cases to the whole population of all networks.

Partners and researchers provided key input into the activities resulting from the establishment of NCEs and were an important data source with respect to the extent of collaboration and networking, research productivity, evidence of technology transfer, and other measures of impact.

***Researcher survey***

In the case of researchers, two comparison groups were created to support the analysis of the incremental impacts of the program. These groups were described earlier (see page 20).

All members of groups 1 and 2 were invited to take part in the survey. Members in receipt of the largest grants within Group 3 were retained into the sample. Groups 2 and 3 were of the same size.

At the conclusion of the field work, the response rates were 35%, 21% and 27%, respectively, in groups 1, 2 and 3 (see Exhibit 3.4 for details).

**EXHIBIT 3.4**
**Researcher survey results**

| Group | Original sample size | Completed questionnaires | Response rate | Adjusted response rate[1] |
|---|---|---|---|---|
| **Researcher treatment groups (see page 20 for details)** | | | | |
| Group #1 | 1,658 | 580 | 35% | 38% |
| Group #2 | 5,440 | 1,157 | 21% | 24% |
| Group #3 | 5,440 | 1,446 | 27% | 30% |
| **Granting council** | | | | |
| CIHR researchers | | | 18% | |
| SSHRC researchers | | | 23% | |
| NSERC researchers | | | 29% | |
| **CIHR pillars[2]** | | | | |
| Biomedical researchers | | | 26% | |
| Health systems and services researchers | | | 20% | |
| Clinical researchers | | | 21% | |
| Social/cultural/environmental/population health researchers | | | 21% | |

[1] Ratio of the number of completed questionnaires to the number of original sample size from which the number of undeliverable invitation messages is subtracted.
[2] Note that each of these response rates are higher than the response rate cited for CIHR as a whole. That is possible because a number of CIHR researchers were not associated with a sub-field.

Three problems were encountered during this survey. First, several questions referred to "the group of researchers you work with most often in this network". Some respondents were unclear as to the definition of the term "researcher" while others were unsure as to how wide a net to cast to capture those with whom they "work with most often in this network". This confusion has to be factored into the interpretation of survey findings since we cannot be certain of the exact nature of the researcher group that respondents had in mind while filling out the questionnaire. This may have affected the findings related to researcher collaboration.

Second, NCE respondents were asked to describe their relationship with researchers in the NCE network, whereas researchers in the comparison groups were asked to refer to the "group of researchers you work with most often". That is to say that researchers in groups 2 and 3 were asked

to describe their proximal research group while NCE researchers described the NCE network. Arguably, NCE researchers are also part of proximal research groups that may produce collaboration that is as intense as that of groups 2 and 3. The comparison of groups 2 and 3 proximal research groups to the NCE researcher NCE network will be carried out prudently because of the differing nature of the two.

Third, the match between the NCE Program file of network researchers and the council files of researchers (which contained e-mail addresses) was difficult to establish. No unique identification field was available to marry the files; the research team had to resort to imperfect name and institution matching. This translated into somewhat incomplete survey samples (where e-mail addresses were unavailable), the misclassification of some researchers (which was corrected as part of the questionnaire itself) and a few duplicate entries.

The response rate for the group of researchers found in the data file provided by CIHR was 18%, whereas it was 23% in the group found in the SSHRC file and 29% in the group from the NSERC file. Therefore, the survey data tends to over-represent NSERC researchers and to under-represent CIHR researchers. Partially completed questionnaires were not included in the final data set.

Note that all analyses of the researcher survey data were conducted by evaluation group (NCE v. comparison groups and Group 2 v. Group 3), by field of study for NCE researchers alone and for all researchers, by maturity of networks and by CIHR pillar. Only significant results are reported.

***Partner survey***

In the case of partners, no comparison groups were created. A total of 207 questionnaires were completed, resulting in a 16% raw response rate (i.e., not accounting for incorrect e-mail addresses, inadequate contact information within partner organizations or other sources of ineligibility). However, since only 995 potential participants could be reached by e-mail invitation, the adjusted response rate is 21%.

These response rate figures are based on the definition used by the program in compiling the list of partners. The NCE Program considers a partnership to exist when an organization makes a cash or in-kind contribution to one or more of the research (knowledge-generating or transferring) components of the NCE, or an organization publicly supports the network (for example, through letters of support), or it has indicated that the network will be beneficial to their organization.

However, some of the organizations and individuals reached for the partner survey did not feel that they deserved the status of NCE partner. Anecdotal evidence suggests that individuals and organizations were listed as partners that had little contact with the networks. Therefore, information gleaned from the original list of partners could not be used to ascertain the level of representativeness of the partner data set, since this study's definition of a partner is more demanding than the one used in the creation of the sampling frame.

Partially completed questionnaires were not included in the final data set.

## 3.7 Survey of students

Because the evaluation is concerned with determining the quality of training students receive through the NCEs (in comparison to other training environments), one target sample for the survey was former as well as present students.

No list of present and past students was available from the networks. It was established that the best source of identification of students involved in NCE-funded research is the researcher — who is likely to know about the sources of the research funding and to know which student worked on which project. Therefore, NCE-funded, network-funded and non-funded academic researchers were asked to invite their students to fill out an on-line questionnaire. Each of these three groups of researchers was given a different URL where they were to send their students so that they could be categorized based on the researcher group that they were associated with.

Sampling by reference (or snowball sampling), such as used in the student survey, does carry the possibility of bias. For example, researchers could have been tempted to systematically select their best students for reference. Fortunately, the impact of such systematic bias would probably not be very significant in this evaluation because the findings are based on the comparison among the three groups — not the absolute scores obtained in any one group. As long as the differences among groups are the same for those invited and those not invited, the findings provide a reliable picture of the effects of the NCE Program.

Comfort can be drawn from Exhibit 3.5, which compares some characteristics of the three groups of students. The amount of time the students were exposed to the researchers who referred them to the questionnaire was the same. Even though the differences among groups reach statistical significance, students from the three groups present the same profile with regard to the level of study: the plurality studies at the master's level and the second-largest group enrolled in doctoral studies. The likelihood of being at the post-doctorate level is higher in the NCE group. In terms of disciplines, the NCE group comprised more students involved in health sciences than Group 3, whereas the latter group included more students in social sciences and engineering.

**EXHIBIT 3.5**
**Characteristics of student respondents**

| | NCE students (Group 1) | Other students supervised by researchers with network-related grants (Group 2) | Students supervised by researchers without network-related grants (Group 3) | Statistical significance of the difference mong groups |
|---|---|---|---|---|
| Discipline[1] | | | | |
| Natural sciences and engineering | 67% | 64% | 70% | ns |
| Health sciences | 22% | 19% | 11% | ** |
| Social sciences and humanities | 11% | 15% | 18% | * |
| Multi-disciplinary | 13% | 15% | 10% | ns |
| Other | 5% | 5% | 6% | ns |
| Working with the referring researcher since...[2] (average) | September 2003 | June 2003 | June 2003 | ns |
| Level of study | | | | * |
| Undergraduate | 14% | 15% | 17% | |
| Masters | 42% | 46% | 41% | |
| Doctorate | 29% | 30% | 33% | |
| Post-doctorate | 14% | 9% | 9% | |
| n | 335 | 708 | 739 | |

[1] Columns total more than 100% as respondents could select more than one category. For the same reason, statistical tests were run on each row separately.
[2] Values prior to 1997 were recoded to 1997.

The survey of students gathered an array of factual and perceptual information on the quality of training, the level of support received, the features of the research environment and the outcomes beyond their student status. The key indicators of program effects were the differences in situations and opinions between students who evolved within the NCE context and those who did not.

During the data collection phase, 1,782 questionnaires were completed, including 335 from students associated with NCE networks, 708 from students associated with researchers supported by other networking programs, and 739 from students working with researchers not supported by networking programs. Partially completed questionnaires were not included in the final data set. Since the sample was a snowball sample, it

is not possible to calculate a response rate. Since no population data are available to compare respondents to a known profile, it is not possible to ascertain the level of representativeness of the student data set. However, since we are concerned only with differences among groups of students, it is unlikely that a selection bias would severely interfere with the findings of this survey.

## 3.8 Network analysis

The original evaluation plan included network analyses to map the relationships within NCE networks and profile the types of networks created. Unfortunately, the level of response to the partner survey, which would have provided the information necessary for this analysis, was insufficient to support this work. The description of the nature and strength of NCE networks was instead based on the descriptive assessments made by researchers and partners as part of their respective surveys.

## 3.9 Cost-effectiveness analysis

One issue of the evaluation study related to the extent to which similar results could be achieved more cost-effectively using an alternative delivery structure. A cost-effectiveness analysis was conducted to assess the NCE model relative to alternatives. Alternative delivery models included network programs operated within the three granting councils, a national network program under an independent Secretariat and the NCE-NI model where funding supports only networking efforts, not research.

The cost-effectiveness analysis was based on existing documentation. It included consideration of overall operating costs, network-level operating costs, and research funded. The relative efficiency of each model was compared to assess the cost per $1000 of research funding, the cost per grant/project and the leveraged money from other sources per $100 of program funding.

The challenges of a cost effectiveness analysis lie in the varying availability and quality of data, as well as in the definitions of administrative costs and resulting variations in financial statements. Where possible, data were collected for a constant fiscal year (2005-2006) to enable comparison. Also, due to limitations in data availability for the alternative models included in the analysis, the data for one of the comparison programs were taken from a recent study for the Department of Foreign Affairs and International Trade and covered the years 2001-2003. The limited availability of data constrained the number and nature of the alternative networks that we could include in this analysis. To increase data reliability, only information reported in financial statements, administrative records or confirmed by auditing procedures was included in the analysis.

## 3.10 Data quality

This evaluation is based on a balanced mixture of qualitative and quantitative evidence, and on the comparison of relevant results obtained by researchers and students, some of whom were involved in the program and some who were not. The researcher groups were shown to be similar on a key variable: average funding from councils over three years; therefore, this important factor can be discarded as an explanation for the differences observed among groups with regard to areas of program effects. The student groups were also compared on three characteristics and found to be composed of similar individuals. The balance of evidence and the availability and equivalence of a program group and of comparison groups are key elements of the strength of this evaluation design.

Case studies were conducted on eight NCE networks distributed along the 16-year life of networks. Available documentation was analysed and in-depth interviews were conducted with some 65 individuals to factor into the evaluation aspects of the dynamics of networks, which structured surveys cannot do justice to.

Surveys of researchers and students benefit from large sample sizes and relatively good response rates, considering the groups that were targeted.

The cost-effectiveness analysis is based on published documents and verified statements. Only comparable programs were included.

Notwithstanding the strength of the design and of the data collection, there were some limitations to the available data. Because of their idiosyncrasies, case studies are difficult to compare with one another. Some aspects of the measurement of research collaboration may have suffered from the differences in the reference group utilized. The absence of a unique researcher identifier made the matching of data from councils and the program difficult. Participation in the survey of partners was limited; this impaired the analysis of network structures. The program definition of a partner might differ from that of the organizations identified as such by the program. The absence of a list of students associated (or not) with the program led to the use of snowball sampling, which cannot guarantee the representativity of the results.

All in all, because the evaluation design is strong and because there are multiple lines of evidence contributing to answering each evaluation issue, these limitations do not put into question the integrity of the evaluation findings. In the view of the evaluation team, the results are valid and reliable. Where the evidence is limited in some way, the report notes that fact and weighs the value of the findings.

# Chapter 4

# PROGRAM SUCCESS

The two pillars of the NCE model are connecting people across disciplines, sectors, institutions, region and language, and developing and transferring knowledge and technology to the user sector (also called the receptor community). The NCE Program goal is accomplished by investing in national research networks that are expected to result in leading-edge research; partnerships / collaboration; high-quality, multi-disciplinary research training; and the transfer and exploitation of research knowledge to develop the economy and improve the quality of life of Canadians.

The terms "collaboration" and "partnership" are used interchangeably in many program and network documents. In this evaluation report, we defined "collaboration" to refer to researcher-to-researcher interactions, and we reserved "partnership" for organization-to-organization interactions. "Networking" could rightly be interpreted to apply to either one of these types of interaction.

The following sections review evaluation findings with regard to collaboration, partnerships, leading-edge research, training, and the transfer and exploitation of knowledge and technology.

## 4.1 Collaboration

***In brief***

An NCE network comprises two levels: a structural level, which is created using the funding received from the program and which comprises a series of committees and positions, and an individual level, animated by individual researchers and partner representatives. The NCE Program successfully facilitates more organized strategies and tasks as well as stronger leadership and decision-making processes at the structural level of the networks; it does this more so than other collaboration and network-related programs.

At the individual level, the NCE Program increases the likelihood of collaboration as well as the size of collaborative networks; however, it does not replace NCE researchers' closest research group in terms of the intensity of collaborations — nor does the program expect them to.

The NCE Program is premised on the assumption that formal networks are effective at producing collaborative activities among researchers, and that collaborative research is more likely than research in isolation to address significant, multi-disciplinary issues, to produce leading-edge research findings, and to generate meaningful results to address significant problems. In general terms, high levels of research productivity, exemplified by published output, have been shown to be associated with high levels of collaboration (Katz, 1997).

Based on case studies conducted as part of this evaluation, we conclude that collaboration can be fostered by various mechanisms: competitions emphasizing cross-team efforts, of course, but also insistence on the multi-disciplinarity of research projects, the composition of network structures (such as the research management committee), and an integrated vision of the problem at hand.

The evaluation assessed the extent to which the NCE networks are, in fact, characterized by collaborative research and the extent to which this level of collaboration differs from that found outside of NCE networks. As stated above, in this evaluation we define collaboration as researcher-to-researcher interaction, during the process of the research enterprise.

***Researcher networks***

Most researchers do not work in a vacuum; they associate with other researchers more or less tightly to pool resources and to stimulate their intellectual processes. This section describes the size and depth of the networks of NCE researchers and of researchers in the two comparison groups.

Note that NCE researchers were asked to describe their relationship with researchers in the NCE network, whereas researchers in the comparison groups were asked to refer to the "group of researchers you work with most often". Arguably, NCE researchers may have another "group of researchers they work with most often" aside from the NCE network. It is possible that the comparison of the proximal group described by non-NCE researchers with the NCE network of researchers described by NCE researchers is unfair.

Exhibit 4.1 contains some basic indicators of collaboration and networking. It documents that NCE researchers (Group 1) more frequently declare a sense of belonging to a research group and that their research group is larger. They are more likely to be members of a research group than other researchers in groups 2 (researchers in receipt of network-related grants other than NCE funds) and 3 (researchers without network-related grants): only 8% of NCE researchers are not members of a research group, compared to 23% of Group 2 and 34% of Group 3. NCE research groups are also significantly larger (81 researchers on average) than non-NCE networked researcher groups (Group 2: 14 researchers on average) and non-networked researchers (Group 3: 13 researchers on average). In fact, the difference between groups 2 and 3 is not statistically significant. NCE researchers are also much more likely to declare being in receipt of funding aimed at building research collaboration (89%) than Group 2 or Group 3 researchers (63% and 40%, respectively).

However, the collaboration of NCE researchers within the NCE research group is less intense[1] than the collaboration of non-NCE researchers with other researchers they work with most often. NCE researchers spend less time on research activities conducted with members of the NCE research group and a smaller percentage of their activities in the group is with foreign researchers. They have fewer research planning meetings with the members of the group, and they present less often with members of the group at conferences than groups 2 or 3. NCE researchers publish less often within the NCE research group than researchers in groups 2 and 3 do within their research network.

**EXHIBIT 4.1**
**Collaboration and networking indicators**

| | NCE researchers (Group 1)[1] | Other researchers with network-related grants (Group 2)[2] | Researchers without network-related grants (Group 3) | Statistical significance |
|---|---|---|---|---|
| **Membership to a research group** | | | | |
| Percentage of researchers who are ***not*** members of a research group | 8%- | 23%- | 33% | ** |
| Number of active researchers in one's research group (mean) | 81+ | 14[ns] | 13 | ** |
| Percentage of researchers with funding aimed at building research collaboration | 89%+ | 62%+ | 40% | ** |
| **Intensity of the commitment in the research group** | | | | |
| Percentage of your work time spent on research activities conducted with members of this group (mean) | 20%- | 38%[ns] | 41% | ** |
| Percentage of your activities with this group that involve foreign researchers (mean) | 4%- | 13%- | 23% | ** |
| Number of research planning meetings with members of this group (mean) | 4.9- | 7.9+ | 6.9 | ** |
| Number of refereed articles written with members of this group and accepted for publication (mean) | 3.1- | 5.4[ns] | 5.3 | ** |
| Number of presentations at conferences with members of this group (mean) | 5.4- | 7.5+ | 6.4 | ** |
| minimum and maximum n | 450, 580 | 826, 1157 | 873, 1446 | |

[1] Comparison of Group 1 to Group 2.
[2] Comparison of Group 2 to Group 3.

[1] The level of collaboration with a group of researchers is defined operationally as the percentage of one's research time spent with members of the group and with foreign researchers, the number of research planning meetings, refereed articles and presentations produced with members of the group.

Note that responses from groups 2 and 3 are more alike. Therefore, we can conclude that the NCE Program increases the likelihood of collaboration as well as the size of collaborative networks; however, it does not replace NCE researchers' closest research group in terms of the intensity of collaborations. Such effects of the NCE Program are larger than the effects documented among other network-related granting programs.

The program has no established expectation regarding the intensity of the collaboration among researchers. The conclusion that NCE networks are less intense than usual networks can either be a non-issue (if one expects that NCE networks could not be as intense as a researcher's proximate research environment) or a shortcoming (if one expects that NCE networks should compete with a researcher's usual lab for his/her attention).

***Nature of collaborative networks***

The concept of collaboration is not a simple one. Rebecca Gajda (2004, p. 66) stated, "In its overuse, the term 'collaboration' has become a catchall to signify just about any type of inter-organizational or inter-personal relationship, making it difficult for those seeking to collaborate to put into practice or evaluate with certainty." To assist in the evaluation of the evolution of collaboration and of the impact of programs on collaboration, Gajda has proposed a tool to gauge the level of collaboration within an alliance. Exhibit 4.2 describes the main features of this assessment tool.

Gajda qualifies networks according to five levels of integration. From lowest integration to highest, they are: networking, cooperating, partnering, merging, and unifying. Each level of integration is described on four dimensions: the purpose of the network, its strategies and tasks, the leadership and the type of decision-making processes, and interpersonal ties and communication mechanisms. In each cell of the combination of levels of integration and dimensions are a series of clues to help assess the state of a network. Using these clues, one can locate the level of integration which characterizes a particular situation. This is useful to this evaluation because it will allow us to compare the level of integration of NCE networks to that of research groups found in other settings. Logically,

we would expect NCE networks to be located at a higher level of integration than non-NCE networks, since the former are established to create more integrated networks than would exist without the program.

**EXHIBIT 4.2**
**Gajda's definition of levels of collaboration**

| Level of integration | Purpose | Strategies and tasks | Leadership and decision-making | Interpersonal and communication |
|---|---|---|---|---|
| 1 Networking | Create a web of communication [...] | Loose or no structure [...] | Non-hierarchical [...] | Communications among all members infrequent or absent [...] |
| 2 Cooperating | Work together to ensure tasks are done [...] | Member links are advisory [...] | Facilitative leaders, usually voluntary [...] | Communications among members clear, but may be informal [...] |
| 3 Partnering | Share resources to address common issues [...] | Strategies and tasks are developed and maintained [...] | Autonomous leadership [...] | Communication system and formal information channels developed [...] |
| 4 Merging | Merge resources to create or support something new [...] | Formal structures to support strategies and tasks is apparent [...] | Strong, visible leadership [...] | Communication is clear, frequent and prioritized [...] |
| 5 Unifying | Unification or acquisition to form a single structure [...] | Highly formal, legally complex [...] | Central, typically hierarchical leadership [...] | Communication is clear, frequent and prioritized, formal and informal [...] |

Note: To limit the size of this table, each cell presents only one ingredient where the author proposes several.
Source: Gajda, 2004, p. 71.

A series of questions was devised for this evaluation to measure the location of networks in Gajda's two dimensional space; it was included in the survey of researchers and in the survey of partners.

The researcher survey data show few differences in the profile of NCE networks, non-NCE funded networks and non-funded networks on the Purpose dimension. On the Strategies and tasks dimension, however, NCE researchers qualify their networks as clearly more structured than Group 2 researchers, and the latter portray yet more structure than the Group 3 researchers. Also, the data depict NCE networks as possessing stronger leadership than either of the two other groups. Finally, NCE networks are also shown to have tighter communications than Group 3 research groups, but at par with Group 2 research groups.

Note that no significant differences were found among NCE researchers according to the field of study. Interestingly, researchers in recently formed NCE networks describe more formal structures and stronger leadership; we conjecture that this could be a result of the dissemination and acceptance of the networking idea over the almost two decades of existence of the NCE Program.

***Incremental impact of the NCE Program on research collaboration***

One-quarter of NCE researchers (23%) indicated that research collaboration would have developed within their group without funding to that effect. Proportions are significantly higher among Group 2 and Group 3 researchers (36% and 42%), indicating that the incremental impact of these other program arrangements is not as pronounced as NCEs.[1]

One-third of NCE researchers (33%) indicated that the collaboration would persist within their group without funding to that effect. This could be interpreted negatively for the NCE Program in that it does not bode well for the persistence of collaboration past the funding phase. It is nonetheless an indication of the importance of the NCE funding in supporting collaboration. This importance is statistically significantly stronger than in Group 3 (45% indicate that the collaboration would continue without funding to that effect), but similar to that measured in Group 2 (36%). Researchers from recent NCE networks are somewhat less likely than researchers from older NCE networks to indicate that collaboration would persist without NCE funding.

Information gathered as part of the case studies suggested that the NCE networks produced significantly more collaboration than would have occurred in their absence. In most cases, NCE networks were established in areas that were not characterized by a high level of collaboration at the outset. Moreover, the *modus operandi* of distributed research projects was new at the inception of each of the case study networks; researchers were used to running isolated single-site research projects that they controlled centrally.

1 The possible effect of the maturity of the networks was tested and found to be statistically insignificant.

Finally, key informants indicated that the following feature among the key results of increased collaboration: simpler and faster communication among researchers and students, information sharing, links between students and researchers, attraction of researchers to the field of study, creation of critical masses of researchers interested in a specific problem area, application of multiple disciplinary perspectives to an issue, establishment of ties with the receptor community.

***Conclusion***

An NCE network comprises two levels: a structural level, which is created using the funding received from the program and which comprises a series of committees and positions, and an individual level, animated by individual researchers and partner representatives.

The evidence suggests that the NCE Program facilitates more organized strategies and tasks as well as stronger leadership and decision-making processes at the structural level of the networks; it does this more so than other collaboration and network-related programs. The data also support the hypothesis that the NCE Program and other network-related programs are more successful than non-network-related grant programs at producing stronger communication within networks. At the individual level, the findings show that the NCE Program increases the likelihood of collaboration as well as the size of collaborative networks; however, it does not replace NCE researchers' closest research group in terms of the intensity of collaborations — nor does the program expect them to.

We don't see these findings as contradictory. There is no obvious connection between network structure and leadership, and intensity of collaboration; a network can be considered to be well-structured and well-led, and still produce limited individual collaboration outcomes. It is easier to draw a relationship between the size of one's network and its depth: the more researchers one's network comprises, the less intense the relationship with each researcher.

Finally, the evaluation study cannot draw conclusions as to why one out of twelve (8%) NCE researchers reported not being a member of a research group. It should be said that, in comparison, one non-NCE networked

researcher out of four and one non-networked researcher out of three answered in the same manner.

## 4.2 Partnerships

***In brief***

NCE networks have been successful at bringing together researchers, public sector and private sector representatives, and NGOs to contribute to the definition of key knowledge issues, the execution of research and the translation of research findings into actionable results. Partnership results are most evident where prior relationships existed among some partners and in sectors where the NCE network can build on existing clusters of interests.

NCE networks are expected to carry out research in partnerships designed to overcome the traditional barriers between university research, industrial exploitation and public use of research results. Partnerships should start from the early stage of issue identification and continue throughout knowledge and technology transfer and exploitation.

According to NCE documentation, a partnership will be considered to exist when an organization makes a cash or in-kind contribution to one or more of the research (knowledge-generating or transferring) components of the NCE; or, an organization publicly supports the network, for example, through letters of support; or, it has indicated that the network will be beneficial to their organization. However, based on contacts made during the survey of partners, some of these organizations that the NCE Program considers partners don't see their relationship as that of a partnership; for example, the simple expression that the existence of a network benefits one's company does not necessarily amount to a partnership.

***Existence of partnerships***

Case studies indicated that, under favorable circumstances, NCE networks were able to create solid partnerships where they did not exist and even where they were unlikely to succeed.

Studied networks reported between 50 and almost 200 partners. Partners included universities, industry, federal and provincial government departments, as well as not-for-profits. The relative balance of the types of partnerships varied from network to network, with universities and industry each being numerically dominant some of the time; governments can sometimes play a key role in partnerships (e.g., the ISIS network).

***Nature of partnerships***

Using Gajda's collaboration model (see page 39 for details on the model), we gathered the views of the partners in the context of a survey. The evidence documents that academia and NGOs attribute more integrative purposes to NCE networks than do the public and private sectors — i.e., academia and NGOs perceive that NCE networks are meant to produce tighter partnerships than the public and private sectors perceive. On the other dimensions, particularly Strategies and tasks, as well as Leadership and decision-making, NCE partners qualify their networks as highly structured, reaching the Merging level — a perspective which portrays a more intense integration than was found in the Researcher survey. Finally, Interpersonal ties and communication channels are rated lower in terms of network integration. The apparent disequilibrium between this fourth dimension and the other three could be cause for concern, as it could hinder harmonious network building.

Partners were also asked to identify up to ten organizations with whom he or she collaborated in the research planning, execution and knowledge transfer phases of their activities, and to rate the strength of those relationships. Unfortunately, too few responses were obtained from four of the case networks to include them in the analysis. Descriptive analyses were produced for the four networks with a minimum of seven partner questionnaires completed.

Two conclusions emerged. First, the average number of partners was similar for all three stages of partnership: research planning, research execution and knowledge transfer. This is somewhat of a (positive) surprise, as we expected that partnerships would focus on knowledge transfer but be less dense with regard to research planning and research execution.

Second, while the majority of partnerships were with universities, two of the four networks included in the analysis also reported significant involvement with government organizations (SFM and CLLRNet). Relationships with NGOs were the least prevalent for all four networks. Private sector involvement varied according to the nature of the network, with CLLRNet having the fewest.

***Partnership results***

The results of the partnerships established varied. They could be observed in terms of additional funding devoted to the knowledge area, the successful commercialization of findings and technologies, a more business-focused approach to the knowledge area, the establishment of best practices or policies, the review of regulations or codes, contribution to dialogue among conflicting interests, etc.

Based on the case studies, partnership results are not consistent from network to network. They were most evident where prior relationships existed among some partners and in sectors where the NCE network can build on existing clusters of interests.

Information from the case studies indicates that duplication of efforts among partners is avoided by the establishment of communication channels via formal and informal network structures, and by concerted effort. For example, the Canadian Stroke Network has avoided duplicating the work performed by the Heart and Stroke Foundation of Canada by frequently communicating with the organization and by inviting them to sit on the network Board of Directors.

## 4.3 Leading-edge research

***In brief***

This evaluation did not attempt to gather new evidence concerning the excellence achieved by NCE networks in research. The reason for this is that the characterization of the level of excellence of the research is a

complex endeavor, which was beyond the resources of this evaluation. At the evaluation planning stage, it was felt that the expert panels that review submissions for new networks and perform mid-term reviews are in a better position to pass judgment on this issue. Nonetheless, experts interviewed as part of this evaluation held the research performed by NCE networks studied here in high regard. Also, the evaluation found that the proportion of NCE researchers who belong to the Thompson Scientific Citation Database list of highly cited researchers is four times higher than the proportion of all Canadian researchers on the list (i.e., 1.5% versus 0.4%).

NCE networks are meant to produce leading-edge research findings that are relevant to the needs of industry, the health sector and government, as well as to Canada's socio-economic development and Canadian's quality of life. Within the networking model, it is important that knowledge production be directed at the research and development priorities of all participants. This explains the emphasis on world-class researchers, strong collaboration and multi-sectoral partnerships.

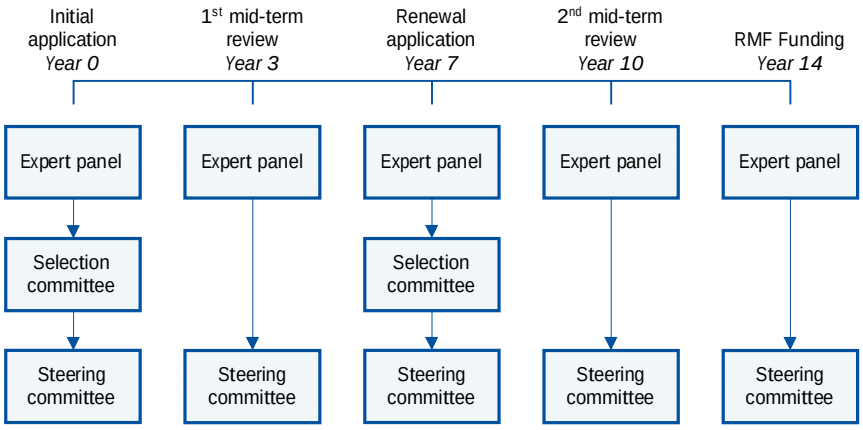
It is acknowledged that excellence in research is difficult to ascertain; it is best measured via peer review. And peer review is the process already implemented by the NCE Program to make the initial selection of networks, to review funding after three years, to reassess network results after seven years, and to review funding again after ten years. In the view of this evaluation team, these four formal, programmed peer review processes (which involve ten different assessments as seen in Exhibit 4.3) far exceed in depth and reliability any work that this evaluation could have offered. They already provide evidence of the high level of excellence of the NCE networks.

Between 2001 and 2006, expert panels have included 269 individuals (some double-counting could have occurred) and 64% of them were non-Canadians. In comparison, during the same period, selection committees included 38 individuals, 32% of whom were non-Canadians. It is expected that selection committees, which deal with several applications concurrently, would comprise fewer individuals in the aggregate over a given period of time than expert panels, which focus on individual networks. It could be argued, however, that a larger international input in

the selection of networks would contribute to better peer-review and more leading-edge research for the NCE.

Some information on the leading-edge character of the NCE networks can be extracted from the case studies and, to a very limited extent, from the survey of researchers and from the ISI (Institute of Scientific Information) Highly Cited list.

**EXHIBIT 4.3 • Sequence of NCE reviews**




### *Significant breakthroughs*

Each of the studied networks with enough history has accumulated significant research output mostly in the form of articles in peer-reviewed journals but also as presentations at conferences, reports, design manuals, education modules, book chapters, exhibits, or compendiums.

Awards and honors given to researchers for the work performed under the auspices of the network are another usual metric. For example, Canadian Stroke Network Scientific Director, Dr. Antoine Hakim, was awarded the Thomas Willis Award at the International Stroke Conference 2007; he was also named an Officer of the Order of Canada for his contribution to the field of stroke.

The Institute for Robotics and Intelligent Systems (IRIS) produced a vast array of research: "IRIS projects range from building an autonomous aquatic walking robot to developing intelligent computational support to analyze gene expression profiles. While some IRIS researchers are devising 3D ultrasound systems for image-guided surgery, others are creating non-player characters with human-like behavior for computer games." (*Excellence has no fixed address*, page 10).

Addressing bio-terrorism was not the initial purpose of Dr. Donald Woods, who led various CBDN projects using genetics, genomics, proteomics and immunological techniques to define the nature of obscure bacterial diseases. The team was working on tropical diseases and found that the vaccines they created could be important tools to respond to bioterrorism attacks. Dr. Woods now assists the US National Institutes of Health (*Excellence has no fixed address*, page 11).

ISIS has established a world leadership position in applied research regarding fiber reinforced polymers (FRP) and structural health monitoring (SHM). Key research accomplishments include the creation of the steel free/corrosion free bridge deck, the development of now commercialized fiber optic sensors and other sensor technology to monitor structures in real-life situations, the revision of the Canadian Highway Bridge Design Code, and the reduction of maintenance costs for public infrastructure and other structures through the increase of durability and service life of structures and the strengthening and repair of existing structures.

Throughout the life of the Mechanical Wood Pulps Network, over 600 scientific papers were published. Researchers worked on network projects and generated significant achievements with regard to mechanical pulping. Research areas included mechanical pulping, bleaching, yellowing inhibition, papermaking, pulp processing, process control and others. According to key informants, the research activities supported by the NCE went beyond what PAPRICAN could support and provided an important added value to their existing investment in research.

Some noted that one aspect of the NCE networks added value is that researchers can work on problems with only distant commercial impact — problems which would not typically be handled by industry because of the

delay in return on investment. Solutions to these otherwise orphan problems may be key to the evolution of the field in due time.

In isolated cases, there have been criticisms of the scientific path of some NCE networks. In one case studied, the expert panel felt that the network lacked a strong theoretical framework that could be used to integrate findings from numerous studies.

***Highly cited***

Citations are an often-used metric to represent research excellence. While a full bibliometric analysis was deemed beyond the scope of this evaluation study, we can get a glimpse at the level of excellence of NCE researchers by analyzing the ISI Highly Cited Researcher data base.[1] As Exhibit 4.4 reports, 1.5% of NCE researchers belong on the Highly Cited list, compared to 0.4% of all Canadian researchers (this latter figure is approximately the likelihood of belonging to this list that would be expected across industrialized countries). This is to say that an NCE researcher is four times more likely to achieve the level of excellence represented by the membership to the Highly Cited list than any Canadian researcher.

NCE researchers represent 19% (34 / 182) of all Canadian researchers found on the Highly Cited list. In comparison, NCE researchers amount to 5% (2,253 / 48,590) of all Canadian researchers.

1 The ISI (Institute of Scientific Information) Highly Cited Researcher data base is built from the Thomson Scientific Citation Databases. It includes the 250 researchers most often cited in the past 20 years in each of 21 categories of knowledge. See http://isihighlycited.com/.

**EXHIBIT 4.4**
**Statistics from the ISI Highly Cited list**

| Indicator | Row | Amount |
|---|---|---|
| Number of NCE researchers identified in the ISI Highly Cited Researchers data base[1] | a | 34 |
| Total number of NCE researchers according to program data files | b | 2,253 |
| Number of Canadian researchers identified in the ISI Highly Cited Researchers data base | c | 182 |
| Total number of Canadian researchers[2] | d | 48,590 |
| Proportion of Highly Cited researchers among NCE researchers ( a / b ) | e | 1.5% |
| Proportion of Highly Cited researchers among Canadian researchers ( c / d ) | f | 0.4% |

[1] NCE researchers were identified individually by searching for the name of each Canadian researcher in the NCE Program researcher list. Source: ISI (Institute of Scientific Information) Highly Cited List.
[2] From tables 49 and 56 of the OECD *Main Science and Technology Indicators*, Volume 2007/1, May 2007.

## 4.4 Research training

***In brief***

The NCE Program offers more opportunities to students with regard to publications and conferences, ethical debates and exposure to real-life practices. Participation in the NCE Program also leads to a better fit between the field of study and employment. According to researcher input, more recently formed NCE networks offer more frequent access to multi-disciplinary initiatives and ethical debates about research, but less exposure to real-life practices than older NCE networks. Access to multi-disciplinary initiatives is somewhat easier in health sciences than in natural sciences and engineering or in social sciences and humanities; access to ethical debates is easier in health sciences and in social sciences and humanities than in natural sciences and engineering.

All in all, the training objective of the NCE Program seems to have been achieved only in part. Within the HQP training aspect of the program, the

emphasis on multi-disciplinarity is of particular concern considering the importance that this feature has in the logic of the program.

The issue of the training of students and young professionals is of great interest to NCE Program stakeholders. Now that the program has been running for several years, it is timely to assess the training and career outcomes of the program. It is often assumed that the involvement of students and post-doctoral fellows in the networks offers new training opportunities not available otherwise. How has the NCE contributed to HQP's training experience in a different way?

***Defining HQP training***

In some networks, there appeared to be confusion in the comprehension of the training function. For example, the Canadian Stroke Network classifies the training of health care practitioners and of emergency care personnel under its training accomplishments, thereby contributing to the intermediate outcome of the "development of a pool of highly qualified personnel". This evaluation team considers that they are knowledge transfer activities (rather than training), which contribute to the outcome "acceleration of the exchange of research results with the network". See Exhibit 2.1 (page 8) for details on the program logic structure.

***NCE network training activity***

According to the 2005-2006 NCE Annual Report (page 8), in that year, "the NCE Program directly supported 2,286 research staff (research associates and technicians) and research trainees (postdoctoral fellows, graduate and undergraduate students). Another 2,181 were involved in NCE project work while supported by other funding sources." The number of students reported by case study networks as having been involved in training activities varies between 75 and 200 per year per network. On average, between 25 and 50 students were reported annually as having completed their studies with each network.

Based on our eight case studies, NCE networks have used various strategies to address their training functions. By far the most common is to have graduate students involved in network research projects.

Supervision, mentoring, workshops, student exchanges, annual conferences, summer student programs, Internet-based courses, field demonstration projects, internships, awards were part of the toolkit as well. Networks report pride in giving students exposure to multi-disciplinary and multi-sectoral environments, but offer limited evidence on how these results were achieved.

***Professional path***

As requested by the program, NCE networks attempt to track the professional path of students soon after they leave the network. It is quite typical to find unemployment rates of about 1% in these tracking studies. More than one-third (36%) of students find employment in Canadian universities once their network involvement is over (as students); one-quarter (22%) work in industry and 4% in government (2005-2006 NCE Annual Report, page 9). One-quarter of the students find employment outside of Canada (24%). The rest (14%) have other or unknown statuses.

Based on the answers obtained as part of the student survey, it was established that students in the three groups showed no statistically different employment outcomes on the following indicators: the percentage of students currently studying, the percentage of students currently working, the percentage of students currently neither employed nor studying, the percentage of students currently employed in the research group and the usefulness of studies in launching one's professional career. However, NCE students are more likely to report a close tie between their field of study and their current employment.

***Opportunities offered to students***

In a survey conducted as part of this evaluation, students were asked to rate the frequency at which various opportunities were offered to them while they studied with the researcher who referred them to the questionnaire; researchers were asked the same in their questionnaire. Based on the groupings of researchers as NCE researchers (Group 1), researchers supported by network-related programs other than the NCE Program (Group 2) and researchers not supported for collaboration and networking (Group 3), the responses of the referred students were

aggregated in similar clusters. Results from students and researchers on training opportunities are summarized in Exhibit 4.5.

Concerning training opportunities, students offered more conservative views than researchers. Based on the students' views, the NCE Program is shown to offer more opportunities than other network programs and other granting programs in the following areas: collaboration in academic publications, opportunities to participate in conferences, funding to attend conferences, access to ethical debates about research, and exposure to industry / hospital / not-for-profit organization practices.

**EXHIBIT 4.5 • Training opportunities according to students and researchers**

| | According to students | According to researchers |
|---|---|---|
| Group 1 (NCE-related) rated the following higher than the other two groups | • collaboration in academic publications<br>• opportunities to participate in conferences<br>• funding to attend conferences<br>• access to ethical debates about research<br>• exposure to industry / hospital / not-for-profit organization practices | • access to highly talented faculty<br>• collaboration in academic publications<br>• opportunities to participate in conferences<br>• funding to attend conferences<br>• exposure to challenging curricula<br>• access to cutting edge technology and research facilities<br>• access to fellowships<br>• financial support (stipends)<br>• access to multi-disciplinary initiatives<br>• opportunities to network with researchers in the discipline<br>• exposure to industry / hospital / not-for-profit organization practices<br>• opportunities to contribute to economic growth for Canada |
| Groups 1 and 2 (supported for networking and collaboration) rated the following higher than Group 3 (not supported) | • opportunities to contribute to economic growth for Canada<br>• opportunities to contribute to improvement of health for Canadians | • access to ethical debates about research<br>• opportunities to contribute to social development<br>• opportunities to contribute to improvement of health for Canadians |

Source: Surveys of students and researchers.
Note: To simplify this table, only instances where differences were found between groups 1 vs. 2 and 3 and between groups 1 and 2 vs. 3 are depicted. More details are found in the technical reports on the surveys of researchers and of students.

Network-related granting programs offer students more opportunities related to contributions to economic growth for Canada and to improvement of health for Canadians. These latter effects are not specific to the NCE Program.

Within the NCE group, some interesting differences by field of study emerged. Researchers in natural sciences and engineering provided higher scores than all other three disciplines regarding collaboration to academic publications, access to assistantship and financial support. All three non-social sciences and humanities fields scored higher on access to technology. Health researchers teamed up with researchers in multidisciplinary fields regarding access to regular seminars and multidisciplinary initiatives, but they joined social sciences and humanities on access to ethical debates. Finally, highest scores on the opportunity to contribute to Canada's economic growth were from natural sciences and engineering as well as multidisciplinary fields whereas highest scores on contribution to social development were from social sciences and humanities, and health researchers scored highest on improvement of health of Canadians.

Researchers from more recently formed NCE networks report more frequent access to multi-disciplinary initiatives (2003 and later vs. before) and to ethical debates about research (1999 and later vs. before), as well as more opportunity to contribute to the improvement of health for Canadians (1999 and later vs. before), but less exposure to industry, hospital and nor-for-profit practices (2003 and later vs. before), and less opportunity to contribute to the economic growth for Canada (2003 and later vs. before). Unfortunately, the sample sizes do not allow us to verify whether this is a trend that is associated with a change in network practices or with the discipline composition of the networks, which changes through time.

Still, according to researchers, multi-disciplinary initiatives are somewhat more readily available in health sciences than in natural sciences and engineering or in the social sciences and humanities. Also, access to ethical debates is easier in health sciences and in social sciences and humanities than in natural sciences and engineering.

Multi-disciplinarity is a defining characteristic of NCE networks. Nonetheless, NCE students indicated that they were no more likely than other students to see their career evolving towards some types of interdisciplinary research or setting. They were also no more likely than other students to have interactions with students or researchers in other

disciplines, at their institution or outside. NCE students rated their access to multi-disciplinary initiatives higher than students supervised by researchers without network-related grants, but at a level similar to what was found among students supervised by researchers with network-related grants. Students associated with more recently created NCE networks report significantly higher likelihood of interactions with students or researchers in other disciplines, at other institutions.

## 4.5 Transfer and exploitation of knowledge and technology

***In brief***

Networking and collaboration programs (including the NCE Program, but not particular to the NCE Program) double the amount of knowledge transfer activities and increase significantly (without doubling) knowledge utilization according to researchers. There was vastly more research finding utilization among NCE public sector partners in 2007 than in the average government agency in 1998, thereby suggesting, within the limits of the comparison, very good performance by the NCE Program in this regard. Network-related programs are particularly adept at affecting the creation of policies, standards, regulations, the modification of behavior and attitudes of target groups, and improving the quality of life of Canadians. Areas where the NCE Program performs better than other network- and collaboration-related programs are patents and licenses, the formation of new companies and the improvement of the health of existing ones, and
the creation of new products, services and processes (that is, a series of areas related to the commercialization of research results — a key objective of the program).

The transfer of research knowledge to industry, the health sector and government is essential to the achievement of the overall objective of the program. Whether it takes the form of publications, highly trained professionals, patents, products, processes or spin-off companies, public policies, or clinical practices, the knowledge or technology generated by the networks must be exploited to yield tangible benefits to Canada.

***Knowledge transfer strategies of networks***

According to case studies, strategies for knowledge exchange focused on the publication of research results in peer-reviewed journals and on the training of HQP, who are expected to carry their knowledge into industry, government and academia. Other strategies included reports, patents, license agreements, support to the commercialization of intellectual property, spin-off companies, pilot projects, participation in conferences and committees, participation in revisions to codes and regulations, software products, press releases, newsletters, workshops, manuals, education modules, best practices, evaluation and monitoring systems, as well as Web sites.

The composition of the strategy portfolio used by any given network appears to reflect the importance of the academic influence over the networks, the dynamics of the ties between the research community and the receptor community, and the attention paid to the translation of findings into actionable results.

One conclusion that can be drawn from the case studies is that knowledge transfer is certainly facilitated by reliance on partnerships with pre-existing organizations that have their own connections in the field. This was the case for the CSN with the Heart and Stroke Foundations of Canada, CLLRNet with the Canadian Childcare Federation, EDGE with the International Development Research Centre and Export Development Canada, and MWPN with PAPRICAN. Otherwise stated, it is an effective strategy to not reinvent the networking wheel.

***Knowledge transfer activities of researchers***

Dr. Réjean Landry from Université Laval and his associates are long-time students of the dynamics of innovation and of knowledge transfer. In a 2006 article, Landry, Amara and Ouimet developed a scale of knowledge transfer activities applicable to researchers; it is reproduced in Exhibit 4.6, along with the results obtained in the researcher survey.

Most importantly, the data show that NCE researchers and Group 2 researchers (that is, all researchers in receipt of funding for networking

and collaboration) behave very similarly with regard to knowledge transfer activities, and that Group 3 researchers, who receive no granting council funding for collaboration and networking, systematically report half as much such activity as groups 1 and 2.

**EXHIBIT 4.6**
**Knowledge transfer activities of researchers**

| (% stating that, over the past three years, they have done the following "usually" or "always") | NCE researchers (Group 1)[1] | Other researchers with network-related grants (Group 2)[2] | Researchers without network-related grants (Group 3) | Statistical significance |
|---|---|---|---|---|
| I have sent my research results to organizations (e.g., firms, departments, hospitals, not-for-profits) outside the academic milieu | 40%[ns] | 41%+ | 18% | ** |
| I have been invited to present my research results to organizations (e.g., firms, departments, hospitals, not-for-profits) that could make direct use of them | 44%[ns] | 43%+ | 21% | ** |
| I have been asked to sit in on working groups that were involved in efforts to directly apply new knowledge, including my own research | 37%[ns] | 33%+ | 18% | ** |
| I have provided consulting services to organizations (e.g., firms, departments, hospitals, not-for-profits) associated with my research field | 32%[ns] | 30%+ | 18% | ** |
| The use of my research results has contributed to the development of new or improved goods or services | 33%+ | 28%+ | 15% | ** |
| The use of my research results has contributed to the development of new or improved company or government policies | 18%[ns] | 17%+ | 10% | ** |
| I have been involved in business activities outside laboratories that are related to my research activities | 16%+ | 10%+ | 7% | ** |
| I have been involved in not-for-profit activities outside laboratories that are related to my research activities | 23%[ns] | 21%+ | 14% | ** |
| Others have attempted to commercialize the results of my research | 13%+ | 8%+ | 6% | ** |
| Average level of transfer activity on a scale from 1 to 5 | 3.1 [ns] | 3.0+ | 2.5 | ** |
| n | 580 | 1157 | 1445 | |

[1] Comparison of Group 1 to Group 2.
[2] Comparison of Group 2 to Group 3.
Note: concepts used in this table are from Landry, Réjean, Nabil Amara and Mathieu Ouimet (2006) "Determinants of knowledge transfer: evidence from Canadian university researchers in natural sciences and engineering" in *Journal of Technology Transfer.*

### *Knowledge utilization by partners*

The results regarding knowledge utilization follow a similar pattern to that of knowledge transfer activities (exhibits 4.7 and 4.8). The list of types of

utilizations is taken from Landry, Amara and Lamari (2001) for researchers and from Landry, Lamari and Amara (2003) for partners.

NCE researchers and Group 2 researchers display very similar action profiles while Group 3 researchers are less involved (but not by a factor 2 as with knowledge transfer activities) than the other two groups of researchers (Exhibit 4.6).

**EXHIBIT 4.7**
**Knowledge utilization according to researchers**

| (% stating that, over the past three years, the following occurred "usually" or "always") | NCE researchers (Group 1)[1] | Other researchers with network-related grants (Group 2)[2] | Researchers without network-related grants (Group 3) | Statistical significance |
|---|---|---|---|---|
| I transmitted my research results to the practitioners and professionals concerned | 64%[ns] | 67%+ | 53% | ** |
| My research reports were read and understood by the practitioners and professionals concerned | 59%[ns] | 62%+ | 52% | ** |
| My work has been cited as a reference in the reports, studies and strategies of action elaborated by practitioners and professionals | 48%[ns] | 50%+ | 43% | ** |
| Efforts were made by practitioners and professionals to adopt the results of my research | 35%[ns] | 35%+ | 28% | ** |
| My research results influenced the choices and decisions of practitioners and professionals | 32%[ns] | 32%+ | 25% | ** |
| My research results gave rise to applications and extensions by the practitioners and professionals concerned | 31%[ns] | 29%+ | 23% | ** |
| n | 580 | 1158 | 1445 | |

[1] Comparison of Group 1 to Group 2.
[2] Comparison of Group 2 to Group 3.
Note: concepts used in this table are from Landry, Réjean, Nabil Amara and Moktar Lamari (2001), "Climbing the Ladder of Research Utilization" in *Science Communication*, vol. 22, no. 4, 2001, p. 399.

In order to ascertain the possibility that the NCE Program has an effect on the transfer of knowledge, we can use the results from Landry, Lamari and Amara (2003) for utilization of research results in government agencies as a benchmark. In that publication, the authors report the results of a 1998 survey of professionals and managers in Canadian and provincial

government agencies[1] involved in policy development, implementation and evaluation; the general topic of the survey was the use of university research pertinent to work.

As Exhibit 4.8 shows, the differences between the average government agency in 1998 and NCE partners from the public sector in 2007 are striking and support the hypothesis that the NCE Program[2] generates significant levels of knowledge utilization beyond what would naturally take place — assuming the differences are due to exposure to the NCE partnerships rather than to the passage of time between the two studies. It is also possible that part of the difference is due to the composition of the group of public sector NCE partners: it may comprise individuals whose area of interest is more conducive than average to utilization of research findings.[3]

***Other knowledge transfer indicators***

Finally, knowledge transfer can take other forms such as patents, licenses, new companies, new products, new graduate students, etc. Exhibit 4.9 reports the assessment of the incidence of such knowledge transfer impacts by researchers.

On the following indicators, NCE researchers rated the following higher than the other two groups:

- patents applied for and patents issued;
- licenses issued;

1 Members of the sample were from all sides of government portfolios: municipal and regional affairs, public works and public infrastructures (13%); economic development, public finance, taxation (27%); education, communication, technology (9%); environment, forestry, fishing, agriculture (11%); social services, health, social security (18%); language, culture, immigration, justice, native affairs (9%); job creation, employment conditions (11%); other domains (2%).

2 Or network-related programs generally — these data cannot distinguish one from the other since we do not have knowledge utilization figures for a sample of partners who would be associated with networks that are not NCE networks.

3 Landry and Amara suggested another hypothesis: the difference between the two groups could flow from the fact that, in the evaluation study, NCE partners were real partners whereas respondents in their 1998 study represented all public sector managers irrespective of their partnership status. We agree with Landry and Amara but we interpret the comparison differently: the 1998 respondents were a natural control group, which was subjected to NCE partnerships only to the extent that such influence existed in the natural order of things; the evaluation study partners were a treatment group strongly influenced by the NCE effects. Seen this way, the differences between the two groups represent the impact of the NCE Program on research utilization by partners.

- new companies formed;
- existing companies made more profitable;
- new products / services / processes created.

**EXHIBIT 4.8**
**Knowledge utilization according to partners**

| (% stating "often" or "very often") | NCE evaluation, all partners | NCE evaluation Public sector partners[1] | Landry, Lamari, Amara results |
|---|---|---|---|
| Reception: My organization received the research pertinent to our work | 58% | 62% | 12% |
| Cognition: People in my organization read and understood the research that we received | 64% | 64% | 55% |
| Discussion: People in my organization participated in meetings for discussion and popularization of the aforementioned research | 56% | 53% | 5% |
| Reference: People in my organization cited research studies as references in their own professional reports or documents | 42% | 45% | 18% |
| Adoption: People in my organization made efforts to favour the use of research results | 52% | 53% | 13% |
| Influence: Research results influenced decisions in my organization | 45% | 42% | 9% |
| n | 223 | 53 | 833 |

[1] Throughout the rows, the lower bound (at the 95% confidence level) of the NCE estimate and the upper bound (at the 95% confidence level) of the Landry, Lamari and Amara estimate do not overlap.
Note: Concepts used in this table are from Landry, Lamari and Amara (2003), as are the results from these authors.

On the following indicators, groups 1 and 2 (supported for networking and collaboration) rated the following higher than Group 3 (not supported):

- increased research funds for members of the group;
- new policies created;
- new standards/norms/regulations established;
- graduate students hired;
- behavior of people and organizations concerned by the research subject improved;
- attitudes of people and organizations concerned by the research subject improved;
- improvements to the quality of life of Canadians.

## EXHIBIT 4.9
## Other knowledge transfer indicators

| (% stating that, as a result of the work conducted by one's group of researchers, the following happened "more" or "much more" often MINUS the % stating that it happened less often or much less often)[1] | NCE researchers (Group 1)[2] | Other researchers with network-related grants (Group 2)[3] | Researchers without network-related grants (Group 3) | Statistical significance |
|---|---|---|---|---|
| **Business outcomes** | | | | |
| patents applied for | 19%+ | 8%[ns] | 6% | ** |
| patents issued | 12%+ | 4%[ns] | 5% | ** |
| increased research funds for members of the group | 66%[ns] | 62%+ | 55% | ** |
| licenses issued | 11%+ | 3%[ns] | 3% | ** |
| new companies formed | 13%+ | 4%[ns] | 4% | ** |
| existing companies made more profitable | 20%+ | 12%[ns] | 10% | ** |
| **Innovation** | | | | |
| new knowledge | 79%[ns] | 76%[ns] | 79% | — |
| new products / services / processes created | 46%+ | 34%+ | 26% | ** |
| new policies created | 26%[ns] | 28%+ | 14% | ** |
| new standards/norms/regulations established | 27%[ns] | 24%+ | 16% | ** |
| **HQP** | | | | |
| graduate students trained | 78%[ns] | 73%[ns] | 70% | * |
| graduate students hired | 73%[ns] | 67%+ | 60% | ** |
| **Societal impacts** | | | | |
| behavior of people and organizations concerned by the research subject improved | 47%[ns] | 49%+ | 36% | ** |
| attitudes of people and organizations concerned by the research subject improved | 51%[ns] | 55%+ | 41% | ** |
| improvements to the quality of life of Canadians | 51%[ns] | 49%+ | 38% | ** |
| n | 534 | 892 | 962 | |

[1] For a better representation of the program impacts, the data are calculated as net effects: the percentage of respondents indicating that the existence of the program reduced the effect is taken out of the proportion who said that it increased it. This is the only set of questions presented this way because other scaled questions were from zero to some positive value (e.g., never to always).
[2] Comparison of Group 1 to Group 2.
[3] Comparison of Group 2 to Group 3.

# Chapter 5

# PROGRAM COST-EFFECTIVENESS AND DESIGN

## 5.1 Cost-effectiveness

***In brief***

Factoring in the limitations of cost-effectiveness analyses, the relative cost-effectiveness measures yield positive messages for the NCE Program. The NCE Program compared favorably to other programs with regard to its operating costs. It ranked second with regard to the ratio of costs per $1,000 of research funding and the cost per grant, and first in leveraging research money and other contributions from sources outside of the program.

The evaluation is concerned with the demonstration of the added value of the program compared to other existing research funding mechanisms. It is also interested in the cost-effectiveness of the NCE delivery model

compared to other approaches. Alternatives to the NCE model that were included in the comparison with regard to the costs of administrating programs are:

- network from selected CIHR institutes were analyzed (ICR, INMD, IHDCYH, IHSPR) as well as the NCE-NI model;[1]
- independent network programs represented by Canadian Policy Research Network (CPRN), Canadian Consortium on Human Security (CCHS) and the Drought Research Initiative Network of the Canadian Foundation for Climate and Atmospheric Sciences (CFCAS).

The cost-effectiveness analysis compared the different models in terms of:

- program-level operating costs,
- network-level operating costs,
- value of research funded,
- the number of grants/projects funded, and
- the leveraging effect with regard to additional funding sources.[2]

In order to analyze cost-effectiveness of the program and networks, data were collected on the overall budget, additional funding sources, operating costs for the program and the individual networks, and funded research.

The output indicators focus on core elements of the programs such as research funding and (financial) collaboration with partners. The relative efficiency of each model can be compared to assess the extent to which the outputs of interest (research funded in dollars, number of grants/projects, leveraging effect) can be delivered more efficiently by any of the alternative delivery models.

The challenges of a cost-effectiveness analysis lie in varying data quality and definitions of administrative costs and resulting variations in financial statements provided by the program and networks. In general, administrative costs are defined as costs associated with common or joint activities and objectives that cannot be identified with a specific project.

1 Other network programs such as SSHRC Metropolis or NSERC Strategic Network Grants were excluded due to limited data availability. The National Rural Research Network is no longer active and was thus also excluded.

2 Leveraging effects were omitted for the CIHR and CFCAS due to limitations in data availability. Research funding is not relevant for the NCE-NI.

This includes costs for administrative facilities and legal services connected to the program, but excludes costs for research activities and program delivery. A difficulty with this definition is the clear distinction of costs, as some costs may be associated with both administration and research activities. This is particularly true for salaries and benefits, as some organizations do not present detailed financial statements separating administrative and program staff accounting. In this evaluation, the definition of administrative costs was based on an example outline provided by the Treasury Board Secretariat of Canada[1] and includes the following items: salaries and benefits of administrative staff; professional services; amortization; office space, utilities, materials, supplies; communication; insurance and taxes; and staff travel.

Where possible, data was collected for a constant fiscal year (2005-2006) to enable comparison. Also, due to limitations in data availability for the alternative models included in the analysis, the data for the CCHS was taken from a recent study for the Department of Foreign Affairs and International Trade and covered the years 2001-2003.

To ensure data reliability, only information reported in financial statements, administrative records or confirmed by auditing procedures was included in the analysis.

Exhibit 5.1 presents the data used in the cost-effectiveness analysis. Figures for costs and outputs are laid out for each case used in the analysis. In all cases, the data are from official annual reports and financial statements.

1 http://www.tbs-sct.gc.ca/pubs_pol/dcgpubs/accstd/tbasdafs1_e.asp#_Toc130608738

**EXHIBIT 5.1**
**Cost-effectiveness analysis data and results for fiscal year 2005-2006**

| | Row | NCE[1] | NCE-NI[2] | CIHR[3] | CPRN[4] | CCHS[5] | CFCAS[6] |
|---|---|---|---|---|---|---|---|
| **Costs** | | | | | | | |
| Total Budget in $000 | a | 82,300[7] | | 813,000 | 2,930 | 903 | 10,900 |
| Agency-level operating costs in % of annual budget | b | 3.5[7] | | 5.8 | 15.7 | — | 3.4 |
| Network-level operating costs in % of annual budget | c | 12.8 | 3.2 | 8.0 | — | 29.2 | 13.8 |
| Total operating costs in % of annual budget | d | 16.3 | 6.7 | 13.8 | 15.7 | 29.2 | 17.2 |
| **Outputs** | | | | | | | |
| Research funded in $000 | e | 79,500 | — | 776,800 | 3,726 | 454 | 13,585 |
| Research funded at the network level in $000[8] | f | 2,554 | — | 6,558 | 3,726 | 454 | 843 |
| Number of grants (case study network average) | g | 39 | — | 87 | — | 10 | 15 |
| Leveraged funds (case study network average) | h | 3,322 | 157 | — | 2,636 | 129 | — |
| **Cost-effectiveness** | | | | | | | |
| Cost per $1000 research funding ( e / ( a * d ) ) | i | $163 | — | $138 | $157 | $292 | $172 |
| Cost per grant ( ( f / g ) * d ) | j | $10,674 | — | $10,402 | — | $13,257 | $9,666 |
| Leveraging effect ($ per $100 of research funding) ( ( h / f ) * 100 ) | k | 130 | — | — | 71 | 23 | — |

[1] NCE Program Annual Report 2005-2006; ISIS Canada 2005-2006 Annual Report; CLLRNet Annual Report 2005-2006; Canadian Stroke Network Annual Report 2004-2005; SFM Network 2005 Annual Report; administrative data base.
[2] NCE Program Annual Report 2005-2006.
[3] CIHR 2005-2006 Performance Report; Institute of Health Services and Policy Research 2005-2006 Annual Report; Institute of Human Development, Child and Youth Health Annual Report 2005-2006; Institute of Cancer Research Annual Report 2005-2006; Institute of Nutrition, Metabolism and Diabetes 2004-2005 Annual Report.
[4] CPRN 2005-2006 Annual Report.
[5] CCHS Evaluation Report (prepared by R.A. Malatest & Associates Ltd. in 2007 for DFAIT). Data for 2001-2003.
[6] CFCAS Annual Report 2005-2006; data only for DRI Network.
[7] Financial statements do not separate data for NCE and NCE-NI.
[8] Defined as the average of case studies included in the analysis.

Factoring in the limitations of cost-effectiveness analyses, the relative cost-effectiveness measures yield positive messages for the NCE Program. The NCE Program compares favorably to other programs with regard to the efficiency of operations as represented by the ratio of operating costs over the annual budget. The NCE Program ranked second (*ex aequo* with CPRN and CFCAS) with regard to the ratio of costs per $1,000 of research funding and the cost per grant (*ex aequo* with CIHR). In leveraging

research money and other contributions from sources outside of the

program itself, the NCE was more successful than CPRN and CCHS (the only cases where comparable data were available).

## 5.2 Effectiveness of the network structure

Under the current model, networks manage their funding through an arms-length Board of Directors. NCE networks also typically possess a research management committee, which is responsible for overseeing the scientific aspects of the network activities.

The appropriateness of this type of structure was tested in each of the eight case studies. In all instances, the structure was considered effective and not overpowering. Some networks felt the need for additional structures, such as the Working Group on Intellectual Property at CBDN, a Marketing Committee at MWPN, a Partner Committee at SFM, a Knowledge Management Committee at CLLRNet, Research Team Groups at EDGE and elsewhere. In one case, a concern was expressed that the network structure was the same for an NCE-NI network, which has less resources than an NCE network.

## 5.3 Design and resources

Sufficiency of resources was not raised as a significant constraint, even though it is obvious to everyone that more could be done with more resources. Those who expressed a viewpoint in this regard as part of the case studies indicated that the resources were managed efficiently by small teams of dedicated staff. Informants from CLLRNet were more critical of available resources because of the lack of other sources of funding in literacy.

The built-in 14-year limit to the funding of NCE networks was criticized from two angles. First, it was seen as an artificial barrier that is detrimental to developing full benefits from a well-functioning network.

One suggestion was that existing networks could be allowed to compete for additional years of funding at the end of their second seven-year term.

Second, the 14-year limit could produce a shift in priorities from the production of useful knowledge to the commercialization of knowledge in an effort to create funding opportunities for the network reaching the end of its NCE funding phase. This concern was expressed during the case study of ISIS: researchers who specialize in fundamental and non-applied research will feel left aside in the last few years of activity of the network because of the insistence on knowledge transfer. This viewpoint is echoed in Atkinson-Grosjean (2006, 199): "Under pressure of the cap, instead of providing fertile climate for research and translation, the program focused the participants' energies on profit and survival. Furthermore, for network scientists, the focus on profit interfered with the 'serious fun' of doing science and belonging to the network. The 'fun factor' is important for many scientists. A majority of respondents considered the effort to replace (public) program funding with funding from private sources to be misplaced, believing that self-sufficiency was doubtful without federal support."

## 5.4 Network management

Obtaining superior results in the areas of collaboration, partnership, research and training demands that networks focus on important and manageable objectives. This type of focus requires making choices and discarding other possible courses of action. And making these choices can create dissent and quarrels where the objective is collaboration and team work. The necessary ingredient to make these choices work is leadership, leadership that is strongly supported within the network.

Some networks have been very effective at leveraging leadership from existing teams and relationships. They tend to be the networks that were able to make the right choices early on, to make the corrections when necessary and to work constructively towards achievable objectives and significant changes in their area of concern; the examples of the CSN and ISIS fit this model. In areas where such leadership did not take root early,

networks have had to take valuable time to build agreement around a research and action program, sometimes at the expense of an integrative view that could ease the translation of knowledge into action.

## 5.5 Network sustainability

The capacity of networks to maintain themselves past the 14-year funding period (which may be extended by two years via the Research Management Fund) is no longer part of the program expectations. Nonetheless, it was presented as a challenge at the forefront of some key informant thoughts during interviews conducted for this evaluation. Similarly, Dr. Fraser Mustard, then on the Board of Directors of the Protein Engineering Network, identified network sustainability as a "key challenge" (*Excellence has no fixed address*, 2004, page 6): "They need to think through the sustainability factor. Rather than cutting off networks after fourteen years, they need to find an evolutionary way of assessing them, at least for those networks that are highly relevant and moving with the field."

Logically, in order to achieve the ultimate program objectives, it would be expected that the research momentum is kept and that knowledge on the issue of interest of each network continues to accumulate. This does not necessarily mean that a formal structure must continue to exist — although such a structure would provide some comfort that the issue has not faded from researchers' interests and that the expected impacts would materialize.

Some of the studied networks had passed the 14-year sunset threshold for NCE Program funding and some others were approaching it. The information collected during the case studies indicates limited thought has been given by networks to a sustainability strategy. Past the funding period, these networks have seemed to disintegrate slowly or at least to morph into much less active entities. MicroNet presents a similar case: one of its founders indicated that it "created a cohesive roadmap for research" but that "We built up quite a capability which is going to disappear. There is no mechanism to try to continue the work or keep the

momentum going." (*Excellence has no fixed address*, page 9). However, other networks have shown that other fates are possible. For example, CGDN indicated that it could go on funding research for many years based on its partnerships, its spin-off companies and revenues from its patents and licenses (*Excellence has no fixed address*, page 8).

Evidence gathered as part of this evaluation tends to support the notion that the sustainability of NCE networks, at least as vibrant knowledge production and translation milieu, is illusory. Sustainability via revenue generation (e.g., licenses) or partner funding is even more difficult in networks concerned with social effects rather than commercial applications. All else being equal, it is probably more likely that a reincarnation of MWPN or ISIS would be able to self-sustain than would be the case for CLLRNet or CSN.

## 5.6 Reporting requirements

Reporting requirements demanded by the NCE Program of funded networks are substantial. They include annual reports, mid-term reviews, etc., and they are structured into a data collection system set up by the program.

We have heard few criticisms of the burden they represent, and the critics we have heard were mainly in the context of NCE-NI networks, which receive less funding than NCE networks. In fact, it has been said that reporting requirements were important tools to help networks keep the focus on the five program criteria (excellence of the research program, the development of HQP, the development of collaboration and partnerships, knowledge and technology exchange and exploitation, and good management of the network). Reporting requirements also produce independent feedback, which is crucial to the steering of the networks. Finally, they give networks an opportunity to realign their action if it was found to produce results that are not in line with the expectations of the program.

Also, some network representatives noted that some key performance indicators (such as patent applications and patents obtained) were not relevant to their network. Given the NCE Program focus on the application of scientific knowledge and on the connection with the receptor community, indicators depicting performance in these regards would be particularly relevant. Similarly, considering the program focus on multi-disciplinary research, it is surprising that the administrative data that are collected in an on-going fashion do not contain more related indicators. For example, to our knowledge, there is no list of funded projects characterized by the key disciplines involved.

# Chapter 6

# PROGRAM RATIONALE

***In brief***

The evaluation supports the rationale for the continuation of the NCE Program. The NCE Program assembles at least three characteristics that other granting council programs do not share or bring together to the same degree: the multi-disciplinary nature of networks; the strong emphasis placed on the training of highly qualified personnel in a multi disciplinary, multi-sectoral, networked environment; and the objective of solving real-world problems via research and knowledge transfer. Moreover, the NCE Program distinguishes itself with a long-term funding commitment, a clearly national scope woven right into its fundamental network requirements and an emphasis on multidisciplinarity that cuts across the granting councils' mandates. Informed stakeholders consider that the NCE Program ranks among the top vehicles of S&T commercialization and translation support for Canadian research and technological application. While many of the positive outcomes of the NCE Program are shared with other network-related programs, it performs better than these programs in some key areas, such as the creation of structured networks, the establishment of intersectoral partnerships, and knowledge utilization — in particular, the commercialization of research findings. In addition, the Government of Canada's newly released S&T strategy has recently given the program a central role.

Contrary to what is usually done, the question of the program rationale is addressed last in this evaluation study. This is because much of the rational support for NCE Program depends upon the program effects and progress towards the achievement of its objectives.

***The NCE Program niche***

The Canadian research landscape has changed significantly since the creation of the NCE Program. The innovative model on which the programs based has been replicated by other granting organizations and other countries, and it is now assumed that networking leads to outcomes not otherwise achieved through other R&D management models. This raises the question of the particular niche of the NCE Program given the current national R&D funding environment.

As the program goes forward, it is time to ask how the NCE Program currently fits into the federal and provincial R&D funding systems. This implies looking at the relationship between the NCE, the programs of the three granting Councils, as well as other federal funding initiatives supporting R&D in universities, the health sector, government and/or industry.

Exhibit 6.1 lines up the objectives of major collaborative programs from each of the granting councils with the NCE Program objectives; the statements of objectives were obtained from official documentation.[1] Within the limits of the comparison of complex statements and without other in-depth methods to explore differences and similarities among programs, it appears that major council programs share the objectives of the NCE Program to some degree. There is little surprise in the observation that all four programs focus on leading-edge research; this is a trademark of federal granting councils. All four programs also state the importance of HQP training.

[1] *NCE Program Guide*, 2003, http://www.nce.gc.ca/comp/programguide.pdf; *CIHR's Blueprint For Health Research and Innovation*, 2007, http://www.cihr-irsc.gc.ca/e/pdf_20268.htm; NSERC *Strategic Network Grants*, http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=b2; SSHRC *Major Collaborative Research Initiatives*, http://www.sshrc.ca/web/apply/program_descriptions/mcri_e.asp#1.

## EXHIBIT 6.1 • Objectives of collaborative programs from granting councils

**LEADING-EDGE RESEARCH**

***NCE*** (*NCE Program Guide, 2003*)
- Stimulate internationally competitive, leading-edge fundamental and applied research in areas critical to Canadian economic and social development

***CIHR institutes*** (*CIHR's Blueprint For Health Research and Innovation*)
- Address emerging health challenges and develop national research platforms and initiatives
- Develop and support a balanced research agenda that includes research on disease mechanisms, disease prevention and cure, and health promotion
- Harness research to improve the health status of vulnerable populations
- Support health innovations that contribute to a more productive health system and prosperous economy

***NSERC Strategic Network Grants*** (http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=b2)
- Generate new knowledge/technology with the strong potential to strengthen Canada's industrial base, generate wealth, create employment, and/or influence Canadian public policy

***SSHRC Major Collaborative Research Initiatives*** (http://www.sshrc.ca/web/apply/program_descriptions/mcri_e.asp#1)
- Support leading edge, collaborative research that meets high standards of excellence, promises a significant contribution to the advancement and transfer of knowledge in the humanities and social sciences, and encourages discussion and debate from a broad perspective on critical issues of intellectual, social, economic and cultural significance for Canadian scholarship and society
- Promote broadly based collaborative research as the central mode of research activity—both within and among disciplines, departments and faculties, as well as with other sciences at universities across the country and abroad

**TRAINING**

***NCE*** (*NCE Program Guide, 2003*)
- Develop and retain world-class researchers in areas essential to Canada's productivity and economic growth

***CIHR institutes*** (*CIHR's Blueprint For Health Research and Innovation*)
- Strengthen Canada's health research communities

***NSERC Strategic Network Grants*** (http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=b2)
- Increase the number of highly qualified personnel in the areas targeted by this program

***SSHRC Major Collaborative Research Initiatives*** (http://www.sshrc.ca/web/apply/program_descriptions/mcri_e.asp#1)
- Provide unique opportunities for training students and postdoctoral fellows in a collaborative, interdisciplinary research environment

**MULTI-DISCIPLINARITY**

***NCE*** (*NCE Program Guide, 2003*)
- Create nation-wide multi-disciplinary and multi-sectoral research partnerships that integrate the research and development priorities of all participants

***CIHR institutes*** (*CIHR's Blueprint For Health Research and Innovation*)
- Encourage and support interdisciplinary, collaborative research designed to resolve complex health issues

**TRANSLATION OF RESEARCH FINDINGS**

***NCE*** (*NCE Program Guide, 2003*)
- Accelerate the exchange of research results within the network and the use of this knowledge within Canada by organizations that can harness it for Canadian economic and social development

***CIHR institutes*** (*CIHR's Blueprint For Health Research and Innovation*)
- Transforming health research into action: to catalyze health innovation in order to strengthen the health system and contribute to the growth of Canada’s economy.

***NSERC Strategic Network Grants*** (http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=b2)
- Foster the increased participation of Canadian-based companies and/or government organizations in academic research
- Result in the transfer of knowledge / technology and expertise to Canadian-based companies that are well positioned to apply the results for economic gain or to government organizations to strengthen public policy

***SSHRC Major Collaborative Research Initiatives*** (http://www.sshrc.ca/web/apply/program_descriptions/mcri_e.asp#1)
- Promote the development of active partnerships with private or public sector groups to ensure their participation in the design and conduct of the research project and in the dissemination of research results

The NCE Program focus on multi-disciplinarity in all of its funding sets it apart, although CIHR shares this characteristic to some extent. Aside from the NCE Program, only SSHRC's objective regarding HQP training makes reference to interdisciplinarity. Arguably, NCE's expression of the objective of translation of knowledge is the clearest among the three that include a similar objective.

Interviews with representatives of NCE Selection Committees, granting agencies and Industry Canada confirmed the findings derived from this study of stated program objectives. Many of the goals mentioned by the interviewed representatives of other network programs were similar to the goals of the NCE Program. Stated goals ranged from supporting excellent and innovative research, increasing and sustaining the number of highly qualified personnel in the research area of the network, and facilitating the application of research findings to the development of effective partnerships. However, some informants who had previously also been involved in NCE networks mentioned that the NCE's focus on creating partnerships with the receptor community was understood to be stronger than in the programs included in the comparison.

At its face, the NCE Program includes at least three characteristics that other granting council programs do not share to the same degree: the multi-disciplinary nature of networks, the strong emphasis placed on the training of highly qualified personnel, and the objective of solving real-world problems via research and knowledge transfer. Moreover, the NCE Program distinguishes itself with a long-term funding commitment (up to 16 years), a clearly national scope woven right into its fundamental network requirements and an emphasis on multi-disciplinarity that cuts across the granting councils' mandates.

***The policy environment***

The key document to situate the NCE Program in current government policy is *Mobilizing Science and Technology to Canada's Advantage*, the most recent S&T policy statement of the Government of Canada. This document states that the federal S&T policy is "focused on encouraging a more competitive and sustainable Canadian economy with the help of

science and technology. This new, focused Strategy recognizes that the most important role of the Government of Canada is to ensure a competitive marketplace and create an investment climate that encourages the private sector to compete against the world on the basis of their innovative products, services, and technologies. Canada must maximize the freedom of scientists to investigate and of entrepreneurs to innovate." (2007, 10).

The new policy sees the NCE Program as an important level of action:

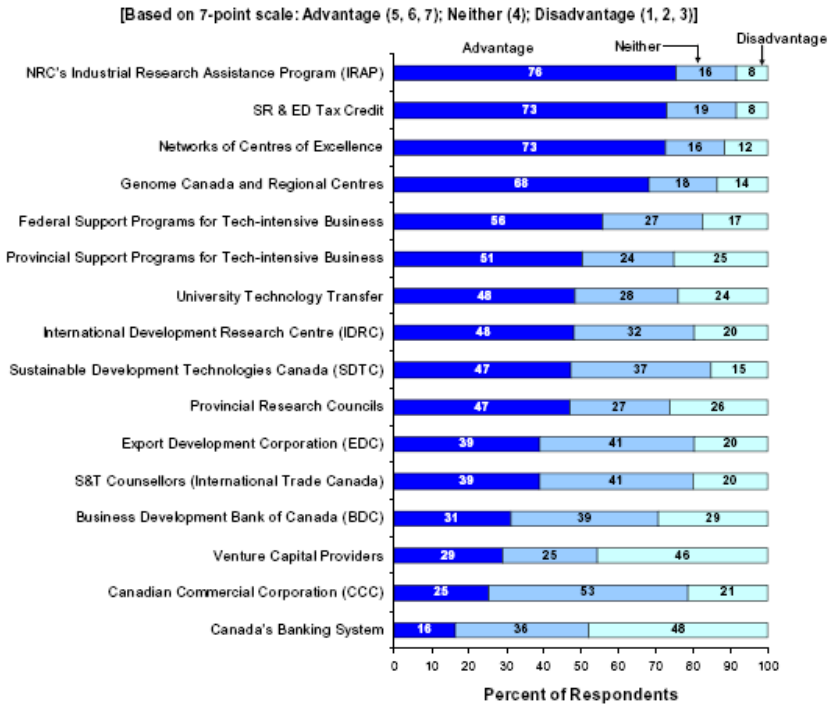
> "The Networks of Centres of Excellence program brings university and industry researchers together, under the leadership of the university, to advance S&T developments with practical applications. To date, centres have spun off 117 companies and contributed to the development of more than 6,000 highly qualified professionals, including researchers, post-doctoral fellows, graduate students, and technicians. There are opportunities to generate even greater commercial outcomes from this program by creating new networks that are proposed and led by the private sector." (2007, 56). [...]
>
> Canada's federal government will strengthen public-private research and commercialization partnerships by:
> - Introducing new business-led research networks under the Networks of Centres of Excellence (NCE) Program in order to bring together government, private, and academic experts from around the world to support applied research in environment, energy, ICT, and health priorities, through a competitive, national process. [...]
> - Establishing a new Centres of Excellence in Commercialization and Research program. [...]
> - Creating a new tri-council private-sector advisory board for the granting councils to provide advice on the implementation of business-driven Networks of Centres of Excellence, Centres of Excellence in Commercialization and Research, and the college initiatives.

Clearly, the Government of Canada assigns an important role to the NCE Program, albeit with an increased private sector involvement.

### *The NCE Program and other tools to commercialization and translation of research findings*

One other independent source situates the importance of the NCE Program in the area of support for commercialization and translation of research findings. In 2006, the Council of Canadian Academies asked the Committee on the State of Science and Technology in Canada (2006) to advise as to Canada's strengths and capacity in science and technology. The Committee commissioned a survey of more than 1,500 senior people considered to be well-informed on S&T in Canada. The sample comprised representatives from academies, universities, businesses, government, and other venues; 11% of respondents were associated with the Networks of Centres of Excellence. Participants were asked to rate their opinion of the degree of advantage each of 16 types of S&T commercialization and translation support provide for Canadian research and technological application relative to other advanced countries. For illustration, the types of support included, among others, NRC's IRAP, S&T tax credits, Genome Canada, and the Export Development Corporation. Among the16, the NCE Program ranked third in the advantage it provides Canada in this area. IRAP and S&T tax credits came first and second, only very slightly better scored than the NCE Program (see Exhibit 6.2).

**EXHIBIT 6.2**
**Advantage provided by types of S&T commercialization and translation support to Canadian research and technological application**
(Source: Committee on the State of Science and Technology in Canada, 2006)




### *The NCE Program performance*

The continued rationale for the existence of the NCE Program is further supported by the results observed as part of this study. While the NCE Program shares the success of other network-related programs in some areas, it exceeds them in performance in many other ways. NCE Program funding was effective at producing larger networks of researchers (although the intensity of collaboration in NCE networks is less than networks closest to researchers). The NCE research networks are more structured and possess stronger leadership. The NCE Program offers more opportunities to students with regard to publications and conferences, ethical debates and exposure to real-life practices; participation in the NCE Program also leads to a better fit between the field of study and

employment. The NCE networks are more productive than other networks in the following areas: patents applied for and patents issued; licenses issued; new companies formed; existing companies made more profitable; and new products / services / processes created. Finally, NCE networks are highly effective at supporting the commercialization of research results and at translating research findings into practical solutions for real-life, national issues.

Eleven key informants were interviewed as part of this evaluation (see section 3.5, page 24 for details on the interviewees). They were not employed by the NCE Program, which they knew as representatives of granting councils or as members of NCE Program committees; in that, they offer a detached view of the program rationale and performance. NCE Program committees assessed the program as a very valuable component in Canada's research funding environment. In their view, the program has connected researchers with receptor communities and it has been particularly successful in the area of partnerships with industry. Several key informants stressed that there is room for improvement with regard to policy impact: to them, the networks have not significantly influenced policies and decision-making processes, despite their connection to government partners. It was felt that many networks are still too much driven by pure research, instead of policy and commercial impact. Overall, key informants viewed the NCE Program and the networks as a successful program because of its strong emphasis on applied research and on the multi-disciplinary approach.

Connecting back to the logic model of the NCE Program (see Exhibit 2.1), this evaluation has provided evidence that the program has:

- increased networking among partners and collaboration among researchers, particularly at a multi-disciplinary level;
- produced leading-edge research findings relevant to the needs of Canadian stakeholders; results from NCE-supported research has been used by industry as well as by governments;
- successfully emphasized nation-wide, multi-disciplinary and multi-sectoral research partnerships between universities, industry, the health sector, government and non-government organizations;
- offered advanced training featuring components not found in other settings;

- supported the transfer of knowledge to the user communities, and commercialization of research findings in particular, beyond what would have happened without the program.

While it is difficult to provide an assessment of the NCE Program contribution to Canadian productivity, economic growth and improved quality of life for Canadians, many of the research findings, industrial results and public policy improvements associated with the NCE networks should lead to such long-term outcomes.

***The NCE Program as an experiment***

When it was established in 1989, the NCE Program was based on new ideas that others have qualified as "controversial" (*Evaluation Planning Report*, page 5): the distributed network model (where network members are not physically close to one another) and the focus on generating practical applications from fundamental research programs, working in concert with the receptor community. The NCE Program was an experiment.

The program evolved over the years, learning on the go as well as through program evaluation studies and other reviews. Its tenets proved so solid that granting councils developed parallel network programs of their own and similar programs burgeoned in other countries. The NCE Program has been a successful experiment.

Rich with years of experience and several positive reviews, the NCE Program could experiment. It launched the NCE-NI networks and then the International Partnership Initiatives pilot project. There is no certainty that these experiences will bear fruit, but the simple fact that the NCE Program is able to attempt these experiments has value in itself. The NCE Program is a rich environment in which to test new ideas. This is another feature which contributes to the program niche.

# Chapter 7

# CONCLUSIONS

Based on a research design that was both strong and respectful of the complexity of the NCE Program delivery context, this evaluation drew some unambiguous conclusions. They are synthesized in this chapter, along with the recommendations that flow from them.

***Findings: program continuation***

The evaluation supports the rationale for the continuation of the NCE Program.

The NCE Program assembles at least three characteristics that other granting council programs do not share or bring together to the same degree: the multi-disciplinary nature of networks; the strong emphasis placed on the training of highly qualified personnel in a multi-disciplinary, multi-sectoral, networked environment; and the objective of solving real-world problems via research and knowledge transfer.

Moreover, the NCE Program distinguishes itself with a long-term funding commitment, a clearly national scope woven right into its fundamental network requirements and an emphasis on multi-disciplinarity that cuts across the granting councils' mandates.

Informed stakeholders consider that the NCE Program ranks among the top vehicles of S&T commercialization and translation support to Canadian research and technological application.

While many of the positive outcomes of the NCE Program are shared with other network-related programs, it performs better than these programs in some key areas, such as the creation of structured networks, the establishment of intersectoral partnerships, and knowledge utilization — in particular, the commercialization of research findings. Clearly, there is an undisputed place for the NCE Program.

In addition, the Government of Canada's newly released S&T strategy has recently given the program a central role.

*Recommendation 1: Since it occupies a unique position in addressing issues that are important to Canada in an integrated manner and in supporting knowledge transfer, maintain the NCE Program.*

***Findings: program funding***

The NCE Program has been able to achieve significant results with existing resources. In general, stakeholders have not criticized the level of funding provided to individual networks, although it is obvious to everyone that more could be done with more resources. This evaluation is not in a position to recommend adding to or subtracting from the current program funding. It can only conclude that the program produces significant incremental benefits to Canada and Canadians, and that it is managed in a cost-effective and efficient manner.

***Findings: excellence in research***

This evaluation did not attempt to gather new evidence concerning the excellence achieved by NCE networks in research. The reason for this is that the characterization of the level of excellence of the research is a complex endeavor that was beyond the resources of this evaluation. At the evaluation planning stage, it was felt that the expert panels that review submissions for new networks and for network renewals, and panels that

perform mid-term reviews are in a better position to pass judgment on this issue. Nonetheless, experts interviewed as part of this evaluation held the research performed by NCE networks studied here in high regard.

Also, the evaluation found that the proportion of NCE researchers who belong to the Thompson Scientific Citation Database list of highly cited researchers is four times higher than the proportion of all Canadian researchers on the list (i.e., 1.5% versus 0.4%).

The evaluation describes how, over their life, networks are subjected to reviews by up to 10 different instances (four times by an expert panel, four times by the Steering Committee and twice by the Selection Committee). In our view, this is the strongest possible mechanism to ensure that networks are focused on excellence in research and deliver on their promises.

Between 2001 and 2006, expert panels have included a healthy 64% of non-Canadian members, thereby contributing to the independence and the rigor of the assessments and ensuring international benchmarking. In addition, 32% of selection committee members were non-Canadians.

***Findings: HQP training***

The NCE Program offers more opportunities to students with regard to publications and conferences, ethical debates and exposure to real-life practices. Participation in the NCE Program also leads to a better fit between the field of study and employment.

According to researcher input, more recently formed NCE networks offer more frequent access to multi-disciplinary initiatives and ethical debates about research but less exposure to real-life practices than older NCE networks. Access to multi-disciplinary initiatives is somewhat easier in health sciences than in natural sciences and engineering or in social sciences and humanities; access to ethical debates is easier in health sciences and in social sciences and humanities than in natural sciences and engineering.

All in all, the training objective of the NCE Program seems to have been

achieved only in part. Within the HQP training aspect of the program, the emphasis on multi-disciplinarity is of particular concern considering the importance that this feature has in the logic of the program.

*Recommendation 2: The program should restate the importance of the HQP training objective and request that networks develop additional strategies designed specifically to bolster the multi-disciplinary and multi-sectoral components of HQP training.*

***Findings: research collaboration and partnerships***

The NCE Program has been more successful than other network-related programs at facilitating the creation of formal structures: its networks have more organized strategies and tasks as well as stronger leadership and decision-making processes. At the individual level, the findings show that the NCE Program increases the likelihood of collaboration as well as the size of collaborative networks; however, it does not replace NCE researchers' closest research group in terms of the intensity of collaborations — nor does the program expect them to.

NCE networks have been successful at bringing together researchers, public sector and private sector representatives, and NGOs to contribute to the definition of key knowledge issues, the execution of research and the translation of research findings into actionable results. Partnership results are most evident where prior relationships existed among some partners and in sectors where the NCE network can build on existing clusters of interests.

Globally, NCE networks have shown more collaboration results than application results. By design, the NCE model sees networking as a predecessor to application: through networking, the most productive avenues of research are identified; networking also contributes to the dissemination of knowledge stemming from the research. There is a risk with the NCE model that networking could become an end, rather than a means. Restating the role of networking as a conduit to knowledge and then application is crucial.

The new policy directions outlined in *Mobilizing Science and Technology to Canada's Advantage*, the most recent S&T policy statement of the Government of Canada, and the new initiatives it contains (business-led research networks, Centres of Excellence in Commercialization and Research, tri-council private-sector advisory board for the granting councils) should revive NCE results in terms of knowledge transfer activities and knowledge utilization. More generally, and in order to impact existing networks, the program should revisit its performance measurement scheme to emphasize the importance of knowledge transfer efforts by networks and knowledge utilization by the receptor community.

*Recommendation 3: Revise performance measurement schemes to emphasize knowledge transfer and knowledge utilization as end results and networking as a means to that end.*

***Findings: knowledge and technology exchange and exploitation***

Networking and collaboration programs double the amount of knowledge transfer activities and increase significantly knowledge utilization according to researchers. This finding is true for NCEs as well as other network programs. When compared to the average government agency, there was vastly more research finding utilization among NCE public sector partners in 2006 than in the average government agency. Although the comparison is somewhat limited by the date of the study (the only available date on public sector use was colleted in 1998[1]), the results suggest very good performance by the NCE Program in this regard. Network-related programs are particularly adept at affecting the creation of policies, standards and regulations, the modification of behavior and attitudes of target groups and improving the quality of life of Canadians. Areas where the NCE Program performs better than other network- and collaboration-related programs cluster around the commercialization of research results: patents and licenses, the formation of new companies and the improvement of the health of existing ones and the creation of new products, services and processes.

1 Landry, Réjean, Mokar Lamari and Nabil Amara (2003), "The Extent and Determinants of the Utilization of University Research in Government Agencies" in *Public Administration Review*, vol. 63, no. 2, March/April 2003, pp. 192-205.

These results are clearly positive for the NCE Program. However, while the NCE Program performs better than other networks-related programs in areas where commercialization is a possible outcome, where the expected outcomes are not related to commercialization — such as public policy, regulations, and changes to practices — this evaluation indicates that the NCE Program does not provide more benefits than other networks-related programs.

One possible reason for this is that the NCE Program was originally conceived and deployed with commercialization as a key intermediate purpose and as a vehicle toward improvements for Canada and Canadians. In some of the issue areas more recently tackled by NCE networks, this building principle does not apply as well (e.g., literacy, care of the elderly, stroke). While the program has made efforts to adapt to this reality, more needs to be done to allow all networks to burgeon to their full potential.

The performance measurement demanded of networks is an important program lever to steer networks toward the expected outcomes. It could be used to better demonstrate the value added of NCE networks in areas other than the traditional commercialization. It could also be used to improve HQP-related results, in particular those that relate to defining characteristics of the NCE networks: multi-disciplinarity, ethical issues, exposure to real-life experiences.

More generally, the performance measurement scheme should be revisited. The current system of performance measurement has the advantage of providing standardized metrics that can be totaled and compared; however, it reaches this result at the expense of sensitivity to the particularities of each network. One side effect of this is that some networks may be left with few performance indicators relevant to them.

Networks deal with varied subject matters, using diverse strategies and a range of network compositions. The one thing that ties them all together is the NCE Program logic model (see page 8): all networks use networking, leading-edge research, nation-wide, multi-disciplinary and multi-sectoral research partnerships, as well as training strategies, to achieve accelerated exchanges with the receptor community and use of knowledge, the development of world-class researchers, the creation of functional

multi-regional interdisciplinary research teams and the development of a pool of highly qualified personnel. We recommend that the program adopts these eight outcomes as the reporting structure for each network and that each network be requested to produce its own list of custom indicators of performance within these categories. This may mean that such traditional metrics as patent applications would become much less important if networks elected to measure their performance via other means of knowledge transfer.

*Recommendation 4: Rethink the performance reporting system around the program logic model so that each network can customize their performance indicators while respecting the overall program logic.*

***Findings: program management***

This evaluation did not collect enough evidence to comment on the relative pertinence of the NCE-NI (New Initiative) model as opposed to the traditional NCE funding structure. More work is already under way to assess the NCE-NI experience.

The capacity of networks to maintain themselves past the 14-year funding period is no longer part of the program expectations. Nonetheless, sustainability was presented as a challenge at the forefront of some key informant thoughts during interviews conducted for this evaluation. Logically, in order to achieve the ultimate program objectives, it would be expected that the research momentum is kept and that knowledge on the issue of interest of each network continues to accumulate.

Information gathered in this evaluation suggests that the rigidity of the 14-year funding period is an impediment to overall program performance. Meanwhile, there was no consensus regarding the appropriate duration of funding — suggesting that a one-size-fits-all approach to the duration of funding is not appropriate. Since the NCE Program possesses well-structured and well-functioning peer-review mechanisms, it would be possible to tailor the duration of funding to the specifics of each network.

*Recommendation 5: Adapt the duration of the funding period to the particulars of each network, based on the level and excellence of research output, the level of application of the knowledge by the receptor community and the remaining salience of the issue that triggered the creation of the network.*

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