Report of an International Panel

to

The Royal Society of Canada

The Canadian Academy of Engineering

and

The Canadian Institute on Academic Medicine

on the

Canada Foundation for Innovation

(CFI)

8 September 2001

Executive Summary

The Canada Foundation for Innovation (CFI) is a major funding initiative of the Canadian Government, designed to upgrade the research capability of Canada's universities, colleges and research hospitals. Setting up the CFI was part of the Government's announced goal to help bring Canadian research and development capacity up from the 15th place to one of the top 5 in the relative ranking of the Organization for Economic Cooperation and Development (OECD).

At the request of the CFI, an International Panel was appointed by the Royal Society of Canada (in consultation with CAE and CIAM) to evaluate the impact of the CFI programs to date. It was specifically asked:

- to evaluate the impacts of CFI funding on the research performance of the institutions receiving that funding
- to identify how the institutional research performance has changed from established patterns as a result of CFI funding, within the following performance categories :
  - Capacity for innovation
  - Training of highly qualified personnel
  - Research collaborations and partnerships
  - Benefits to Canada (preliminary assessment only)

Four key questions were posed by the President of the Royal Society of Canada to guide the evaluation exercise:

1. Are the changes or impacts, as identified, likely to be stable over time?
2. What issues of research management are being created for the institutions as a result of the CFI funding?
3. Are there problems or difficulties in research management being created by the pattern of CFI funding and, if so, can remedies for them be identified?
4. Are there alternative frameworks for CFI funding that may be suggested for improving institutional performance?

The Panel members (*Annex A*) were given written information of the various programs of CFI, including many examples of submissions by various types of Canadian institutions. They were also given information on the programs set up in parallel, in particular the Canada

Research Chairs (CRC) Initiative. They assembled in Ottawa to obtain personal presentations from the President of CFI and from officials of the various Ministries involved, and visited the institutions mentioned in *Annex B*, meeting with Vice-Presidents (Research) and the colleagues these had invited to present their views (*Annex C*). One last day of discussions and a lengthy exchange of opinions by e-mail have enabled the Panel to reach a consensus on an *Interim Report*, which has been submitted to the critical appraisal of three independent referees. A renewed discussion by e-mail between the Panel members has led them to agree on replies to the reviewers, and on the present *Final Report*.

The conclusions of the Panel are therefore based on a variety of sources:

- Documents provided ahead of the visits by the Secretariat of CFI: lists of operations, numerical data, progress reports, etc.
- Oral presentations by the staff of the CFI, and by representatives of the Federal Ministries involved,
- Written submissions to the CFI, site visits to organizations and discussions with individuals in these organizations, which had been selected by the RSC,
- And the remarks made by the reviewers of the *Interim Report*.

The major conclusions are the following ones:

- The CFI Initiative is only beginning to have an impact on Canadian research capacity. The early indicators are that this impact is mostly positive, and that these positive effects cannot fail to increase steadily in future years. Given the long time-frame of the initiative, and the way that the program is being delivered, the Panel concludes that it is likely that the impacts will be felt in Canada for many decades to come.
- The CFI and CRC Initiatives have demanded that the research institutions prepare Strategic Plans. While the Panel did not have the time or resources to review the Strategic Plan of each institution, it was clear that the institutions varied greatly in the quality and success of their planning efforts. Institutional plans of this nature are new to most Universities and colleges, and since they are not part of their "culture", there tends to be a long and difficult learning curve. The CFI Program provides a major incentive for institutions to move towards this goal, and the Panel saw this as a valuable outcome of the CFI Initiative.
- Problems in research management created by the CFI funding are significant, and are addressed within the Report and by the Panel recommendations.

- In its report, the Panel identified emerging areas of imbalance in the various elements of a national research effort, including direct and indirect costs of the research. The most serious current problems lie outside the mandate and funding resources available to the CFI (e.g. the direct costs of research). In areas that are within the purview of the CFI, this organization has shown a capacity to progressively introduce novel frameworks for its funding; if this flexibility and this sensitivity continue to be demonstrated in coming years, the CFI will continue to meet the infrastructure needs of innovative Canadian research. One area which does require attention, however, is the need to ensure a close cooperation between the activities of the CFI and those of the Research Councils.

Submitted by the members of the International Expert Panel:

Guy Ourisson, *Chair* (France)
Nicholas Anthonisen (Canada)
Mildred Dresselhaus, (United States)
Peter Lachmann (United Kingdom)
David Layzell (Canada)
Jorge Niosi (Canada)
Martha Salcudean (Canada)

International Panel Report on CFI

Introduction

An International Panel[*] was given the mandate to evaluate the impact of the CFI funding to-date on the research performance of the institutions receiving the funding. The panel was also asked to identify how the institutional research performance has changed from established patterns as a result of CFI funding, within the following performance categories:

- Capacity for innovation,
- Training of highly qualified personnel,
- Research collaborations and partnerships, and
- Benefits to Canada (preliminary assessment only).

The Panel has interpreted this mandate as one of:

- registering how the CFI program has been received and interpreted by the various components of Canada's research community,
- assessing the changes brought about by the CFI funding on the institutional research climate,
- assessing how the stated goal of promoting excellence is being pursued at various institutions,
- gathering suggestions from the present beneficiaries and applicants regarding how the CFI program could be further improved,
- identifying possible obstacles in the participation of the other partners (Provincial Governments, Industry, internal University resources…) that are required to provide matching funds,

[*] The International Expert Panel on the Evaluation of CFI was appointed by Dr. William Leiss, President of the Royal Society of Canada, acting with the support and advice of the Canadian Academy of Engineering and the Canadian Institute of Academic Medicine. In choosing the panel members from other countries (Dr. Mildred Dresselhaus, Dr. Peter Lachmann, and Dr. Guy Ourisson), Dr. Leiss also consulted with officials at the national academies in France, the United Kingdom, and the United States. All members of the panel were chosen for their expertise and personal experience in matters relevant to the tasks of the evaluation of CFI; the foreign participants therefore act as individual experts and not as representatives of the national academies in their respective countries.

- assessing the impact of the CFI program on other elements of the Canadian research and innovation system, and offering suggestions for where improvements could be made.

The Panel has however **not** attempted to evaluate what else could have been achieved, had the same level of new funding been made available within the traditional system or under completely different new rules. This would have required a completely different type of study.

This report will provide a brief overview of the CFI Initiative, summarize the Panel's review process, and report on the results of its findings.

Overview of the Canada Foundation for Innovation

The Canada Foundation for Innovation (CFI) is a novel initiative taken by the Canadian Government, as part of its goal to upgrade Canada's research and development up from the 15th place to one of the top 5 in the relative ranking of the Organization for Economic Cooperation and Development (OECD).

Another major explicit goal has been to base the funding of the CFI primarily on research excellence, on long range institutional planning, and on building capacity for research excellence.

A unique feature of the CFI is that it is an independent corporation, not administered by government, even though it is publicly funded. In setting up the CFI, and through subsequent reinvestments, the government has provided full funding until year 2010. This gives the organization the opportunity to make its own long range plans, to monitor and improve its operational performance, and to take advantage of new opportunities. The resources of the CFI are exceptionally large by Canadian standards ($ 3.15 B plus interest), so that the input of the CFI has the potential of having a profound effect on Canada's research community. As a Foundation aimed at building a strong base for future research and innovation, the CFI has focussed its activities on investments in infrastructure. More recently, it has added a Fund to address the maintenance and operation costs of that new infrastructure.

An important feature of the funding by the CFI is that it provides only 40% of the infrastructure cost; other partners must be found to provide the remaining 60% of the funding needs. This was done to enhance the involvement of provinces, industry and other stakeholders in university, college and hospital research.

The Panel Organization and Review Process Employed

The Royal Society of Canada (RSC) was commissioned by the CFI to carry out the present independent review of its programmes and operations. It appointed a small International Review Panel for this purpose (Appendix A). This Panel was composed of 4 senior Canadian academics and three scientists from France, the UK and the USA. The RSC and CFI provided extensive documentation, and organized consultations with a representative selection of interested parties. The first day of the Panel review was spent in orientation, meeting with CFI and key Government officials. This was followed by a 3-day programme of site visits (Annex B).

At each site that was visited, the schedule was organized by the Vice-President (Research) of the institutions involved. Typically, the Panel met with the administration and the Deans or investigators involved in CFI-funded operations, as well as with some individuals who had failed to obtain support. On several sites, the Panel members also met with non-University participants, such as representatives of industry and provincial governments.

General Comments on the Funds within the CFI Initiative

In its discussions with the Research Institutions, the Panel received comments and suggestions concerning the various Funds administered by the CFI. An overview of these Funds, and the response of the research community, are summarized here, along with specific recommendations from the Panel.

Innovation Fund

The Innovation Fund supports large institutional infrastructure awards. The fund is perceived by the Canadian research institutions as having a major impact on their research capacity and performance. The Panel was told by Research Institutes across Canada that the impacts included:

- rapid improvements in the research infrastructure in Canada, which is becoming comparable with the best in the world,
- the initiation or strengthening of a strategic planning process at many of the institutions. This process has encouraged the institutions to "think big" (or at least bigger) in identifying their research goals, and it has forced them to begin the process of critically analyzing their strengths and weaknesses as a first step in setting priorities and making choices.
- the formation of new collaborations within and between institutions as a result of shared facilities and research goals. The CFI has encouraged multidisciplinary and interdisciplinary research initiatives. Hospitals and colleges have been brought into closer linkage with the university research sector.
- a greater optimism for the future of Canadian research, which has helped to invigorate the research community and attract some of Canada's best young students into research careers.

Despite the enthusiastic support noted for this program, some concerns and issues were brought to the Panel's attention. These included:

- difficulties in obtaining matching funds in some regions (as discussed below, this is especially a problem in the Atlantic Provinces);
- additional costs to the university ($) and researchers (time) associated with applying for and receiving CFI funding, including for the maintenance and operation of the facilities,
- difficulties in attracting sufficient research funds to use the new facilities in an optimal way,
- challenges in coordinating the grant application process for CFI with that of other funding programs.

These issues will be discussed in a later section.

New Opportunities Grants

These grants supply infrastructure support to new faculty recruits who have been hired into research institutions. All institutions were very positive about this program: no negative comment was received. The program was considered to be a very important tool to attract new, highly qualified, excellent investigators to Canadian Universities, making Canada competitive in this respect with any other country.

This program is considered to allow Canada to enter new research fields and to make it possible for universities to develop their strategic plans. It was enthusiastically supported by both researchers and universities, and a number of individuals and institutions stressed the importance of maintaining or enlarging this fund. However, concerns were expressed about the speed of the review process for CFI grants, and there are cases where the delays have resulted in the loss of talented faculty.

Recommendation 1: The Panel recommends that the CFI assess the funding needs for the New Opportunities Program by Universities in terms of anticipated faculty hiring levels and then allocate more funding if appropriate, even if this means that funds must be transferred from other CFI Programs. Furthermore, to provide a more competitive hiring environment, the CFI should respond more rapidly to requests for the New Opportunity Grants.

Another concern was expressed: Canadian researchers recruited from abroad, who had held an appointment at a Canadian university prior to their appointment outside Canada, are at

present ineligible for a New Opportunity Grant. It was felt that this policy may impede repatriation of some excellent Canadian researchers.

Recommendation 2: The Panel recommends that the CFI review its eligibility criteria and review procedures for the New Opportunities Grants, to ensure that it is providing the optimal support for the hiring of excellent new faculty in the coming years. (After this study was completed by the Panel, it was learned that this matter has since been addressed.)

Special CFI Fund for Canada Research Chair (CRC) Recipients

The universities felt that this program was extremely important to retain excellent faculty and to attract new faculty from abroad and from other Canadian universities and colleges. Concerns were expressed about the timing of response of the CFI program to applications for infrastructure support from CRC applicants, which was felt to be too slow. One university reported that the delay in a CFI decision had resulted in two excellent candidates going elsewhere.

Recommendation 3: The CFI Fund for CRC Applicants and the CRC Chair program need to be better integrated, possibly by joint, or at least simultaneous, review of the CRC and CFI proposals.

International Access Fund

This Fund, which will not require a matching investment from other organizations, will provide access for Canadian investigators to international research projects.

The idea for this Fund was received positively, although most universities that were visited told the Panel that the rules to be followed by the CFI administration and the criteria for program selection were not sufficiently clear.[*]

International Joint Venture Fund

This Fund is to support joint ventures with non-Canadian institutions and the $100 million that is available will be restricted to four initiatives. As with the International Access Fund, there was insufficient understanding in most universities of the objectives and rules for

[*] After completion of the study by the Panel, it was learned that the mode of operation of these International Funds is indeed at present being studied with the help of some foreign experts.

this Fund. Several of the smaller institutions were concerned that this Fund would be inaccessible to them and would serve only the larger universities. This concern was exacerbated by the fact that, for this program, there is no need for matching funds. Because of the uncertainty about the criteria for selection, at least one university pressed on the Panel the importance of not allocating all of the funds in the first competition, to allow for later adjustment of the operating rules.

Recommendation 4: The CFI should more clearly inform the potential Canadian applicants of the rules and criteria for selection, both for the International Access Fund and for the International Joint Venture Fund.

Operating Expense Fund

The announcement of this program, which was designed to meet the costs involved in setting up and operating the facilities provided by CFI, was very well received by the research institutions and community. It was widely agreed that this Fund will help to address a serious need.

The Panel approves the proposed plans for implementation of this Fund (i.e. an across-the-board, 30% of the CFI contribution), although some universities expressed a preference for individual applications for this Fund.

Assessment of Proposals to CFI

The CFI told the Panel that it evaluates proposals on the basis of the three criteria that reflect its mandate:

- quality of research and need for the infrastructure,
- contribution to strengthening the capacity for innovation,
- potential benefits of the research to Canada.

The Panel was also told that assessments by external reviewers and expert committees are forwarded to a multi-disciplinary Assessment Committee which is responsible for making recommendations on funding.

High quality peer review is essential if those funding the work and the user community are to have confidence in the fair distribution of the available funding. The Panel was pleased to hear that the Assessment Committees contain a high proportion of internationally-recognized scientists from outside Canada since these should help to evaluate the excellence of the proposed research and the track record of the principal investigators, while limiting the

risk of conflict of interest. The Assessment Committees would have the difficult task of balancing all criteria for a successful application to the CFI, but competent and credible panels provide some assurance that the evaluation process is both efficient and fair.

It is worth noting that while the Panel did not have an opportunity to look at the composition of the Assessment Committees, its Members did have some thoughts on the issue. The Panel felt that while the participation of some qualified scientists from outside the University community *stricto sensu* was certainly desirable, it would be undesirable for administrators or those outside the research community in its widest sense to be used for peer review. Also, rigorous procedures to maintain confidentiality and to prevent leakage of ideas from the proposals must also be maintained.[*]

In situations where the main purpose of the grant by the CFI is to build capacity for excellence rather than to build on existing excellence, different evaluation criteria may have to be applied. The Panel felt that this should be made clear, so as to maintain the transparency and fairness of the peer review process.

Benefits of the CFI Initiative

The Panel was impressed by the fact that the vast majority of the input it received showed that the members of the Canadian academic community it has met consider the program of the CFI to be a major contributor to the fulfillment of their research mission. They identified explicitly a number of benefits of the CFI Initiative on Canadian Research, Development and Innovation. These include :

- ***Increased Commitment to Research***

  The intervention of the CFI has led to major commitments to research funding by the Provinces. It has also leveraged significant financial contributions from a wide variety of private sector sources.

- ***Increased Research Capacity***

  World class, state-of-the-art equipment and facilities not previously hoped for in Canada are being acquired by Canadian research institutions. This infrastructure will help Canadian academics to compete even more successfully on the international scene.

[*] The Panel has not had any indication that they were not.

Therefore, the Panel felt that one of the primary missions of the CFI is being successfully implemented. Of course, many of these facilities are still being set up and commissioned, and it will take time for their full impact to be demonstrated. It is however important to stress that this increased research capacity should make it possible to explore original research directions.

- ***Faculty Recruitment and Retention***

The CFI program has allowed Canadian research institutions to offer internationally competitive recruitment packages to candidates for junior and senior faculty posts. The New Opportunities program and the CFI/CRC program are both powerful tools to recruit and "jump start" new investigators. These start-up packages also help them secure research grants from other sources. Evidence was provided that some faculty members, who had considered leaving Canada, have decided to stay because of the improved opportunities provided by the CFI Funds.

- ***Recruitment and Training of Research Personnel (Graduate Students, postdoctoral fellows, technical staff).***

The education and training of highly qualified personnel are of central importance to the future of science in Canada. These human resources will be needed by Canadian universities for faculty renewal and by the private sector for its recruitments in the next ten years. The Panel saw many examples of how the CFI facilities were giving students and research personnel opportunities to work and learn with state-of-the-art equipment and facilities, within multidisciplinary communities and among other excellent and enthusiastic students and colleagues. Any investment in trained personnel is bound to be beneficial; this may well be the most essential contribution, in the long range, of the CFI programs.

- ***Improved Morale in the Academic Community.***

The Panel was told by many researchers and administrators that the CFI initiative has already resulted in a major improvement in the morale of the Canadian academic community (faculty and students). Faculty members are now much more optimistic than they have been for many years. They see new opportunities for research becoming a reality and are starting to believe that they will be rewarded for excellence and additional effort. Senior investigators are now much more ready to recruit young researchers because the research and career opportunities are improved.

- ***Enhanced Collaboration and Multi-disciplinary Initiatives.***

  The Panel noted that the CFI initiative has resulted in what appeared to be a greatly improved collaboration within and among research institutions, and between the university, government and industrial sectors. Hospitals are now getting integrated to a greater extent into the university research programs, as well as with other hospitals, within the same university and between universities.

- ***Leveraging Research Funding.***

  The Panel heard over and over again that the successful CFI applications resulted in greater success of the awardees to attract other research funds from industry, provincial governments, national granting councils, foundations and other sources.

- ***Impact on Industrial Development.***

  The Panel felt that the new research capabilities would significantly enhance technology transfer from academia to the industrial sector. Patents, licenses and spin-off companies are among the outputs that are expected and these should be monitored.

- ***Strategic Planning***

  It was obvious to the Panel that the CFI initiative has promoted institutional strategic planning within universities, to establish priorities and make choices at the university level. In many (but not all) institutions, the process has led to thinking bigger, taking more risks and focusing resources. Clearly, the importance and efficiency of research within the university's mandate have been greatly enhanced. In one institution however, the Panel was told of the highly critical views of some staff members versus any kind of strategic planning This view would be certainly be shared by several of the Members of the Panel themselves if this planning were understood as "research planning". It must be made quite clear that strategic planning <u>at the level of an institution</u> is something quite different.

After hearing about these beneficial impacts of the CFI Program, the Panel was convinced that the effects would be long-lasting and would transform the Canadian research scene. The Panel felt that the CFI program provided a strong basis that Canada could use to propel its research and development capacity towards the announced objective of being among the top five countries in the OECD ranking.

Challenges, Limitations, Concerns

The Canadian colleagues with whom the Panel met also identified a number of Challenges, Limitations and Concerns. These are listed below, along with recommendations from the Panel as to how these issues could be addressed.

- ***Matching Funds***

At most institutions, matching funds are made up of a 40% contribution from the provincial government and a further 20% contribution from other sources. Some institutions have encountered significant difficulties in raising these matching funds.

The Panel was told that the 20% non-governmental contributions present difficulties, especially in the less industrialized regions of the country. The threat of '*donation fatigue'* by those providing matching funds is of concern to all universities since both private partners and provincial Government organizations tend to stop giving after repeated requests. In addition, the Panel noted that there were large variations among research institutes and subject areas in the availability of internal resources to contribute to that 20%. In some fields, deep discounts for major equipment, notably for computers or large instruments, can be obtained from the suppliers, and are accepted as forming part of the "matching funds". This source of matching funds is of course not available in all research areas. The Panel also recommends that the CFI study whether, and with which safeguards, industrial collaboration, in the form of contributions towards infrastructure as part of collaborative programs, could not count towards matching funds.

Similarly, the Panel noted that there were significant differences among Provinces in whether or how they provided the matching 40% of funding. In several Provinces, matching was either automatic or relatively easy to obtain.

In the Atlantic Provinces, however, the universities faced difficulties in meeting the required matching funding, as the provincial governments have not felt it possible to supply their 40% contribution. A possible alternative source of this contribution would be the federal government's Atlantic Innovation Fund (AIF). However, the stated objective of this Fund is to foster business development and this is therefore obviously not a perfect match to the purposes of the CFI program. It is therefore not clear whether this Fund can really meet the research needs of the universities in the Atlantic provinces. Although the Fund was established 18 months ago, the rules by which its resources will be allocated had not been established at the time of the Panel's visit, and we were told that the AIF has not funded a

single award to date. The Panel was given to understand that some CFI-approved projects have yet to be implemented in this part of the country since they are still awaiting matching funds from AIF.

Moreover, the Panel was told by more than one Atlantic research institution that the difficulty in obtaining the 40% provincial match had caused them to deliberately limit the subject area for which CFI grants were prepared, and to orient the projects towards regional development.

Recommendation 5: The Panel urges the CFI administration to work closely with the Atlantic Innovation Fund to ensure that matching funds are made available to CFI-approved projects.

- ***Additional costs associated with receiving CFI funding.***

The Panel also heard about the impact of the CFI funding on researchers and administration, who needed to invest significant time and resources to prepare a successful CFI application and to manage the resources after an award has been made. It was noted that the time and effort necessary for the CFI application lead necessarily to a decreased research output by those involved. The additional administrative support that is needed for the preparation of an application include :

- coordination and organization of the research community involved in each project,
- preparation of proposals,
- setting budgets,
- securing matching funds,
- preparation of reports for CFI, provincial agencies and industrial partners,
- direct costs associated with setting up, maintaining and operating the equipment or facility. Some of these costs may be met from the additional CFI funds now being allocated to this area. Concerns were expressed, however, that the grants provided in the first two competitions were not allowed to tap into this funding. There were also concerns that there might not be sufficient resources in the Operating Expenses Fund.
- indirect costs associated with underpinning the research which uses the new facilities.

The Panel applauds the launching of the new Program Operating Expense Fund and the flexibility it will offer to address these needs. Clearly, the available funds in this new program are insufficient to meet the full additional costs of the new infrastructure. However,

if the Canadian government is to meet its goal of being within the top five of the OECD ranking of R&D, it will have to address the indirect costs of research.

Recommendation 6: The Panel recommends that the CFI assess the ability of the Operating Expense Fund to meet the full direct costs associated with the maintenance and operation of the CFI-funded facilities.

Recommendation 7: The Panel encourages the federal government to provide Canada's universities, colleges and hospitals with the funding needed to address the indirect costs of research.

- ***Optimizing the CFI Investment***

To obtain the full benefits of the CFI investment, the Panel was told by virtually every institution that adequate funding was needed for the research teams who will utilize the new, CFI-funded facilities. Some new resources will of course become available thanks to the replacement of old facilities, expensive to run, by new and more optimal ones. However, it can be safely expected that the improved infrastructure will provide new opportunities for excellent projects in new areas and therefore the number of projects to be funded can be confidently expected to increase. Thus, it is considered quite generally that the funding by the Research Councils (CIHR, NSERC and SSHRC) will need to be increased significantly, as announced by the Prime Minister in his answer to the Speech of the Throne, forecasting a doubling of R&D federal expenditures in Canada (Annex C). The new funding by the CFI, though still difficult to evaluate precisely (Annex D) leaves much leeway to meet this goal.

Recommendation 8: The Canadian government is strongly encouraged to invest more resources into the Granting Councils in order to fully realize the benefits of the CFI investment.

- ***Timing and Coordination Problems***

The Panel was informed of a number of timing and coordination problems associated with the CFI Programs, including the following:

- Larger research initiatives that might involve infrastructure and research granting components would benefit from joint reviews by CFI and one or more of the Granting

Councils. The Granting Councils seem to be able to coordinate their efforts but the Panel was told that they find it difficult to coordinate with the CFI.

- Joint, or simultaneous, review of the Canada Research Chairs program and the associated applications to the CFI would be very important in optimizing the efficiency of this program.
- Better coordination between provincial funding groups and CFI would be beneficial.
- The adoption of a common format for submission of CVs among Canadian research granting agencies would save time to the research community to fill out forms.

Recommendation 9: The CFI should work towards harmonizing its review and funding programs and processes with those of the granting Councils and other granting Agencies.

- ***Application Processes and Forms***

The Panel was told that the processes for applying for CFI support and for administering the grants are still evolving. Future fine-tuning of the process should take into account the following concerns:

- *The high opportunity cost of submitting an application*

Some principal investigators have spent months in preparing an application, even when professional help was available to coordinate the process. While this may be justified for large applications, simpler procedures should be used for smaller ones.

The structure of some of the forms was criticized, and it was suggested that experts in individual fields could help to refine the forms and make them easier to fill in. Some non-technical questions also gave rise to difficulty. For example, it may not always be possible with any honesty to predict in what way a piece of basic science will address Canada's economic prospects.

- *The 'Progrid' form*

There is widespread criticism of the '*Progrid'* form. It was described as highly repetitious, and as lacking space to answer many of the questions. Many researchers expressed a desire to standardize the CV format required for a variety of grant requests [see above] and felt that the CFI form for the CV lacked substance, as it did not require

information on the track record of the applicant. There were comments that the application does not allow enough space for the description of the science proposed.

- *Web-based submissions and performance*

  The research community welcomed the opportunity to submit applications 'on line', but noted a number of technical problems, especially in the ability of the Web site of the CFI to handle the number of users in the hours leading up to the submission deadline. Also, the Panel was told that the Web interface does not allow attachments, which makes it inconvenient to use if pictures or mathematical / chemical symbols are to be used within an application.

- *Site Visits*

  There were complaints about some site visits having been held "off site", and about insufficient time having been available with the review Panel.

- *Post-Award Administration*

  The post-award requirements by CFI are considered onerous by some institutions.

Recommendation 10: The CFI should carry out a reassessment of its Web-site capacity, Web page, application forms and CV requirements, to ensure that they are meeting the needs of the program. They should reconsider the best format and location for site visits.

Changing the face of the university community - Antagonism towards CFI

While the Panel was told repeatedly about the beneficial effects of the CFI on the research community, a number of concerns were also expressed, especially about some perverse effects the CFI Initiative might have in changing the face of the university community. These concerns included:

- ***"Big science vs small science".*** A few researchers expressed concern that the large research infrastructure initiatives supported by CFI may result in the exclusion of excellent and creative small science, in a competition with large science programs. Examples were given of such trends in the USA.

- ***"Support for Social Science Research".*** At many institutions, the Panel heard concerns that the CFI funding might result in the Science and Engineering faculties being disproportionately strengthened at the expense of the Social Sciences and Humanities.

- ***"Doing Deals, not Science".*** The Panel was also told of concerns that the CFI program might reward those individuals who were spending their time "doing deals" and pulling together large initiatives, not those who where actually "doing the science".

- ***"Increasing the gap"***. At smaller, less research-intense institutions, the Panel heard concerns that the CFI funding might result in "*the rich getting richer and the poor getting poorer"*. Concerns were expressed that the rewarding of existing research excellence was not balanced by the appropriate support for building research capacity across the nation.[*]

The Panel considers that these concerns are valid ones, but that it is difficult to identify any readily available solutions that the CFI could control, or that would not create problems of equal or greater magnitude. The Panel urges the CFI board to remain sympathetic to these concerns and to address them if they deem it appropriate and within their mandate.

Flow of information to the Community

The Panel observed that not all the people it interviewed were as well informed about the CFI programs and processes as the Panel felt they should be. Generally speaking, the CFI relies on its web site and on the effectiveness of the V.P. (Research) of individual institutions to disseminate information. Both are variably efficient, and the CFI may look also into other methods for communicating with research communities (information bulletins, on paper or on line, relay via the learned societies, via the committees of the granting Councils, etc.)

Benchmarking, Impact and Performance Assessment

The Panel members consider that procedures for monitoring the outcome of CFI funding need to be put in place. Outcomes reflecting the mission of the CFI such as peer-reviewed publications, the recruitment or training of highly qualified personnel, patents,

[*] However, at least two of the small institutions visited considered on the contrary that they had at last managed to obtain modest but reasonable research facilities, thanks to funding by the CFI.

licenses, spin-off companies, honors and awards, and international comparisons should be monitored and made known to the Government and to the public.

Recommendation 11: The CFI should inform the Government and the public of the success of its operations towards its stated objectives.

The impact of the CFI will also have to be assessed in the context of the progress toward achieving the Government's stated objective of bringing Canada into the top five of the OECD countries. In that context, the balance between the funding of research and direct and indirect research support will have to be addressed. Also, issues of balance between the efforts directed towards different fields, sectors and areas, (e.g. health science and engineering, social sciences) will have to be addressed.

If the CFI establishes a more formal outcome assessment, we recommend that this be done with a light touch and be not unduly onerous. The CFI should allow sufficient time to elapse between the start of a grant and its assessment: high quality research is usually long-term.

Recommendation 12: The CFI should move early enough towards developing a reasonable, light-touch process to assess the outcomes of its grant awards.

Conclusion

The Panel noted with pleasure that the CFI has already had a very large and beneficial impact on the research capacity of Canadian institutions. The CFI initiative, combined with the CRC program, has already enhanced the ability of Universities, colleges and research hospitals to retain and attract some new excellent faculty. It has allowed and continues to allow for the training of highly qualified personnel in world-class facilities. It has prompted institutions to engage in strategic planning activities and to establish thereby institutional priorities. The actions of the CFI have led to an unprecedented involvement of the Provinces in funding research and it has improved substantially the morale of Canadian researchers.

In the long run, the impact of the CFI will have to be evaluated together with that of the Canada Research Chairs program, with the necessarily increased funding of the Research

Councils, and with an effort towards addressing the issue of indirect costs of research. Only through a balanced approach of all these elements in the Innovation effort, will it be possible for Canada to achieve its explicit goal of being in the top five countries of the OECD ranking for Research and Development capacity.

Recommendations for specific improvements

1. The Panel recommends that the CFI assess the funding needs for the New Opportunities Program by Universities in terms of anticipated faculty hiring levels and then allocate more funding if appropriate, even if this means that funds must be taken from other CFI Programs. Furthermore, to provide a more competitive hiring environment, the CFI should respond more rapidly to requests for the New Opportunity Grants.
2. The Panel recommends that the CFI reviews its eligibility criteria and review procedures for the New Opportunities Grants, to ensure that it is providing the optimal support for the hiring of excellent new faculty in the coming years.
3. The CFI fund for CRC Applicants and the CRC Chair program need to be better integrated, possibly by joint, or at least simultaneous, review of the CRC and CFI proposals.
4. The CFI should inform more clearly the potential applicants of the rules and criteria for selection, both for the International Access Fund and for the International Joint Venture Fund.
5. The Panel urges the CFI administration to work closely with the Atlantic Innovation Fund to ensure that matching funds are made available for CFI-approved projects.
6. The Panel recommends that the CFI assess the ability of the Operating Expense Fund to meet the full direct costs associated with the maintenance and operation of the CFI-funded facilities.
7. The Panel encourages the federal government to provide Canada's universities, colleges and hospitals with the funding needed to address the indirect costs of research.
8. The Canadian government is strongly encouraged to invest more resources in the Granting Councils to fully realize the benefits of the CFI investments and to meet its announced goals.
9. The CFI should work towards harmonizing their review and funding programs and processes with those of the granting Councils and other granting agencies.
10. The CFI should carry out a reassessment of its Web-site capacity, Web page, application forms and CV requirements to ensure that they are meeting the needs of the program. They should reconsider the best format and location for site visits.
11. The CFI should inform the Government and the public of the success of its operations towards its stated objectives.

12. The CFI should move early enough towards developing a reasonable, light-touch process to assess the outcomes of its grant awards.

Our Report and the recommendations above provide answers to the questions formulated by the President of the Royal Society of Canada:

- *Are the changes or impacts, as identified, likely to be stable over time?*
- *What issues of research management are being created for the institutions as a result of the CFI funding?*
- *Are there problems or difficulties in research management being created by the pattern of CFI funding and, if so, can remedies for them be identified?*
- *Are there alternative frameworks for CFI funding that may be suggested for improving institutional performance?*

  - ❖ The CFI Initiative is only beginning to have an impact on Canadian research capacity. The early indicators are that this impact is mostly positive, and that these positive effects will increase steadily in future years. Given the long time frame of the initiative, and the way that the program is being delivered, the Panel thought it was likely that the impacts would be felt in Canada for many decades to come.
  - ❖ The CFI and CRC Initiatives have demanded that the research institutions prepare Strategic Plans. While the Panel did not have the time or resources to review the Strategic Plan of each institution, it was clear that the institutions varied greatly in the quality and success of their planning efforts. Institutional plans of this nature are new to most Universities and colleges, and since they are not part of their 'culture', there tends to be a long and difficult learning curve. The CFI Program provides a major incentive for institutions to move towards this goal, and the Panel saw this as a valuable outcome of the CFI Initiative.
  - ❖ Problems in research management created by the CFI funding are significant, and are addressed within the report and by the Panel recommendations.
  - ❖ In its report, the Panel identified emerging areas of imbalance in the various elements of a national research effort, including direct and indirects costs of the research. The majority of the most serious current problems lie outside the mandate and funding resources available to the CFI (e.g. the direct costs of research). In areas that are within the purview of CFI, the organization has shown

a capacity to progressively introduce novel frameworks for its funding. If this flexibility and this sensitivity continue to be demonstrated in coming years, the CFI will continue to meet the infrastructure needs of innovative Canadian research. One area which does require attention is the need to ensure a close cooperation between the CFI's activities and those of the Research Councils.

Annex A

Panel Membership

Nicholas Anthonisen

Nicholas Anthonisen, Ph.D. (McGill, 1969), a Fellow of The Canadian Institute of Academic Medicine and a Fellow of The Royal Society of Canada (elected 1989), is Distinguished Professor of Medicine, University of Manitoba. He is a specialist in respiratory medicine and lung function and a widely-recognized authority in chronic obstructive pulmonary disease. He was Head of the Respiratory Medicine Division (1975-88) and Dean of the Faculty (1988-99) in the Faculty of Medicine at Manitoba. He has held many professional offices, most recently as Chair, Safety and Data Monitoring Board, NIH Asthma Clinical Research Network (1994-) and Chair, Steering Committee, American Lung Association Asthma Clinical Research Centers (1999-).

Mildred Dresselhaus.

Mildred Dresselhaus, Ph.D. (Chicago, 1958), is a member of the US National Academy of Engineering (elected 1974) and the National Academy of Sciences (1985), and a Fellow of the American Academy of Arts and Sciences (1974). She is an Institute Professor at the Massachusetts Institute of Technology and a member of both the Department of Electrical Engineering and Computer Science and the Department of Physics. She is affiliated with MIT's Center for Materials Science and Engineering and was its Director 1977-83; her general field of research is the physics of solids and she has specialized in studying the structure and properties of carbon-related materials. She has been awarded honorary degrees at many universities in the United States and other countries and has served on numerous national commissions, and was President of the American Association for the Advancement of Science (AAAS) in 1997-98. She was awarded a National Medal of Science in 1990 and has served as Director of the Office of Science at the US Department of Energy.

Peter Lachmann.

Peter Lachmann, MB 1956, Ph.D. 1962 (Cambridge), is a Fellow of The Royal Society of London (elected 1982) and a Founding Fellow and Founding President of The Academy of Medical Sciences (UK, 1998). He is currently Emeritus Sheila Joan Smith Professor of Immunology, University of Cambridge (since 1999) and Head, Microbial Immunology

Group, Centre for Veterinary Science, University of Cambridge. His research work has specialized in immunology, in particular the immunochemistry, biological properties and genetics of the complement system; the expression of complement control proteins by microorganisms; enhancement of the immune response; and immunopathology. He has held many professional and editorial offices and is a foreign Fellow of the National Academies of Norway and India.

David Layzell.

David Layzell, Ph.D. (Western Australia, 1980), is a Fellow of The Royal Society of Canada (elected 1998) and Professor of Biology at Queen's University. He was a NSERC Steacie Fellow in Biology (1992-4) and specializes in plant biology, especially nitrogen fixation and reductive metabolism in plants. He chaired the Implementation Committee for the 39 M$ BioSciences Complex building at Queen's and is President and CEO of Qubit Systems Inc., which designs and manufactures laboratory instruments and scientific educational materials (the latter are used in over 500 universities in 45 countries). He holds five US patents (others are pending) and is the author of more than one hundred scientific publications. He is the founding executive director and scientific research director of BIOCAP Canada, a national research network in the area of biosphere greenhouse gas management and industrial bio-products.

Jorge Niosi.

Jorge Niosi, Ph.D. (Paris, 1973), is a Fellow of The Royal Society of Canada (elected 1994) and a Professor in the Department of Management and Technology at the Université du Québec à Montréal (UQAM). He is the author or editor of *The Economic and Social Dynamics of Biotechnology* (2000), *Canada's National System of Innovation* (2000), *Flexible Innovation: Technological Alliances in Canadian Industry* (1995), *New Technology Policy and Social Innovations in the Firm* (1994), and *Technology and National Competitiveness* (1991), as well as earlier volumes and other publications. He is Principal Investigator of UQAM's Chair on Bio-Industries, and his current funded research projects include "*Indicators of the Knowledge Economy*," "*A Comparative Analysis of National Systems of Innovation*," and "*The Development of the Canadian Software Industry*."

Guy Ourisson (Panel Chair).

Guy Ourisson, Ph.D. (Harvard, 1952), Dr. Sc. (Paris, 1954), Dr. Hon. Causa (ETH, Zurich, 1999) is Past-President of France's Académie des Sciences and Emeritus Professor of Chemistry at Louis Pasteur University in Strasbourg. He describes his research field as "organic chemistry at the borderlines with biology and geology," including biochemistry, biophysics, and organic geochemistry. He has published over 350 scientific papers in refereed journals and has supervised more than 100 doctoral theses. He has been awarded numerous honours and scientific prizes both in France and elsewhere and has served on many national and international commissions. He is a foreign or corresponding member of the National Academies of seven countries and was the Founding President of Louis Pasteur University (1971-76).

Martha Salcudean.

Martha Salcudean, Ph.D. (Romania), is a Fellow of The Canadian Academy of Engineering (elected 1992), a Fellow of The Royal Society of Canada (elected 1994), and a Professor Emerita in the Department of Mechanical Engineering, University of British Columbia, where she was also Associate Vice-President, Research from 1993 to 1996. She specializes in the fields of heat transfer and fluid flow and now holds a post-retirement position as Weyerhauser Industrial Research Chair in Computational Fluid Dynamics. She has collaborated with large industrial firms such as Cominco, Pratt & Whitney, Atomic Energy of Canada, and Weyerhauser. Among the scientific prizes she has been awarded are a Science and Engineering Gold Medal from the Science Council of British Columbia and an Izaak Walton Killam Memorial Prize, awarded in 1998 "*in recognition of her outstanding achievements and distinguished career contribution in engineering.*"

Annex B

Panel Itinerary

May 27, 2001

Arrival

Ottawa, ON

May 28, 2001

Meeting with Howard Alper, Vice-President (Research), University of Ottawa

Meeting with David Strangway and CFI Staff

Meeting with Kevin Lynch, Deputy Minister, Department of Finance

Meeting with David Strangway and CFI Staff

Meeting with Robert Giroux, President, Association of Universities and Colleges of Canada (AUCC)

Meeting with Peter Harder, Deputy Minister, Industry Canada

Group A—Departure to Vancouver

Group B—Departure to Montreal

May 29, 2001

Group A

Meeting with Bruce Clayman, Simon Fraser University

Meeting with Martin Taylor, University of Victoria

Meeting with Tony Knowles, BC Institute of Technology

Meeting with Indira Samarasekera, The University of BC

Group B

Meeting with representatives at Concordia University

Meeting with Alain Caillé, Université de Montréal

Meeting with Pierre Bélanger, McGill University

Departure to Halifax

May 30, 2001

Group A

Departure to Edmonton

Meeting with Keith Archer, The University of Calgary

Meeting with Roger Smith, University of Alberta

Departure to Toronto

Group B

Meeting with Carl Breckenbridge, Dalhousie University

Meeting with Memorial University of NFLD

Departure to Toronto

May 31, 2001

Groups A & B

Meeting with Heather Munroe-Blum, University of Toronto

Meeting with Andrew Paskauskas, Sheridan College

Meeting with David Strangway

Departure to Ottawa

June 1, 2001

Final Meeting of the Panel

Annex C

Institutional Representatives met by the Panel at the various sites:

Ottawa :

Howard Alper, Vice-President (Research), University of Ottawa
David Strangway, President, Canada Foundation for Innovation
Carmen Charette, Canada Foundation for Innovation
Kevin Lynch, Deputy Minister, Department of Finance
Robert Giroux, President, Association of Universities and Colleges of Canada
Peter Harder, Deputy Minister, Industry Canada

Simon Fraser University

Dr. Bruce Clayman, Vice-President (Research)
Nikitas J. Dimopoulos, Chair of Dept of Electrical and Computer Engineering
Dr. Peter Borwein
Mr. Mike Rostad, Silicon Graphics

***University of Victoria* (not visited; meetings in Vancouver)**

Dr. S. Martin Taylor, Vice-President, (Research)
Dr. Nigel Livingston, Department of Biology
Dr. Nikitas Dimopoulous, Department of Electrical & Computer Engineering
Mr. Greg Schick, IBM Representative

British Columbia Institute of Technology

Dr. Tony Knowles, President
Dr. Gerald Moss, Vice-President
Dr. Norman Streat, Dean, Applied Research, Director, Technology Centre
Silvia Raschke, Researcher
Nancy Paris-Seeley, Researcher
Dr. Gary Brich, Partner
Michael Hrybyk, Researcher
Dan Hoffman, Spirent & Empowered Networks

The University of British Columbia

I.V. Samarasekera, Vice-President (Research)
M. Marra, Genome Sequence Centre
G. Mauk, Laboratory of Molecular Biophysics
B. McManus, Pathology
V. Ling, Center for Integrated Genomics
C. Ventura, Earthquake Engineering Research Facility
M. Cynader; Spinal cord research
D. Kilburn/Brian Ellis, Biotechnology Laboratory

B. Gick, Linguistics
R. Ward, Director, Centre for Computers and Integrated Systems
P. Pare, iCapture
St. Vincent, Brain Research Centre
K.D.Sristava/Anne Condon, Institute for Computing, Information and Cognitive Systems,

Concordia University

Dr. Claude Bedard, Dean, Graduate Studies and Research
Dr. Nabil Esmail, Dean, Engineering and Computer Science
Dr. Osama Moselhi, Chair, Building, Civil & Environmental Engineering
Dr. Catherine Mulligan, Assistant Professor, Building, Civil & Environmental Engineering
Dr. John Capoblanco, Vice-Dean, Research, Arts & Science
Prof. Andrew Chapman, Psychology
Prof. Gilles Peslherbe, Chemistry & Biochemistry
Dr. Luc Varin, Assistant Professor, Biology
Ms. Joanne Beaudoin, Interim Director, Research Services

Université de Montréal

Monsieur Alain Caillé, vice-recteur à la recherche
Monsieur Joseph Hubert, vice-doyen à la recherche, Faculté des arts et des sciences
Monsieur Vincent Castellucci, vice-doyen à la recherche, Faculté de médecine

McGill University

Ian Butler, Associate Vice-President (Research)
Robert Marchessault, Professor Emeritus

The University of Calgary

Dr. Keith Archer, Interim Vice-President (Research)
Dr. Martin Kirk, Director, Research Services
Dr. Gil Schultz, Assistant Dean Research, Faculty of Medicine

University of Alberta

Dr. Roger S. Smith, Vice-President (Research)
Ms. Lynda Brulotte, CFI/ISRIP Coordinator, Research Grants Office
Dr. Ron Dyck, Executive Director, Alberta Science and Research Authority
Dr. William A. Graham, Associate Dean (Research), Faculty of Science
Dr. Harvey Krahm, Associate Dean (Research), Faculty of Arts
Dr. Byron Kratochvil, Professor Emeritus
Mr. Chris Lumb, President & CEO, Micralyne Inc.
Dr. David T. Lynch, Dean, Faculty of Engineering
Dr. William A. McBlain, Associate Vice-President (Research)
Dr. Jonathan Schaeffer, Professor, Department of Computing Science
Dr. Joel Weiner, Associate Dean (Research), Faculty of Medicine & Dentistry

Dalhousie University

Dr. Carl Breckenridge, Vice-President (Research)

Memorial University of Newfoundland

Dr. Christopher Loomis, Acting Vice-President (Research & International Relations)
Dr. William Driedzic, Director, Ocean Sciences Centre
Dr. Mark Whitmore, Senior Researcher

University of Toronto

Heather Munroe-Blum, Vice-President (Research)
Carl Amrhein
Richard Bond
Judith Chadwick
Fred Keeley (Hospital for Sick Children)
Uli Krull
Michael Marrus
Dwayne Miller
Richard Peltier
Janet Rossant (Mount Sinai Hospital)
Barry Sessle
Mel Silverman
Pekka Sinervo
Ian Spence
Henry vanDriel
Cecil Yip
Safwat Zaky

Sheridan College (and Elder Research Center)

Ian Mishkel, Vice-President, Business Development
Avrim Katzman
Pat Spadafora, Director, Research Center
Andrew Paskauskas

Annex D

Canadian Government Policy regarding R&D:

Liberal Government Election Platform
(http://www.aucc.ca/en/election/liberal_platform.html)

"*A new Liberal Government will help Canada move by 2010 to the top five countries for research and development performance by at least doubling federal expenditures on R&D.*"

Address by Prime Minister Jean Chrétien in answer to the Speech from the Throne, Jan. 30, 2001
(http://pm.gc.ca/ ; www.pm.gc.ca°)

"We must strive for Canada to become one of the top five countries for research and development performance by 2010. This is a challenge for all Canadians, but in particular for the private sector as the largest research investor in Canada. ***As its contribution, the Government will at least double the current federal investment in research and development by 2010****. In making new investments, the Government will continue to pursue excellence in Canadian research by strengthening the research capacity of Canadian universities and government laboratories and institutions; accelerate Canada's ability to commercialize research discoveries, turning them into new products and services; and pursue a global strategy for Canadian science and technology, supporting more collaborative international research at the frontiers of knowledge…."*

Annex E

Quantitative evaluation of the contribution of the CFI to higher education research and development funding:

Preliminary figures obtained from *Statistics Canada*[*] show that the direct and indirect contribution of the CFI to higher education reseearch and development (HERD) has already been substantial in dollar terms, and may be much more substantial than our minimal evaluation.

Between 1995 and 1998, before the CFI started granting R&D funds to higher education institutions, these had spent a stable average of $ 3687 million every year (see Table 1). Since 1998, when CFI started distributing funds, the HERD jumped by 7 % and then 11 % (to $ 3939 in 1997-8 and to $ 3963 in 1998-9). This last figure is similar to our calculation of the direct contribution of the CFI since 1998 (an average of 7.9 %), but lower than the 19.7 % that it would have been if all partners' contributions had brought new funds, suggesting that some of the partners' contributions did not represent new moneys, but where hardly different from past allocations.

When the figures for the HERD up to 2001 will be published by *Statistics Canada*, we shall know more precisely how important the impact of the CFI has been so far; our simulation suggests that if all partners' funds triggered by the CFI were entirely new moneys, then the CFI would have been responsible for an addition of **over 25%** to higher education research and development expenditures.

In summary, the CFI has contributed to increase the HERD somewhere betwen 7% and 27% since its creation. More precise figures will require more recent data, to be provided by *Statistics Canada.*

[*] http://www.statcan.ca/

Table 1

CFI investment for higher education research and development

Cumulative to March 2001

$ Current Million

HERD spending 1994-99	CFI direct contribution since inception	Average CFI Direct contribution as a percentage of average HERD 1998-2001	New R&D funds triggered by CFI (includ. CFI)	CFI direct and indirect contribution as a % of average HERD
1994-5 = $ 3643 1995-6 = $ 3700 1996-7 = $ 3718 Average annual HERD 1994/7 = $3687 1997-8=$ 3939 1998-9=$ 3963	1998-2001 =$873 including 2000-1 = $ 408	1998/2001 = 7.9 % 2000-1 = 11 %	1998-2001 = $ 2183 2000-2001 = $ 1000	1998/2001 = 19.7 % 2000/1 = 27 %

Sources:
Statistics Canada : Estimation of Research and Development Expenditures in the Higher Education Sector, Ottawa, Catalogue 88F0006XIB01002, February 2001.

CFI: Annual Report 2000-1.