

**Advancing Innovation Through the
New Opportunities Fund (NOF)
(Final Evaluation of the NOF)**

June 29, 2007

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Preface/Acknowledgements/Staffing

Preface: This report represents an independent evaluation of the New Opportunities Fund (NOF), which was conducted in 2006-2007 by SPR Associates, Toronto and Ottawa, with the assistance of a number of researchers based in universities across Canada (see Evaluation Team, below).

All conclusions and recommendations are the sole responsibility of SPR Associates, and do not necessarily imply the views of the CFI, or other parties to the NOF

Persons Within Canada: This evaluation would not have been completed without the strong support of many individuals at the CFI and with other organizations such as the AUCC. Additionally, members of the CFI's Evaluation Advisory Committee and many others provided useful suggestions at the start of the project, and at other points.

We would also like to thank the close to 3,000 individuals who participated in the evaluation surveys and interviews: over 150 Vice-Presidents - Research, Deans and Heads of Canadian universities who completed surveys or participated in telephone interviews, provincial representatives and other federal funding agencies, 1,506 NOF Project Leaders who completed the evaluation web survey, over 800 graduate students, post-docs and technicians who completed a web survey on training, employers who completed interviews or surveys, non-awardees who completed surveys or interviews, and countless others including research administration staff of the institutions participating in the NOF, who provided the evaluators with information and encouraged others to participate in the evaluation activities.

Persons Outside Canada: We would also like to thank those persons from outside Canada who assisted and/or participated in interviews regarding various international programs. In addition, the evaluators benefitted greatly from the prior work of *Hickling Arthur Low* on the 2002 Interim Evaluation of the NOF, and the work of *Bearing Point*, in the planning stage of this evaluation.

The SPR Evaluation Team was led by Dr. Ted Adam Harvey. Invaluable assistance was provided by Consultants to SPR, Professor Adam Holbrook, Dr. Bruce Clayman (Simon Fraser University), Dr. David Wolfe (University of Toronto) and Dr. Brent Rutherford (York University), who provided key input and reviewed the final report. Dr. Aldo Geuna (SPR's Consultant on International Research Programs) reviewed the plan and the final report for the International component of the evaluation. Ms. Marian Ficysz was responsible for the design of the web surveys and countless other key tasks. Supporting SPR staff included Mr. David Judge, Mr. Mario Gravelle, Mr. Maxime Cappeliez, Ms. Amesika Baeta, Ms. Kristin Mills, and others.

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Executive Summary

Introduction: In 2006, the Canada Foundation for Innovation (CFI) initiated a final evaluation of its *New Opportunities Fund* (NOF). The goals of the evaluation were to assess whether the NOF's objectives had been achieved and to determine whether lessons and strategic directions could be identified for future NOF-type programs and for the *Leaders Opportunities Fund* (LOF) which replaced the NOF in 2005.

Profile of the NOF: Initiated in 1998, the NOF was made into an ongoing program the following year, with a focus on one key CFI objective: to attract high calibre researchers. Universities were invited to submit applications to the CFI for researchers who were assuming their first full-time academic position in a Canadian university. The NOF operated within the framework of the CFI Funding Agreement with the additional objectives of: creating an environment for high quality research training; enabling researchers to undertake leading-edge research; enabling institutions to address their strategic research priorities; facilitating collaborations and partnerships; and contributing to socio-economic benefits for Canada.

Funds were allocated on a "block" basis to universities, based on past performance in obtaining research funds. Applications were submitted to the CFI and in some cases, the universities' submissions were preceded by an internal competition for merit review. Applications (prepared by universities, with the assistance of their professors or Project Leaders (PLs) were aligned with the universities' goal of strengthening their strategic research capabilities. Through the NOF, the CFI funded up to 40% of a project's infrastructure costs which were invested in partnerships with eligible institutions and their funding partners from the public, private, and voluntary sectors (most importantly the provinces).

Between 1999 and 2005 (the time period covered by this evaluation which did not cover the 1998-1999 NOF), 2,022 NOF projects, representing \$317 million in funding for research infrastructure, had been awarded to Canadian universities by the CFI. The average CFI amount for each NOF award was approximately \$155,000 and, on average, each award took approximately 2.2 years from the CFI decision to the time when the entire infrastructure became fully operational. The CFI established a rigorous reporting scheme as part of its accountability structure, with project progress reports required from universities on an annual basis (often these were completed by PLs).

Methodology and Data Sources: The various methods employed and data sources consulted during the evaluation included: a document and literature review; analysis of administrative data (extensive file and financial data collected by CFI); key informant telephone interviews with 49 Vice-Presidents-Research (VPRs) or their delegates, officials representing all of the provinces and representatives of other federal agencies; a web survey of 1,506 NOF PLs, a survey of 77 non-awardees; a survey of 821 graduate students, post-docs, and technicians (hereafter referred to as *trainees*) who worked (or are working on) NOF-funded infrastructure; and 33 exploratory interviews with employers of NOF trainees (mostly SMEs in the private sector).

The evaluation also included an international comparison study of infrastructure programs and training programs for highly qualified personnel (hereafter HQP) including post-docs, graduate students and technicians) in five countries and the European Union. This research included web-searches, a literature review and interviews with senior officials of funding agencies.

Limitations: A number of limitations were faced by the evaluation, many similar to those faced in the 2002 interim evaluation of the NOF. These included the absence of experimental controls, comparison groups and benchmarking, and the need to rely on the views of participants and stakeholders for many key assessments. *These limitations mean that evidence in the evaluation is often indicative, rather than definitive (as might be expected with an experimental or quasi-experimental design).* To offset some of these limitations, tests for reliability, statistical tests, and cross-referencing of data sources were used to validate findings.

Perhaps the greatest limitation for the evaluation was the "newness" of the NOF. Even though the NOF had been operating for more than 7 years at the time of the evaluation, the rate at which research develops and the time required to establish significant infrastructure means that current evidence of the NOF's impacts must be considered as being only preliminary. Thus, more complete assessment of NOF-type programs calls for a long-term evaluative perspective.

Strengths: In addition to validations from independent sources (e.g. provinces and employers), the evaluation was strengthened by massive CFI databases and by contributions from close to 3,000 participants who were interviewed or surveyed (VPRs, Deans, PLs, trainees and others).

Findings Related to the NOF's Key Objectives:

- 1. Attracting high calibre researchers:** Responses from VPRs, Deans, Heads, PLs and Provincial officials strongly supported the view that the NOF has been successful in improving the competitiveness of Canadian universities in attracting internationally excellent researchers -- many from the world's leading universities. The surveys and interviews revealed that administrators felt strongly that the calibre of NOF PLs was higher than that of researchers who had not received NOF funding. As well, the NOF award and its related infrastructure were noted by PLs as being the primary (although not the sole) influence in their decision to accept a first full-time academic position at a Canadian university.
- 2. Creating an environment for high quality research training:** The evaluation points towards strong positive impacts of the NOF in the training of HQP (post-docs, graduate students, technicians). This includes a positive environment for training, with transferable skills being developed as a result of trainees' experience working with state-of-the-art infrastructure. Trainees who were surveyed indicated that the NOF was an important factor in their decision to join their specific university, and trainees expressed extremely high levels of satisfaction with the training provided on the NOF infrastructure. The acquisition of skills by these trainees was also a key reason in employers' decisions to hire them (according to an exploratory training study conducted within the evaluation), and resulted in noteworthy contributions to innovation.
- 3. Enabling researchers to undertake leading-edge research:** VPRs, Deans, Heads and PLs all agreed that the NOF had substantial impacts on researchers' careers, including contributing to increased research productivity, increased levels of collaboration, more publications and enhanced international reputations. The NOF selection process was positively assessed, as it was seen to provide leading-edge infrastructure to those with the highest potential to benefit. Statistical comparisons indicated higher levels of research performance at the time of the award as well as during the post-award period by NOF recipients, as compared to non-awardees (in terms of publications, grants, etc.).
- 4. Enabling institutions to address their strategic research priorities:** VPRs saw the NOF as aiding strategic research priorities, allowing universities to build up their research capability. However, the strength of Strategic Research Plans (SRPs) varied greatly in terms of links to institutions' decision-making structures and links to industry and other partners. These findings may suggest a need for further analysis of SRPs.

5. **Facilitating collaborations and partnerships:** VPRs and other administrators were also very positive regarding the impacts of the NOF on partnerships and collaborations. More than half of PLs surveyed also asserted that the NOF infrastructure has led to increased collaboration with other researchers at their own institution. Similarly, many PLs indicated increased collaboration with other researchers at other Canadian and international institutions. Many did however note that it was still "too soon to tell" about longer-term impacts as regards this NOF objective.
6. **Contributing to socio-economic benefits for Canada:** VPRs, Provinces and PLs all agreed that the NOF had resulted in positive impacts on international competitiveness and innovation capacity (excluding those indicating "too soon to tell" and "can't assess"). Other impacts included: aiding a sustainable environment; enabling educational and training opportunities for undergraduate and graduate students; assisting Canadian policy-makers; and providing overall long-term benefits for Canada. Echoing the views of university administrators, PLs emphasized that many of their advancements and discoveries would not have been possible without the NOF-funded infrastructure.

Many of these stakeholders, however (including one-quarter of PLs), indicated that it was "too soon to tell" about long-term economic impacts resulting from research enabled by the newly-acquired infrastructure. Even more -- nearly half of PLs also noted that it was "too soon to tell" whether their research had resulted in significant societal or quality-of-life impacts.

Operational findings relating to features such as perceived efficiency and perceived value-for-money were:

7. **Universities developed a remarkable range of funding partnerships** (based on a sample of 1,979 projects for which final funding data was available): Universities obtained substantial support (both cash and in-kind) from a variety of sources for NOF-funded projects, including 1,892 contributions from provincial governments or agencies, and contributions from 5,758 corporate partners, 80 eligible federal agencies, 37 voluntary organizations, 29 municipal or foreign governments, and 281 other partners, including private donations. Provincial governments provided the largest portion of cash contributions.
8. **Efficiency of the NOF:** Nearly all university administrators surveyed indicated that they were satisfied with the process by which NOF funds had been distributed to institutions. This was not fully echoed by provincial *agencies*, however, with 9 of 10 provincial officials interviewed indicating that they were dissatisfied with the level of consultation, coordination and communications by the CFI on the NOF prior to the establishment of the program. (Significantly, however, provinces and regional bodies strongly endorsed the NOF's accomplishments in spite of their dissatisfaction with consultation processes.)

PLs had a more diverse view of the NOF. While 70% of PLs felt that the NOF process of awarding funds was efficient overall, nearly one-quarter were dissatisfied with certain aspects of the NOF. These sources of dissatisfaction included issues related to matching funds, uncertainties surrounding in-kind contributions of funding partners, long delays experienced for the development of some projects, and the level of bureaucracy and paperwork required by CFI. The dissatisfaction of some PLs proved to be significant, as dissatisfied PLs were less likely to report that they intended to stay in Canada. Importantly, the dissatisfaction of PLs appeared to be linked as much (or more) to the process of university administration than to CFI processes per se.

VPRs, Deans and Heads suggested a number of changes which could be made to future NOF-type programs: increasing the amount of funding for infrastructure; reducing and simplifying the application process; reducing the amount of bureaucracy; providing greater flexibility to institutions; revising budget approval processes; reducing the demands associated with partner funding; and providing more operational support for infrastructure in general. Nearly all of these suggestions for changes were echoed by PLs.

9. **Links to other federal funding agencies:** Improved coordination of NOF-type programs with the programs of other federal funding agencies was an issue raised in the 2002 interim evaluation. This was also a strong concern of VPRs and all other key groups surveyed as part of this evaluation. The evaluators noted that emerging cooperation and co-assessment of awards between CFI and SSHRC, NSERC and CIHR as a valuable step forward which should be continued.
10. **Other findings:** The evaluation indicated no obstacles at the CFI level to equity group access, but VPRs and others deemed the NOF was difficult to access for those in the social sciences and humanities, and in other areas such as clinical health. NOF researchers were also found to be more productive when chosen through competitive university processes which applied peer review to the selection of NOF PLs. Also, as regards funding, the strong concerns of some PLs' regarding negative impacts of in-kind funding were supported by a significant negative correlation found between the level of in-kind funding of projects and the research productivity of PLs.
11. **International comparison:** The evaluators examined programs in five countries (UK, Germany, Australia, the U.S. and Japan) and the European Union. Over 35 major programs were examined, with data obtained from over 30 agencies. No programs exactly like the NOF -- which combine infrastructure with HQP attraction -- could be identified. In spite of the NOF's uniqueness and the fact that many research organizations in other countries would like to learn from the NOF, this comparative assessment pointed to a number of lessons and insights to be obtained from other jurisdictions, including: rapid growth of research funding initiatives in other countries, promising greater competition for Canada; a strategic focus on S&T policy and HQP at the national level; and increased competition for funding among institutions.

Key Conclusions: The NOF has achieved its intended goals in a substantial way, including:

- *making Canadian institutions more competitive in hiring new and highly qualified faculty, often individuals of international calibre in their fields.* Attraction impacts were also seen in the retrieval of Canadian talent from abroad.
- *having a substantial impact in providing high quality training environments and attracting and developing HQP,* as evidenced in a variety of data sources including a substantial survey of graduate students, post-docs and technicians.
- *universities being able to mobilize a vast array of funding partners who provided hundreds of millions of dollars for NOF-funded infrastructure, to aid putting extensive state-of-the-art infrastructure in place.*
- Employers who hired NOF graduates pointed towards a strong business case for NOF-type programs which should be the subject of future research.
- The NOF was widely regarded by all participants and stakeholders, including provinces and employers, as providing good value-for-money.

Of the above conclusions, the impacts on attraction are the most important. The fact that the NOF was highly successful, when linked to Canada's need to hire more than 20,000 new university professors (according to Association of Universities and Colleges of Canada (AUCC) forecasts) in the next ten years, has important implications. This time period may represent a window of opportunity for Canada to replenish its university faculty through aggressive hiring in the international academic labour market -- an opportunity that may be unique. This may call for substantially expanded funding for NOF-type efforts aimed at attracting highly-qualified researchers.

Recommendations for the CFI: The main report offers recommendations in all of the areas examined, including a number with implications for CFI's many stakeholders who contributed to the NOF (universities, provinces, others and PLs). While the NOF is deemed to have been remarkably successful, a number of areas for program refinement are still suggested by the evaluators, to aid continuous improvement of NOF-type programs, including LOF. Key areas of recommendations are noted below (see Section 6.2 for a more complete summary and Appendix F for rationale and details, including operational implications for CFI and others):

1. Continue and expand NOF-type programs for attraction, by providing significant additional funding targeted specifically for attraction, probably within LOF;
2. Improve administrative processes (in collaboration with universities), for example in the area of simplifying annual reports. These changes would address some CFI processes, but also address certain areas for improvement noted for NOF-type programs, which are affected by universities; this calls for collaborative efforts with universities, and key university bodies;
3. Improve targetting of NOF-type programs (both to consider goals of the federal policy framework for S&T), and to improve access and support for the social sciences and smaller universities);
4. Review the potential to build more competitive processes between universities; this recommendation calls for a replacement of the current "block" funding which is guaranteed to universities, by a mixed "block" system (e.g. a floor allocation), and a substantial pool of funds for which all universities could compete;
5. Expand coordination with other federal research granting agencies, such coordination would occur in a number of areas and build on initiatives which have been instituted in the past few years;
6. Further strengthen provincial consultation for future NOF-type programs, for example, through a mechanism similar to CFI's Stakeholder Advisory Network (SAN); and
7. Improve evaluation by building research and evaluation capacity between the CFI and partner agencies; expanding coordination with other federal granting agencies, and encouraging more academic and basic research on NOF-type programs.

Recommendations for Other Stakeholders: Building on past success, and developing more effective NOF-type programs in the future requires collaborative and independent actions by many CFI stakeholders whose efforts have been essential to the success of the previous NOF. Noting this complexity of NOF-type programs, the report includes additional recommendations which the evaluators address to universities, provinces and the federal government.

1. Introduction: Goals of the Evaluation, Objectives of the CFI and NOF, Methodology

1.1 Goals of the Evaluation

The goals of the evaluation were to assess whether the NOF's objectives had been achieved and to determine whether lessons and strategic directions could be identified for future NOF-type programs and for the *Leaders Opportunities Fund* (LOF) which replaced the NOF, incorporating remaining NOF projects and funds in 2005.

1.2 Objectives and Features of the CFI and the NOF

Relation to the CFI's Objectives: The objective of this evaluation was to assess the NOF within the context of the CFI's national objectives, as outlined in the organization's 1997 Funding Agreement. Specifically, CFI objectives were:

1. to support economic growth and job creation, as well as health and environment quality through innovation;
2. to increase Canada's capability to carry out important world-class scientific research and technology development;
3. to expand research and job opportunities for young Canadians; and
4. to promote productive networks and collaborations among Canadian post-secondary educational institutions, research hospitals and the private sector.

Specific Objectives of the NOF Program: Although the NOF operated within the framework of the CFI Funding Agreement, it also had its own set of specific objectives, namely:

1. attracting and retaining high calibre researchers;
2. creating an environment for high quality research training;
3. enabling researchers to undertake leading-edge research;
4. enabling institutions to address their strategic research priorities;
5. facilitating collaborations and partnerships; and
6. contributing to socio-economic benefits for Canada.

Within this mandate, the NOF was intended to support the recruitment of researchers to Canadian universities. Support is provided to researchers taking up their first, full-time, academic appointment at a Canadian university.¹ These personnel, along with graduate students, post-docs and technicians are referred to within as highly qualified personnel (**HQP**). Since 1997, the Government of Canada has allocated \$3.74 billion to the CFI. Based on the funding scheme whereby the CFI funds up to 40% of a project's infrastructure costs.

¹ The vast majority of NOF awards went to faculty members taking up their first full-time academic appointment, who were within 10 years of receiving their Ph.D. In the Project Leaders survey, 88% reported assuming their position since 2000. Of these, 77% reported that they had received their highest degree after 1994.

Time Period Covered by this Evaluation: While the NOF was fully operational from 1998 to 2005, it should be noted that this evaluation focused on the period 1999 to 2005 (this is because in 1998, a different competitive model was applied by the NOF). Thus the evaluation focuses on 2,022 NOF projects funded in the period 1999 to present.

When the NOF was launched in 1998, it was informed by two overriding concerns about the state of university funding: first, as studies have shown, Canadian research infrastructure has suffered from under-investment over several decades;² and second, the NOF responded to concerns among many Canadian universities that they could not offer sufficiently attractive funding opportunities and research environments to draw highly qualified new recruits, particularly from highly-regarded international institutions. This was reinforced by long-standing concerns in Canada regarding the “brain drain.”

Evaluation Issues: Ten specific issues were to be addressed in this evaluation (*Bearing Point, 2005*), all of which are covered in this report within the above-noted framework, centred more broadly on the objectives of the CFI and the NOF. These issues address the need for an infrastructure program, impacts on attraction and research careers, impacts on the training of students and others, the need for operations and maintenance funding, advantages and disadvantages of a university-focused funding system, impacts on universities’ strategic priorities, delivery processes, and lessons learned (see Annex A).

Contextual Factors: A number of contextual observations affecting the evaluation are noted below:

- Canada is regarded internationally as having very significant and innovative research funding administration systems. The NOF is an example of these advanced capacities – its focus and funding scheme achieved what other countries studied wish to emulate in terms of training. That is, that enabling good faculty to obtain start-up infrastructure funds attracts good students. A program such as the NOF acts not only to attract well-qualified faculty to Canada (and retain them within Canada) but also to attract and retain highly qualified students as well.
- There is a general lack of benchmark data on faculty, students and research. While the NOF has improved the competitiveness of Canadian universities, other nations are also investing large sums in research infrastructure and HQP. From 1998 to 2007, international competition has increased, thus affecting Canada's ability to attract and retain HQP.
- It should also be noted that the NOF evaluation results are congruent with the results from other evaluations of CFI programs such as the *2002 Interim Evaluation of the NOF*. This evaluation may provide a useful reference check on a current program of CFI evaluations: *the Outcome Measurement Study (OMS)*. The purpose of the OMS is to assess the degree to which the CFI’s investment in research infrastructure has been a critical contributing factor in the realization of certain outcomes.

² See: *A Survey of Canadian Academic Research Equipment: Its Adequacy and the Implications for Research Capability*, D. Rank and D. Williams, in *Equipping Science for the 21st Century*, John Irvine et al., Edward Elgar Publishers, 1997.

1.3 Methodology

1.3.1 Main Methods Applied

Methods and data sources included drawing on extensive information collected by the CFI over the history of the NOF and using new data which the evaluators collected through a series of surveys and interviews (see Annex B for additional details, including a table showing sample sizes):

- **Document Review:** Annual Reports; a previous NOF evaluation (HAL, 2002); the CFI Evaluation Framework; and other documents were reviewed as part of the background research. As well, a sample of project applications, universities' strategic research plans, and related documents were reviewed by the evaluators.
- **Analysis of Administrative Data:** An examination of key administrative data files included electronic Annual Reports filed by Project Leaders (PLs) (in particular, the very complete 2006 file), and financial and other CFI data files for the period 1999-2006. These data are used throughout this report to validate or cross-reference opinion data from surveys and interviews.
- **Key Informant Interviews/Administrative Survey:** Eighteen key informant telephone interviews with Vice-Presidents-Research (VPRs), Provincial officials and other federal agencies were conducted, examining key evaluation issues. In total, data was collected from 151 university administrators, including 49 VPRs and/or their delegates.
- **A Survey of Project Leaders** covered over 2,000 PLs who received awards between 1999 and 2005. Survey questions dealt with the NOF application process, the impact of the NOF on their acceptance of a faculty position, use of infrastructure, training, and publications, grants etc., both before and after the NOF competitions. This survey was completed by 1,506 PLs -- a response rate of 75%.
- **A Survey of Non-Awardees:** A sample of 155 non-awardees were surveyed by web and telephone. The questions posed were similar to those asked of PLs, to allow for comparisons to be drawn as to research productivity (publications, grants, etc.), both before and after the NOF competitions. Information was also gathered regarding membership in equity groups (women, visible minorities, etc.), and regarding satisfaction with the NOF process. Responses were obtained from 77 non-awardees, for a response rate of 50%.
- **A Separate Training Component of the Evaluation** examined the NOF's achievements through:
 - A Web Survey of Trainees: 821 graduate students, post-docs, and technicians were asked about the quality of training, satisfaction with NOF-funded infrastructure, impact of training on subsequent employment, and other issues;³ and Interviews with Employers of NOF Trainees: 33 employers of NOF trainees who had worked on NOF infrastructure and who then "graduated" to employment with private sector firms, NGOs, or public R&D organizations were asked about impacts on their businesses, and the importance of the NOF to their hiring of trainees.
- **An International Comparison Component of the Evaluation** examined infrastructure and HQP programs in five countries (UK, U.S., Australia, Germany and Japan), and the European Union. Research was based on documents and contacts with key program officials in all the jurisdictions, with over 35 major programs examined (details are provided in a separate report).

³ No response rate could be calculated for this survey, as the population invited was not known with certainty because of a method constrained by privacy requirements.

1.3.2 Strengths, Limitations and Challenges Faced by the Evaluation

[Note to readers: The evaluators note that some of these limitations are common to all attempts to impose "after the fact" scientific evaluations on real world programs. Readers who are familiar with these issues may wish to skip past certain sections.]

Data Strengths are seen in the diversity of responses among VPRs, Deans, and Heads, and PLs, many of whom had very different views on the NOF. As well, *File Data* from CFI annual reports allowed validation of views of administrators and PLs. These annual reports by universities and individual researchers measure key factors such as the output of HQP. As well, much of this data forms statistically reliable indicators. Another positive feature of this data was that results of evaluation surveys were highly consistent with CFI file data.

Limitations: Several limitations faced the evaluation, including the reality that the evaluation was, in fact, a "final evaluation" (because the NOF is now closed and is no longer issuing new awards), even though the program is relatively "new." Other limitations included the need to use subjective, qualitative information to address many issues because of the lack of benchmark data or experimental controls. As well, all issues could not be cross-validated in different surveys because of the need to keep surveys relatively brief. In a related vein, analysis of some issues which could only be addressed qualitatively, was difficult, in that the extent or significance of concerns raised could not be determined in a precise or statistical manner (See Annex B, Qualitative Data). In these cases, findings are sometimes noted as being "indicative". A final limitation is that no direct consultations were undertaken with industry partners in funding (this was not in original study plan)

The NOF as a Relatively "New" Program: The NOF is a relatively new program and has not yet experienced its full impact. As of February 2007, the CFI had disbursed about \$290 million of the total \$315 million of NOF awards (with unfinished projects slated to receive the remaining disbursements as they are developed), as per its mandate.⁴ As a result, many projects examined were still reported to be in their early stages. Thus, survey responses to questions regarding the impact of the NOF were frequently "too soon to tell." (The "newness" of the program must also be considered in light of the very long-term process of building infrastructure, and conducting academic research). "Newness" means that the magnitude of expected impacts of the NOF would be modest (for example, if research usually requires about 5 years from start to publication or other results (patents etc.), or as long as ten years for economic-social impacts, and the average NOF project has operated for 2.2 years).

The Need for Benchmarks and Experimental Controls: Another challenge of the evaluation was a lack of historical and comparative benchmarks allowing for key comparisons. No data were available, describing researchers or trainees prior to the NOF. Similarly, it is not possible to assess directly the quality of researchers who were selected for the NOF as compared to all others, as no data are available on researchers who were not aware of the NOF or whose infrastructure proposals were not chosen by universities for submission to CFI. Because virtually all Canadian universities were eligible and received funding through the NOF, a "control" group could not be established (e.g. on the basis of a random assignment methodology, or to simulate this in a quasi-experimental design).⁵

⁴ Total allocations slated to be awarded under the NOF during period from 1998-2010 were \$535million. The unused institutional allocations of ~\$221 million were rolled into the LOF (to be awarded in the same period) when the CFI's program architecture changed in 2005.

⁵ A similar issue is that there is no real way of knowing if another type of researching funding mechanism in Canada would have had similar results (e.g. increased funding for other CFI programs). Comparative studies across funding programs could provide a degree of control (e.g. comparing the NOF to Canada Research Chairs (CRC) etc.).

Thus, some improved outcomes, while indicated, may be difficult to attribute directly to the NOF (other programs, with or without CFI funding, might have had equally beneficial outcomes). In addition, research performed using the CFI-funded infrastructure benefitted from a variety of other funding sources, so the impacts of CFI funding are part of a larger process. These elements were important in shaping the overall evaluation and required a methodology using multiple methods.

Partly as a result of the lack of benchmark and experimental controls and objective data, much of the data presented here are based on surveys, and much of it is based on views of participants and stakeholders. This was also true for the 2002 NOF Evaluation. Those directly accessing the program included university administrators and researchers "holding" NOF awards. (It is noted that although awardees -- researchers who have prepared (or assisted in the preparation of) proposals⁶ at universities, referred to by the CFI as Project Leaders -- have a moral and intellectual interest in the projects, yet they do not "own" NOF-funded infrastructure *per se*, since the awards are made to the institutions rather than to the individual PLs.) As well, data from surveys such as those developed for this evaluation tend to *autocorrelate*: universities and PLs who have had successful experiences with the program tend to view it favourably; only those who are dissatisfied offer critical observations. Such limitations are particularly noted for our discussion of "value-for-money," where a number of attitudinal questions are posed for participants and stakeholders, but no formal cost-effectiveness analysis is undertaken (which could be a topic for future evaluations).

Cross-Validating the Data: The above challenges placed a particular responsibility on the evaluators to cross-validate data and identify independent tests of conclusions. To this end, the evaluators cross-referenced data from different sources to minimize or understand potential bias (e.g. comparisons of responses of university administrators and researchers). Some indicators of reliability and validity of the survey data are also derived from statistical analyses (indicators such as Cronbach's Alpha -- for example, a Cronbach's Alpha of .75 (good by usual standards) was found for PL survey responses on reasons for accepting the NOF position). As well, some *independent assessments* are provided by Provincial officials who were interviewed, and the exploratory survey of employers (mostly in the private sector, who participated in the NOF, or hired trainees who worked on the NOF projects). Additionally, some statistical tests have been used to validate the results -- for example, correlating Project Leaders' reports of delays in the start-up of NOF projects, with the actual time required for CFI approval of projects.

Transition of the NOF into the LOF -- A Challenge in Framing the Results: The fact that NOF was folded into the Leaders Opportunity Fund (LOF) in 2005 creates unique challenges in drawing conclusions from this evaluation. *Partly this is because some comments from NOF participants are dated -- changes and improvements have already been made by the CFI (within the LOF), or have even been made during this evaluation. Therefore, it is a challenge to "decipher" some of NOF evaluation results -- to determine exactly which findings could be applied to future reforms of the LOF and which are more of historical interest only since the LOF has already incorporated improvements.* In this vein, it is important to note that the policy objective of the NOF was that the funding was to be applied solely to "new hires," while the LOF can be used for longer-term faculty. Therefore, the LOF is not a direct replacement of the NOF. This fact affects responses from university administrators (VPRs, Deans, Heads). Universities benefitted more directly from the NOF program, because the NOF provided a type of recruitment incentive for universities to use (although it is emphasized that NOF funds did not flow to PLs personally). The NOF was often used as part of a total recruitment package. Because the NOF program was focused on new hires and increased international competitiveness in attracting HQP, these were key aspects of the evaluation.

⁶ Future evaluations should examine the extent to which others, for example, university research offices aided PLs with their applications. While it is commonly understood that PLs prepare the majority of the proposals, it seems likely that there are many cases where colleagues, departments or university research administrators do provide substantial assistance.

1.4 Complexities of the NOF

Partners and Stakeholders: Several features of the NOF reflect the fact that the program is not just delivered by the CFI but, to a great extent, administered by the universities themselves, with major funding and/or operational roles played by the provinces,⁷ industry and others such as the Federal research funding agencies (see Section 2 for a more complete description of the NOF). This makes attribution of strengths and weaknesses a challenge and also calls for a number of different types of recommendations, including those directly aimed at CFI, others recommending that CFI coordinate further with other funding agencies, and yet others directed more broadly to the federal government or to Industry Canada, as the department responsible for the CFI. PLs themselves are important stakeholders to these efforts, contributing millions of hours of administrative⁸ work towards programs such as the NOF (it may be useful as well to think of PLs as customers or clients of the NOF, even though the direct clients of the NOF are the universities).

Universities themselves present a special complexity, as they represent a set of education institutions with annual budgets cumulatively, of over \$12 billion, serving millions of individuals, employing tens of thousands of individuals, and playing a vital role in Canada's R&D effort (AUCC, 2002). They are formally under the provinces, making the provincial role in NOF-type programs especially important. They are, however, also highly independent in that they have a variety of unique cultures, values and goals. As well, they relate to a number of umbrella groups which can aid this work, including the AUCC, the Canadian Association of University Business Officers (CAUBO) and the Canadian Association of Research Administrators (CAURO).

Canadian universities are also facing many changes related to the goals of recruitment, retention and development of HQP. This is emphasized by the AUCC's publication *Trends in Higher Education* (2002) which notes that, partly as a result of the "greying" of university faculty, Canadian universities will need to hire between 30,000 and 40,000 new faculty by 2011. Nearly 20,000 of these new hires will be replacing retiring faculty -- a "long-run challenge."⁹ As well, Canadian universities face many challenges in the areas of growing enrolment, faculty retirements, teaching loads and related factors that may all influence research and research productivity.

Need for Balance in Funding: Research funding for Canada as a whole must be balanced so that infrastructure which is built is complemented by suitable research funding to use the infrastructure. This will ensure optimal use of research investments.¹⁰ This goal may not be achieved if NOF-type funding is disconnected from supporting research funding, so additional emphasis is placed in this report on the importance of coordination with other Federal research funding programs.

International Context: Yet another complexity facing the NOF surrounds its goals of improving Canada's international competitiveness -- programs and conditions in other countries have affected its potential for success and will continue to affect NOF-type programs in the future. This is particularly true for other countries which are expanding research funding and introducing new programs, increasing the overall level of international competition for HQP (see Section 5, below).

⁷ See: David Wolfe, *Innovation and Research Funding: The Role of Government Support*, <http://www.utoronto.ca/president/04conference/presentations.html> (2007).

⁸ This estimate was based on reports by PLs that they spend about 30 hours per month on research administration and maintenance or at least 3.6 million hours over the course of the NOF projects, with a value of about \$22 million per year. See Appendix B for details on this computation.

⁹ Personal communication, AUCC staff.

¹⁰ This consideration was underlined by one high level key informant interview for a major institution which indicated that much more infrastructure was established for its faculty than could be "driven" by research funding.

1.5 Organization of the Report and Method of Presentation

Organization: Findings emerging from the key informant interviews with VPRs and Provincial officials, and the web surveys of VPRs, Deans and Heads, Project Leaders, NOF Trainees and Non-Awardees are provided for each of the key evaluation topics where these data provide relevant evidence. Major sections of the report address: The NOF Profile, Findings as Regards NOF's Objectives, Operational Findings, International Comparison, and Lessons and Recommendations.

Statistical and Qualitative Data: *Statistical data* drawn from the web surveys are generally shown in the form of percentages (with reference to the original survey question¹¹). Statistics from the web surveys are provided within (usually with the % in text excluding answers such as "don't know" or "too soon to tell"). A caution is that some graphs show the percentage of responses among sub-groups answering a prior question in a certain way. Such responses must be interpreted carefully, in-line with the size of the samples which have been surveyed.

Statistical Tests: All tests of correlations noted are computed using *Pearson's r*. Differences in means are assessed using *t-tests*. All statistical displays and graphics for PLs are based on a core sample of 1,506 PLs, except where noted otherwise.

Significance of results: Where comparisons are drawn, as to differences or correlations, findings are noted as particularly relevant where significant at the $p < .05$ level (likely to be reliable, non-chance findings, 95 times in 100, and in some cases where significant at $p < .10$ (likely to be non-chance 90 times in 100). Relative to the point raised earlier regarding *magnitude of impacts* -- it is emphasized that findings which are statistically significant in such a new program are likely indicative of more substantial findings that would emerge in a longer-term analysis.

Qualitative data has been drawn from key informant interviews (conducted with VPRs and Provincial officials) and for *web survey questions*. For these data selected quotations have been included for illustrative purposes. *Assessments of Qualitative Data:* generally, statistical estimates are not drawn from open ended data as to the extent or significance of comments which evaluation participants made in response to open end questions, such as "what are the lessons learned from the NOF?". The reason for this is that the percentage of respondents who cite a particular factor, such as the problems of "matching funds" in such a question is generally likely to be much smaller than the percentage who would respond directly to a specific closed response question on matching. That is to say that statistical counts drawn from open-end questions will under estimate the importance of a given response. Nonetheless, the evaluators sometimes attribute a weight to such responses, noting that "some" or "many" respondents indicated that a particular lesser or issue was noteworthy.

Other Data: While the focus is on interviews and surveys, some reference is made to other components, such as the international comparison.

Some Historic Materials: Some materials, particularly the profile of the NOF (next section), will be of limited interest to those who are very familiar with the NOF, and may be "skipped" by such readers.

Terminology and Short-Forms: A variety of abbreviations and specialized terms are used throughout the report, and are summarized in Annex C.

Recommendations are suggested by conclusions throughout the report, but presented in detail in Section 6.2 at the end of this report.

¹¹ Questions from The PL, Provincial and Administrators surveys are referenced as Q#, where # is the question number in the actual survey. Questions from the trainee survey are noted as "T#", and questions from employer interviews are noted as "E#".

2. Profile of the NOF

2.1 Overview

Program Structure:¹² Between 1998 and 2005, over 2,200 NOF awards were made to virtually all Canadian universities. The NOF program was structured to facilitate the recruitment of new faculty members to Canadian universities. The NOF was also designed as “block” funding. Universities were provided with NOF allocations based on historical performance attracting research funding and were responsible for channeling funds to incoming researchers, with the CFI's approval. Some universities undertook internal selection processes that included evaluating individual researcher qualifications, the potential of the project and the need for infrastructure, prior to submission to the CFI's own merit review process. As a result, 90% of all applications were approved by the CFI.

Relationship with Partners and Stakeholders: The Universities were the CFI's key partners for the NOF. While the NOF was designed to aid Canada's innovation generally, the NOF also responded to historical features of Canadian universities, among them: a historical tendency of funding agencies to allocate funds on the basis of one-time project proposals with specific outcomes, rather than the creation of a base for ongoing research. This resulted in a historical shortfall in research infrastructure funding, as noted by writers such as Davey¹³ and by reports of the Canadian Association of University Research Administrators regarding the decline of university infrastructure. NOF also responded to the historical sense of Canadian disadvantage in international competition for high-level research faculty (reflecting Canada's historical problems with the "brain drain" of high level talent, particularly to the U.S.). Administratively, the NOF functioned to a great extent like a "transfer" program, with universities held responsible for most of the administrative work. To ensure that the NOF fits within a university-wide strategic orientation, universities were required to orient NOF to Strategic Research Plans (SRPs). Other Stakeholders: Relationships with other stakeholders have resulted in the creation of liaison groups from time to time, such as the Stakeholder Advisory Network established in 2006, which provided a venue for discussions with a range of key stakeholders such as the provinces.

An Interim Evaluation (2002): It is important to note that an interim evaluation of the NOF was conducted in 2002 by Hickling, Arthur, Low. While conducted early in the program and highly reliant on subjective survey data, the evaluation pointed to a number of conclusions. For example, the evaluation suggested that the NOF was succeeding in its goal of attracting international HQP, and pointed to a need for improved coordination of the NOF with other federal funding agencies. Some other conclusions of the 2002 evaluation are echoed in this final evaluation report.

Program Changes: In the fiscal year 1998-1999 NOF operated on a unique competitive basis, which was replaced by a revised program structure in 1999-2006. Subsequently, the NOF was complemented by another program, the Infrastructure Operating Fund (IOF) established in 2001. In November 2005, the NOF was replaced by a new CFI program called the Leaders Opportunity Fund (LOF), which assumed NOF projects and funds still to be allocated. The LOF was intended to support individual researchers, but the selection criteria for individual awardees, included not only the recruitment of first, full-time faculty, but also retention of leading researchers. As well, the infrastructure component of the Canada Research Chairs Program was placed under the LOF. The LOF was also intended to benefit from coordination with funding from funding agencies (NSERC, CIHR, SSHRC).

¹² Portions of this discussion are drawn from the RFP for this study (*Bearing Point*, 2005).

¹³ Ken Davey, "The Infrastructure of Academic Research", *Research File*, August 1996, Vol. 1, No. 4.

2.2 Operational Characteristics of the NOF

The NOF Application Process: Universities were provided with block funding, based on their total historical sponsored research income, excluding CFI awards. Within this scheme, large research-intensive universities received much larger allocations. For example, the university with the largest allocation, the University of Toronto, was allocated \$52,400,000 while Athabasca University was allocated \$270,000 (allocations for all universities are provided on the CFI's web-site).

NOF Applications: Under the NOF criteria, universities were to designate areas of high priority outlined in their Strategic Research Plans (SRPs), and were able to submit applications three times per year. To be eligible, candidates within the university must have been hired within an 18-month period preceding the application. Most awards were for projects with single researchers; however, some also went to small groups (usually 2 researchers) who shared the infrastructure.¹⁴

Review Procedures: The CFI usually submitted each application to at least two reviewers – one member of the CFI's College of Reviewers and one expert reviewer.¹⁵ The merit of each proposal was evaluated according to CFI's criteria for all of its programs: Quality of the research and the need for the infrastructure; contribution to strengthening capacity for innovation; potential benefits of the research to Canada.¹⁶ Final approval rested with the CFI's Board of Directors.

Monitoring: In addition to financial reporting, the CFI established a system for annual reporting by PLs, on projects (e.g. state of infrastructure, number of students and others involved, subjective assessments of collaborations, etc.). This reporting system, much like a survey, began in 2001 and continued with several modifications, achieving very high response rates (as high as 96% in 2006).

2.3 Overall Finances and Fund Matching Provisions

Between 1999 and 2005 nearly \$317 million in funding for research infrastructure had been awarded to Canadian universities by the CFI.¹⁷ Key cost-sharing and matching provisions were built into CFI from the start. The CFI provided 40% of the cost of the infrastructure for the NOF projects and various other funding sources (universities, provinces, industry, etc.) contributed the remaining 60% in cash or "in kind". Since July, 2001, the CFI also has provided each university with funds for infrastructure operations and maintenance (O&M). For each approved NOF award, the CFI provided operating funds equal to 30% of the CFI's contribution to the cost of the infrastructure (or, 12% - 30% x 40% - of the total cost of the infrastructure). Universities also received a 30% O&M allocation for each of their awards under the CFI's Innovation Fund. Universities were free to distribute these operating funds among their NOF and Innovation Fund projects as they saw fit, within guidelines set for eligible O&M costs (CFI Communication).

¹⁴ *New Opportunities Fund Overview, 1999-2003*, Section 1.4. See Section 4.1 for additional details on NOF finances.

¹⁵ Where the proposed research spans diverse disciplines, the total project costs are over \$1 million, or the project is otherwise highly complex, CFI seeks advice from additional reviewers. CFI may also seek advice from the College of Reviewers or the New Opportunities Fund Adjudication Committee.

¹⁶ More precise criteria are suggested by the NOF application form: the quality of the research and its potential impact within the research community; the reputation and/or the potential of the researcher; the need for the infrastructure; the importance of the HQP skills being trained; the impact on strengthening research collaborations and partnerships; and potential socio-economic benefits to Canada. Three other criteria were applied: (1) effective management, operation, and maintenance of the infrastructure on an ongoing basis; (2) enhancing the institutional capacity in its strategic research priority areas; and (3) building regional or national capacity for innovation and for international competitiveness.

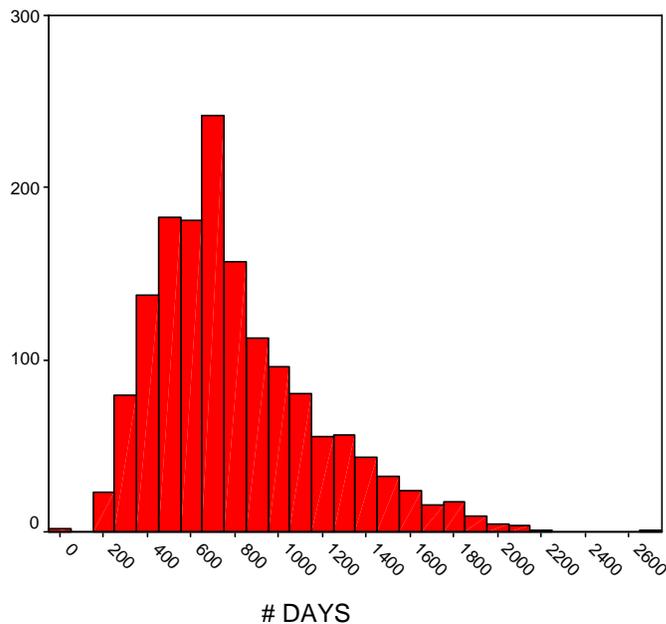
¹⁷ CFI personal communications and financial reports, March 2007.

2.4 Timing of Awards and the "Newness" of the NOF

Overview: A key question in the evaluation methodology was: "Is the relative 'newness' of the NOF an issue to consider in evaluating the program and lessons learned?" The answer is "yes" – "newness" of the program is an issue in assessing impacts. Because the NOF was for researchers who were assuming their first full-time academic position in a Canadian university their careers were typically only starting to unfold, in a process which by conservative estimates takes at least 5 years for noteworthy success. This underlines the extent to which the NOF might as of 2006 (when most of this evaluation's data was collected) be expected to show only modest magnitude impacts. Time to establish infrastructure: The NOF infrastructure itself was established through a process which usually took one or more years. This is in addition to the time it takes for research project results to be reported in the academic literature (typically 3 to 5 years), and the 10 years or more that it may take for societal benefits to emerge. Thus, many of the benefits of the NOF are still in the future.¹⁸ As well, the real results of NOF may be even longer term in that they may be best revealed in the work of NOF trainees, who will contribute to innovation for decades to come.

Actual infrastructure in place: NOF-supported infrastructure was not always installed quickly because of delays encountered in approvals of expenditures, university administration processes, time required to manufacture or construct the infrastructure, etc. For example, CFI data suggest that the time elapsed from approval of an award to full payout and operation of projects was substantial (see display below). Time elapsed between an application for NOF funds and a CFI decision, was estimated by CFI staff to be relatively short -- about 121 days. When the final budget is submitted, CFI turnaround time is reported to be 2-3 weeks. Yet, *overall, time to establish infrastructure was very substantial*, as seen in Display 2.1. This process, from approval of an award, to final payout, was estimated to take an average of nearly 2.25 years.

Display 2.1
Total Time (in Days) From CFI Decision to Final Payment
(Mean = about 800 days or 2.25 years) (data from the CFI)



¹⁸ Gustavo Crespi and Aldo Geuna, "The Productivity of UK Universities," SPRU Electronic Working Paper No. 147, February 2006.

The impact of elapsed time is further reflected in "on-the-ground" reports by PLs who, in 2006 Annual Project Progress Reports, indicated that many projects approved in 2004-2005 were still not fully operational, and that the same was true for a small number of projects approved as early as 2001 (Display 2.3 below). As a result, when asked how long projects had been operating, PLs surveyed in 2006 indicated that their infrastructure had been operating an average of two years and three months (some were not yet operational as reported by PLs, and the longest was reported as being operational since the start of the NOF).

Display 2.3
Percentage of NOF Projects Fully Operational in Spring, 2006
 (based on PL's reports to the CFI, -- 1,462 cases with complete data, Annual Report, 2006)

Year of the NOF Award	% Fully Operational as of Spring, 2006	N
1999	100	5
2000	100	74
2001	98	206
2002	97	349
2003	91	354
2004	75	347
2005	47	127

Conclusion Regarding the General Distribution of Funding: As of February 2007, the CFI had disbursed about \$291 million of the total \$317 million of NOF awards (with unfinished projects slated to receive the remaining disbursements as they progressed), as per its mandate. Review of the complexity of the program, however, suggested that particular attention in the evaluation might be applied to the roles of different stakeholders and how their interrelated contributions affected success.

Need for a Streamlined Process: One concern, particularly as expressed by many PLs was the long time period required for the establishment of infrastructure. While no standards are known to exist for assessing this aspect, the issue of improving timely establishment of infrastructure was highlighted as a concern for the evaluation by a substantial minority of PLs -- about one-quarter of all PLs surveyed. Thus, in the evaluator's recommendations, particular attention is given to the topic of streamlining future applications and the time required for project implementation. Attention is also given to the roles of PLs in NOF-type programs.

3. Findings Regarding Achievement of the NOF's Objectives

3.1 Attracting and Retaining High Calibre Researchers

The NOF was aimed at "new" faculty, providing an attractive hiring incentive for high calibre researchers. It also brought in some more experienced researchers. The NOF had an 18-month window which allowed universities to retain newly hired faculty (in particular, newly-graduated faculty). These young, excellent faculty are potentially highly mobile. Thus, university administrators appear to have viewed the NOF as having both an attraction and retention role – the NOF could be used initially to enrich "hiring incentive packages," but once hired, PLs tended to stay.

3.1.1 Attracting High Calibre Researchers

Administrators Viewed the NOF as a Successful Tool for Attraction: Almost all VPRs, Deans and Heads indicated that the NOF had positively affected their institutions' ability to attract researchers. As well, many indicated that they would not have been able to hire many of their key new faculty without NOF. These impacts were directly linked to the NOF providing improved infrastructure. As Canadian universities are engaged intently in hiring in the new millennium, while retirement of faculty looms as a major issue, this further demonstrates the continuing need for a program to attract new researchers.¹⁹ Administrators strongly emphasized these positive impacts, as reflected in the following comments:²⁰

In the past 2.5 years, the accessibility to new infrastructure through NOF has allow[ed us] to attract ... very successful researchers (some have been offered [positions] in other places but with the infrastructure here they decided to stay).

The NOF cannot be looked at in isolation from other programs but the combination of CFI funding and the CRC program have allowed us to attract some of the best scientists in their fields from the U.S. and Europe...

Canada is now assuming leadership in fields where it would otherwise not be present. The infrastructure has attracted ... people who would otherwise not be at Canadian universities and training the next generation of scientists.

Comparison to Other Hires: VPRs, Deans and Heads agreed that the NOF had enabled their universities to recruit higher calibre researchers as compared to non-NOF researchers who had been hired during the same time period. Administrators also noted that many of their new "hires" were internationally regarded researchers who were attracted to their institution because of the NOF funding. Approximately 85% of VPRs, Deans and Heads reported that their institution's success in competing for HQP with American or other international institutions had been more successful in 2006, as compared to before the NOF began. As well, approximately half of all VPRs, Deans and Heads indicated that the NOF PLs hired by institutions were of a much higher calibre than other (non-NOF) researchers hired during the same time period.²¹

¹⁹ This issue may diminish in significance as compulsory retirement ages are being raised or abolished. It is useful to note that hiring requirements are likely to be a good predictor of NOF funding requirements. (See Section 1.4 for a discussion of the "greying" of Canadian university faculty.)

²⁰ Comments drawn from Surveys of Vice-Presidents-Research, Deans and Heads, Q.15.

²¹ A few VPRs, Deans and Heads explained that NOF not only attracted new hires but also (less directly) lured high quality graduate students to the institutions. It appears that NOF attracted the faculty and that these faculty members subsequently attracted the students.

Administrator's View of How and to What Extent the NOF Impacted Recruitment: VPRs, Deans and Heads also provided a variety of views regarding how the NOF had improved recruitment at their institution.²² These views were typified by one VPR who noted: "Nearly all of our highly competitive recruits expect a significant "start up" package that would be impossible for us without a combination of sources including the NOF." Other comments included:

We have hired 9 new faculty members since this program went into effect. The recruitment of at least 8 of these individuals was dependent upon the NOF program. Most would have gone to the U.S. if this program were not in effect.

[There are] quite a few faculty members that would have been previously untouchable: e.g.[an American] candidate was attracted due to the NOF and to some extent the quality of life in Canada.

It's not that we've only had people who came here because of the NOF, but also we see some people coming here in terms of the funding and the equipment. As well, it's not just faculty that the NOF attracts, but also students. Good faculty who are attracted by the NOF funding in turn attract Ph.D. and graduate students who are excellent as well [...]

At least two recently hired faculty members indicated that they could not have hoped to build successful research programs in our institution without the NOF and would not have accepted the position not being reasonably hopeful of access to funds from the NOF.

Overall, VPRs, Deans and Heads were unanimous in their assessment that NOF had levelled the international "playing field" for competition. This view was expressed by 99% of administrators, with 69% indicating that competitiveness had improved "to a great extent" and 30% indicating that competitiveness had improved "to some extent."

Project Leaders also saw the NOF as Aiding Attraction: PLs' reasons for choosing the NOF academic appointment were consistent with those of VPRs, Deans and Heads. That the NOF had been a very significant factor in faculty recruitment, was reflected in PLs' ratings of the NOF infrastructure as the main reason for accepting their position (62% of PLs rated the NOF as being "very important" to accepting their appointment).

However, PLs emphasized that NOF was not the *only* factor affecting their decision. Location and personal considerations,²³ and the institution's reputation were also noted by PLs (although the NOF was more typically rated as the "most important" factor). The second most important factor (location-personal considerations) was rated as being "very important" by 56%, and institutional reputation was rated as "very important" by 51% of PLs.

Display 3.1 shows the percentage of PLs who rated various factors as "very important" in their decision to accept the NOF-related position. Percentages are based on responses from 1,506 PLs.

²² Comments are drawn from the Survey of Vice-Presidents-Research, Deans and Heads, Q.12.

²³ In general, locational and personal factors are difficult to assess further, as these were not examined in-depth in the survey but were based on PL's comments and clearly include such diverse issues as Canada's quality of life, spousal employment prospects and the Canadian medical insurance system.

Display 3.1
Project Leaders' Response to the Question:
"How important were each of the following factors in your
decision to accept the NOF-related position? " (Q.21)
 (Percentages total more than 100% because more than one answer could be chosen)
 (based on responses from 1,506 PLs²⁴)

	% Rating factor as 'Very Important'
The promise of NOF infrastructure	62%
Location/personal considerations (family, relationship, medical, etc.)	56
The institution's reputation	51
Other infrastructure	47
Your teaching responsibilities (less/more opportunity to train students)	44
Salary-financial factors	25
Other factors	35

International Recruitment: Consistent with the reports of VPRs, Deans and Heads, the PL Survey indicated that while most recruits were Canadian, many PLs had been recruited from highly-ranked foreign universities as well, such as Chicago, MIT, Stanford, Cambridge, Princeton and Berkeley. To assess the quality of NOF recruits in more detail, an analysis of the university where PLs obtained their highest degree (usually the Ph.D. (97%)) was conducted, using an indicator of international standing of universities (Shanghai index).²⁵

This analysis showed that 39% of the NOF PLs came from the top 100 universities in the world as ranked by the Shanghai index, thus suggesting a high quality cohort of recruits. (It is noted that only 4 Canadian universities are included in this ranking of the top 100 universities.) An analysis of the origin of NOF PLs also showed a number of interesting recruitment paths -- for example, through the NOF, a number of Canadian-trained PLs were recruited back to Canada from the U.S. (e.g. National Institutes of Health).²⁶

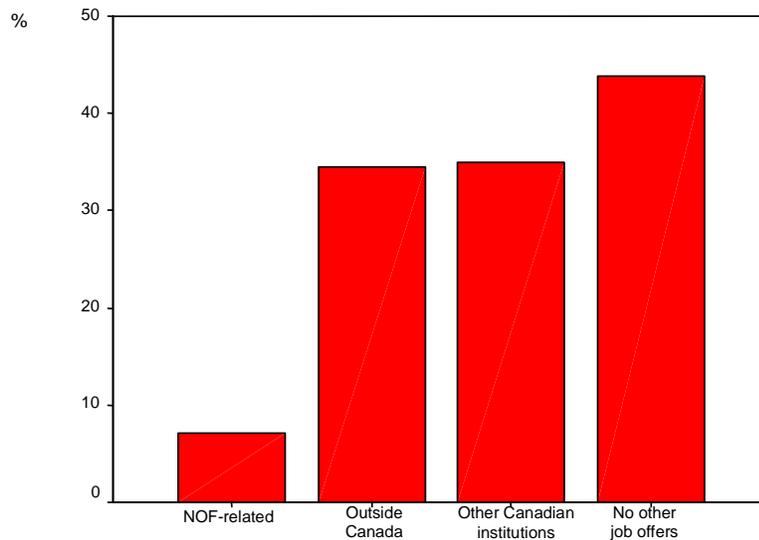
²⁴ Responses to sub-questions were based on slightly different numbers of responding PLs. All sub-items were rated by 1,458 to 1,470 PLs, except for "other factors" which was rated by 1,330 PLs.

²⁵ The evaluators note that while all such rankings are subject to critiques, this indicator is widely used, for example, by major Canadian universities, and appears to have good reliability and validity. The Institute of Higher Education at Shanghai Jiao Tong University publishes an Academic Ranking of World Universities ranking research universities by their academic and research performance. The ARWU is a highly-regarded ranking as many internationally recognized institutions, government agencies, companies and the media have cited the ARWU. Approximately 1,000 institutions have been ranked by the Shanghai Jiao Tong Academic Ranking of World Universities. The criteria and weights for the Academic Ranking of World Universities are based on four sets of criteria, including prizes and medals, publications cited and performance relative to size. The highest ranked institution is assigned a score of 100%. More information about ARWU can be found at: <http://ed.sjtu.edu.cn/ranking2006.htm>. (Also see appendix B for additional details).

²⁶ Among internationally-recruited PLs, who were surveyed, 21 had been working at the U.S. National Institutes of Health prior to accepting their appointment at the NOF institution.

NOF PLs Were in Demand: As can be seen in Display 3.2 below, over one-third of NOF PLs reported that, at the time they were considering the NOF-related job offer, they had received job offers from other Canadian institutions, and over one-third reported receiving job offers from institutions outside of Canada.

Display 3.2
Project Leaders' Response to the Question:
"What type of job offers were you considering (if any)
at the time you accepted the NOF-related faculty position?" (Q.8)
 (Percentages total more than 100% because more than one answer could be chosen)
 (N =1,506, scale is topped at 50% for purposes of graphic presentation only)



Did the NOF Recruit the Strongest Researchers? There is no objective benchmark data available regarding non-NOF faculty hired at the same time as NOF awardees. However, some data are available for PLs and some comparisons are possible as regards non-awardees. First, administrators indicated clearly that NOF nominees were superior to other new faculty. Second, PL and non-awardee comparisons supported this assessment, with the majority of PLs reporting that they had published prior to receiving their NOF award.

Indications of high publication rates among NOF researchers, as well as the ability of many of these PLs to obtain other research funding prior to obtaining their NOF award, provides confirmation of the high quality of these researchers. As well, survey results show that NOF PLs were more likely to publish articles as primary authors than were non-awardees, and that they were more likely to publish books, be invited to attend conferences, etc.

The comparison provided below in Display 3.3 indicates that although both PLs and non-awardees were all highly rated by their universities, PLs were more productive than non-awardees in all areas (specifically, in solo publications and co-authored papers), and significantly more productive in a number of other areas.

In addition, when compared on a standardized productivity indicator, PLs scored significantly higher, than non awardees, affirming that they were more productive overall.²⁷ These data provide objective support for assessments of administrators and PLs that productivity was substantially improved by the NOF.

Display 3.3

Differences in Productivity between NOF PLs and Non-Awardees

(Means) at the time of application for the NOF award (based on n = 1,410 survey reports)

Aspect of Productivity	Non-Awardees	PLs	Significance of Difference(t-test)
Publications (Sole or Primary Author)	7.30	8.79	PLs higher, sig = p<.05
Papers (Co-authored)	5.48	7.99	PLs higher, sig = p<.05
Conferences invited to	4.03	4.33	PLs higher, NS
Books published	.27	.31	PLs higher, NS
Patents approved	.04	.10	PLs higher, NS
National-international Awards	1.27	1.49	PLs higher, NS
Dollar value of grants-contracts (in 000's)	\$106.57	\$199.90	PLs higher, sig = p<.10
Overall Indicator of Productivity	16.3	20.2	PLs higher, sig = p<.05

Since their NOF-related appointment, approximately 20% of PLs indicated that they had received job offers for positions outside of Canada, demonstrating their professional visibility and reputation. This may also reflect increasing international competition for HQP and increasing retirement rates among university professors as a major issue in other countries.

Responses from Provincial Representatives regarding the influence of the NOF on hiring higher calibre researchers mirrored those of VPRs, Deans, Heads and PLs. There was near unanimity among provincial officials who offered an opinion on whether the NOF had been helpful in attracting higher calibre researchers. A significant majority also noted that the NOF had helped "level the playing field" between Canada and other countries.²⁸ Typical comments on this issue provided by provincial representative included:²⁹

"[The NOF] Provided a level playing field for undergraduate institutions and prompted professors to become active in research even though Atlantic provinces have mainly teaching institutions.

This was a very good mechanism that should be continued as we are at varying stages of increasing and renewing our pool of HQP. It was a key piece of the recruiting package in trying to attract new hires. Not certain it made a significant difference on the world stage but it certainly was felt across provinces as NOF allowed for leveling the playing field within Canada.

Although the initial response [to the matching funds] was negative due to a lack of consultation and the fact that the province did not have an existing program [to meet] the matching funds requirement, the NOF was the best program ever offered by CFI. ... Nova Scotia was able to lure researchers by offering good facilities usually only available in Central Canada and the advantage of their quality of life. The NOF finally allowed Nova Scotia to get into the 'CFI game'."

²⁷ This indicator was an average of z-scores of the six productivity measures, an average of standards scores on the six sub-indicators of productivity (see Annex C for a more detailed explanation of z-scores).

²⁸ Of 10 provincial officials interviewed, 6 indicated that NOF levelled the playing field "to a great extent", 2 indicated "to some extent", and 2 that it was "too soon to tell" how the NOF had affected Canada's international competitiveness.

²⁹ Comments drawn from the Survey of Government Representatives/Other Federal Funding Agencies, Q.49.

Conclusions Regarding the NOF and Attraction: Responses from VPRs, Deans, Heads, PLs and provincial officials support the view that the NOF has been very successful in improving the competitiveness of Canadian universities in attracting internationally-renowned HQP. In interviews and surveys, administrators argued strongly that the calibre of NOF PLs was higher than that of researchers who had not received NOF funding. The NOF award and its related infrastructure were also noted by PLs as being significant influences in their decision to accept NOF-related positions.

These findings point to an important need which the NOF has addressed, to recruit HQP, and must be considered in light of the fact that other international jurisdictions are not "standing still" in this area. Many countries have developed (and are still developing) recruitment and retention initiatives similar to Canada's. This competition underlines the continuing need to reinforce the support for recruitment programs similar to the NOF. (See *Section 5: International Comparison Component*.) Accordingly, recommendations at the end of this report note the importance of reinforcing NOF-type attraction programs for Canada in this first decade of the new millennium.

3.1.2 NOF PLs are Retained

PLs' responses showed a strong inclination to stay in their current positions. Almost all who responded fully to this question -- about 80% -- indicated that they intended to remain at their current institution for at least the next five years. This response was reported by over 90%, when "uncertain" answers were discounted. A similar proportion of PLs indicated that they intended to stay in Canada for the next five years.

Of those PLs who indicated that they intend to remain at their current institution, NOF infrastructure was indicated as the most important factor in their decision to stay (approximately 75% of PLs indicated this factor as being "very important"). The next most significant factor was location/personal considerations (almost 70% indicated this as being a "very important" factor in their decision to stay at their current institution). This was followed by the attraction of other existing infrastructure.

It should be noted that while the NOF was cited as a major reason for NOF researchers to remain at institutions, retention was almost always based on a number of factors -- again, locational/personal considerations were important.

Display 3.4

Project Leaders' Response to the Question: "How important are the following factors in your decision to stay at your current institution?" (Q.49)

(Percentages total more than 100% because more than one answer could be chosen)
(based on 1,244 PL responses)

	% Rated "Very Important"
NOF infrastructure (existing or future)	72%
Location/personal considerations (family, relationship, medical, etc.)	70
Other existing infrastructure	54
Institution's reputation	50
Teaching responsibilities (less/more opportunity to train students)	47
Salary-financial factors	34
Other factors	38

Were PLs in Demand? About 30% of NOF PLs reported receiving recent job offers from institutions within Canada or internationally since their NOF award (Q.20), but most (about 70%) did not, suggesting that they were not "looking" -- consistent with their intentions to stay at the same institution.³⁰

Overall Conclusion Regarding Retention: The NOF helps retain good researchers at Canadian universities. However, retention is much more difficult to measure than repatriation or hiring of foreign researchers. Thus, as we note later, there is a need for Canada to better track such researchers.³¹

³⁰ This points to value in tracking the stock and flow of Canadian university professors, a measure which could be undertaken by enhancing the current Statistics Canada University and College Academic Staff System (UCASS) survey (see *Section 6: Recommendations for Research*).

³¹ For example, there are questions suggested by the data as to whether the LOF strategy (aiming at retention of more senior researchers) is actually keeping the HQP who will be most productive over the long-term. More research is clearly needed to provide a more clear understanding of these issues.

3.2 Creating an Environment for High Quality Research Training

Overview: This section provides findings from a special sub-study of training which was included in the evaluation and was intended to determine whether the NOF had made a substantial contribution to the development of HQP. As well, recognizing the exploratory nature of the research, it was intended to identify ways in which future CFI studies of training could be conducted to the greatest effect, including examination of business impacts.

The contribution of the NOF with respect to training was examined in four key areas: the quality of training received by post-docs, graduate students and technicians; the usefulness of the NOF experience vis-à-vis trainees obtaining employment; and the relevance of skills gained from training on NOF infrastructure (how useful skills were to employers who hired NOF "graduates"). Access to infrastructure was also examined in those instances where employers actually had access to the NOF-funded infrastructure. The research also examined the magnitude of the NOF-related training effort -- in terms of the total number of trainees participating in NOF projects (this data was obtained mainly from NOF annual reports).

Methodology and Data Sources: The training research relied mainly on data from two surveys: a *web-survey of trainees* (graduate students, post-docs, and technicians).³² This survey obtained trainees' views on the effects that their involvement with NOF-funded infrastructure had been on key skills, their ability to obtain employment, and their innovation contributions to employers; and *interviews of employers*: Telephone interviews were conducted with 33 employers (24 private sector employers and 9 employers from R&D NGOs and government), to obtain their views of whether trainees had met their needs and had contributed to their company's innovation capacity. *The questions from which data are drawn for tables presented below are noted as (T#) for trainee survey questions and (E#) for employer survey questions* (see technical report for the actual questionnaires). Supplementary information was obtained from CFI files (a sample of NOF applications and strategic research plans), the PL survey, and other sources. Numerous obstacles were faced in conducting this sub-study, particularly in "tracking" trainees and employers, as no lists were available to the researchers (see Annex A and Section 6: Recommendations for Future Research).

3.2.1 Training Results: Attraction of HQP, Quality of Training

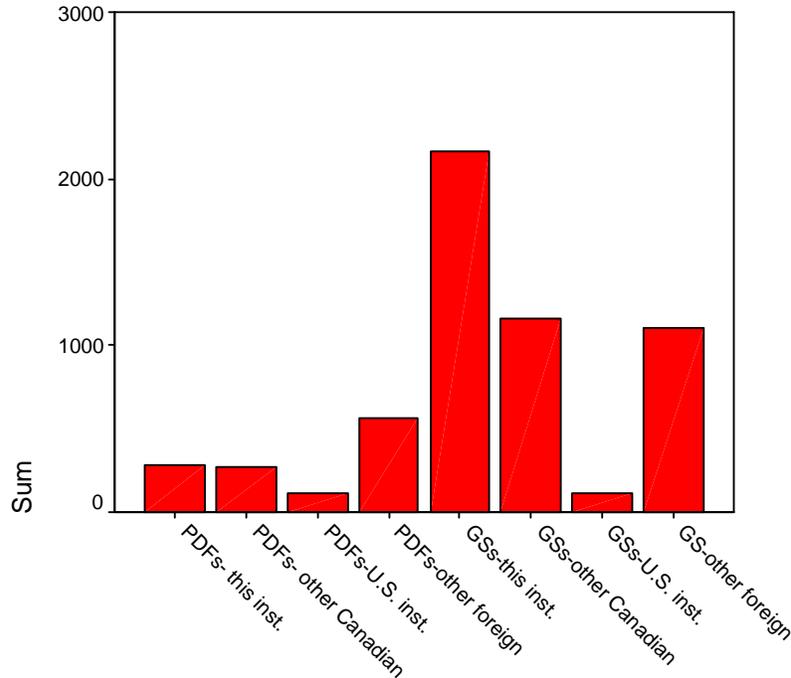
Attracting HQP: One of the key elements of the training research consisted of examining the NOF's impact in attracting graduate students, post-docs and technicians to work with PLs in important skills areas; thereby contributing both to the PL's own overall research objectives, as well as meeting their training commitments under the terms of the NOF.

Trainees Attracted by NOF Projects: Annual project progress reports by PLs in 2006 indicated that over 6,000 post-docs and graduate students had been attracted to their institution (by the NOF) in the past year. The largest group of these (about 2,500) came from the same institution and about 2,000 from other institutions in Canada and approximately 1,500 came from the U.S. or other institutions outside of Canada.

³² The original target response was 200, however, the survey exceeded this target, yielding 821 responses.

Display 3.5
Number of Trainees Indicating that NOF-Funded Infrastructure
was a Factor in their Decision to Join the Institution

(based on responses from 1,558 PLs, from 2006 annual project progress report files, Q.4, for PDFs (post-doctoral fellows, first 4 bars), and GSs (graduate students, last 4 bars)³³)



NOF as a Factor in Attracting Trainees: Trainees were attracted to NOF institutions for a variety of reasons, of which the NOF was a major one, along with reputation of the professor and institution.³⁴ To validate this analysis we considered the length of time which typically elapsed before the delivery of NOF funds (following an application) and the level of attraction to join the NOF institution after the award. This comparison showed that the existence of the NOF program as an attraction factor increased substantially, from 40% to 55% after the actual NOF award. NOF-funded infrastructure was therefore in the evaluators' assessment validated as an important factor which trainees considered when choosing one institution over another (see Display 3.6, below).

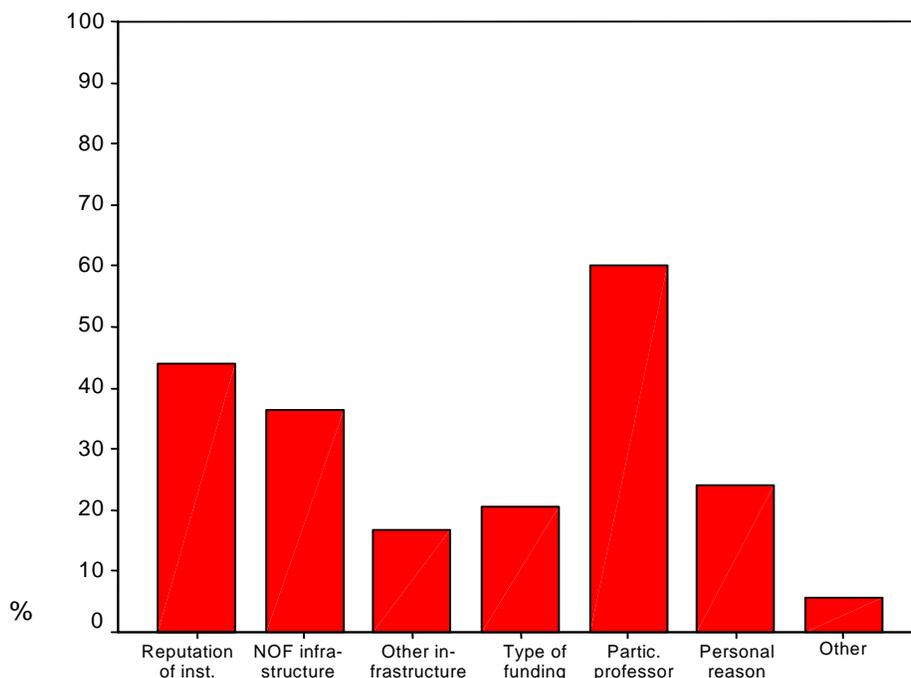
³³ Responses, in percentages, were: PDFs – this institution = 4.8%; PDFs -- other Canadian institutions = 4.8%; PDFs – U.S. institutions = 2.0%; PDFs – other foreign institutions = 9.7%; GSs – this institution = 37.5%; GSs – Other Canadian institutions = 20.1%; GSs – U.S. institutions = 2.0%; and GSs other foreign institutions = 19.1%.

³⁴ Trainees could choose all those factors which had influenced their decision to attend the NOF institution.

Display 3.6
Trainees' Reasons for Choosing the NOF Institution

(based on responses from 821 trainees)

(Percentages total more than 100% because more than one answer could be chosen)



Quality of Training: The NOF's impact in creating a positive training environment for HQP was also examined in the PL survey and was reflected in the recruitment (as noted above). These data are discussed below; however, the main evidence on quality of training is drawn from trainees' reports on skills learned, other benefits derived from the NOF, and their level of satisfaction with certain aspects of their NOF experience.

PL's Assessments of Training were Very Positive: Almost all PLs (95%) responded positively regarding the impacts of the NOF on HQP, indicating that the NOF had enabled them to provide improved training to graduate students, post-docs and technicians (at the same time, it is noted that many felt it was still too early to assess these impacts in full).³⁵ Importantly, more than half of those who provided an assessment of linkages with industry indicated that they could identify particular employers who had benefitted from NOF-funded infrastructure by hiring NOF trainees.

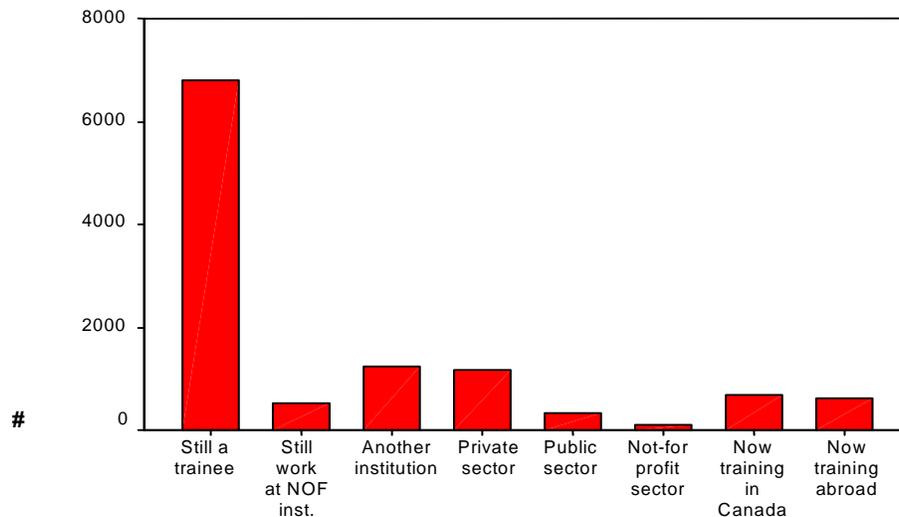
Trainees' Assessments of Skills Learned Were Extremely Positive: Trainees' assessments of skills development, impacts on learning, and overall satisfaction were also very positive. Trainees reported they were able to develop a wide range of new skills in technology and instrumentation, research methodology and laboratory research, as a result of their experience working with the NOF-funded infrastructure. (T14) (T23)

³⁵ Regarding specific linkages with industry, nearly half of PLs indicated that it was "too soon to tell" whether employers had benefitted from NOF-funded infrastructure. This view was also echoed by those employers who were interviewed.

3.2.2 Graduation of NOF Trainees to Other Institutions/Sectors

"Graduation" Rates and Workforce Pathways: Based on 2006 annual project progress report data, PLs indicated that since the beginning of their NOF projects, out of about 10,000 trainees, 6,786 trainees or 68% (in this case, PDFs and graduate students) were still studying or working at the NOF institution. PLs indicated that 1,234 trainees (about 12%) had moved on to other institutions and 1,173 trainees (or 11%) had joined the private sector, while others went on to pursue further training at another institution in Canada or abroad.

Display 3.7
Number of Trainees and Current Employment Status
(based on responses from 1,558 PLs, from 2006 annual report files, F6)

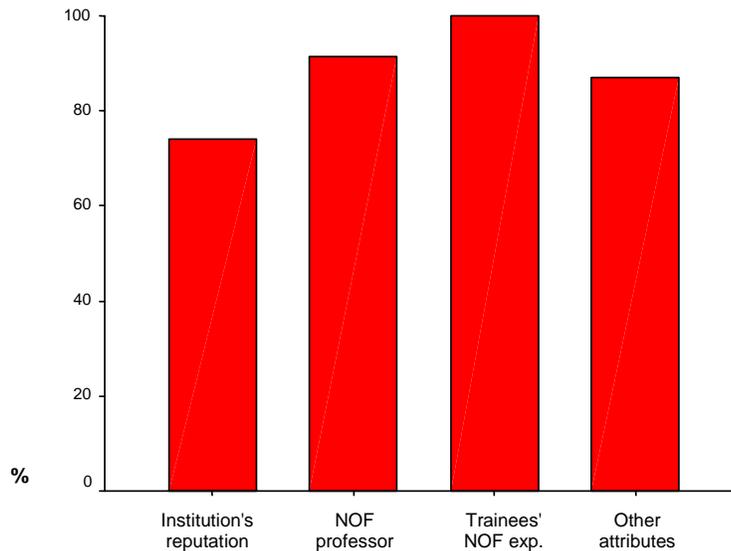


Trainees reported that the NOF aided their transition into the workforce: Generally, those trainees who had "graduated" and were currently employed reported that their experience working or studying with NOF-funded infrastructure had a definitive impact in terms of providing them with contacts with potential employers (72%). (T15) These trainees also reported positive impacts of their working with NOF-funded infrastructure in fostering employment opportunities and giving them an edge when looking for (and landing) a job. (T21) (T22)

Employers reported that NOF training was a key factor when hiring: When hiring a trainee, 75% of the employers interviewed reported that they considered the trainees' association with a particular institution to be a factor indicating suitability -- because of the reputation of the institution. As well, 95% indicated the reputation of the specific professor as a strong indicator of the individual's suitability for the position. All employers who had an association with the PL and were familiar with the NOF-funded infrastructure reported that trainees' experience using the NOF-funded infrastructure had been the main reason in their decision to hire the trainee.³⁶ In general, such high-level learning and training experience on state-of-the-art infrastructure was a major asset from the employer's perspective. While these findings were based on a very exploratory sample, they were seen as very positive indicators of the NOF's innovation and business impacts.

³⁶ Based on responses from 30 of 33 employers interviewed.

Display 3.8
Employer's Reason for Hiring the NOF Trainees (E.5)
 (% indicating "somewhat important" or "very important", n = 33)



3.2.3 Employer's Views of NOF Impacts on Business and Innovation *[Note: Specific impacts on employers are examined below, but a more detailed treatment of socio-economic benefits to Canada is provided in Section 3.6. It is emphasized that because of the sample size and method, and the exploratory nature of the research, results are deemed to be indicative.]*

Trainees Reported Positive Impacts of NOF Skills: As noted earlier, trainees reported positive impact in finding jobs that allowed them to use the skills they had developed while working on NOF-funded infrastructure. This suggests that there is a strong demand for trainees' skills in advanced research, and also that trainees are quite successful in finding the right kinds of jobs to realize the value of their educational experience (T24). Twenty-four of 33 employers we interviewed indicated that NOF-related training had increased their organizations' ability to contribute to the development of new products or processes (E6). Employers who provided an assessment of impacts³⁷ reported that training on NOF-funded infrastructure had increased their trainees' ability to contribute to new products (82%), patents (38%), spin-outs from the organization (44%), other innovations (86% of responding employers), spin-offs of university developments (65%), and licenses (30%). (E9)

A number of employers also reported that trainees' work with NOF-funded infrastructure had reduced the time required to adapt and had increased their ability to contribute without additional in-house training.³⁸ Trainees' technical expertise in very specific processes was also noted by employers as being an asset (e.g. the manipulation of porcine ova in the laboratory, or the environmental engineering design of culvert systems). The ability of trainees to provide leadership and the capacity to learn were also noted as fostering innovation within the workplace. In a number of cases, employers also reported that trainees could move quickly into product development and design and assume more advanced or senior positions within the organization very rapidly. Employers also provided illustrations of positive impacts of the NOF on innovation, as noted below.

³⁷ About 25% of employers indicated that their trainee had been employed for too short a time to respond to this question.
³⁸ Statistics are not noted here, as the data applied are qualitative (general comments from employers), however these comments indicate a business case for NOF-type programs which should be examined in future research.

Employers reported positive impacts of the NOF on partnerships: More than three quarters of employers we interviewed (77% of 28 responding to this question) indicated that trainees had contributed to partnerships and collaborations with others (for example, the trainee's credibility as a researcher helped maintain cooperation with automotive manufacturers in testing security features developed by one company). (E12) In some cases, trainees were hired specifically to provide the company with special expertise to converse and work with a partner company. As well, several employers who reported that it was too soon for final conclusions on this question, indicated that trainees' contributions to partnerships demonstrated high potential. (Q13)

Some employers used NOF-funded infrastructure in their own projects: About 10% of trainees working in R&D who provided an assessment reported that their employer had access to and used the NOF-funded infrastructure. (T26) (Such use and access was reported by about 30% of the employers interviewed.) Those employers who reported that they had access to the NOF-funded infrastructure cited advantages such as being able to run tests in a controlled environment to verify field observations and to use special design tools. This type of access often filled a gap in SMEs' affordable access to high-level technology. As another employer commented on the value of having access to a NOF-funded environmental research laboratory: "Most companies look to commercial labs for their instrumentation but they can't always supply the specialty analytical tools we require. [Our company] has been fortunate, and possibly unique, in being able to have access to earlier infrastructure at [the university]." (Senior Geochemist, Environmental Consulting Company).³⁹

3.2.4 Perspectives of PLs, Employers and Trainees

PLs' and Trainees' Views on Improving Training in Future NOF-type Programs: Nearly all PLs (99% of those whose infrastructure was operational) reported that the NOF had provided state-of-the-art infrastructure; however, the level of funding made available for HQP (such as graduate students, post-docs and technicians) from other sources was (they thought) often not commensurate with the level of infrastructure funding which, in their opinion, meant that sometimes the infrastructure could not be fully utilized. Not surprisingly, many trainees also indicated the need for additional funding for post-docs, graduate students and technicians, alongside a NOF-type program.⁴⁰ Trainees also suggested other improvements, such as establishing minimum standards of skills for access to NOF-funded infrastructure, and using industry links to ensure that the most appropriate equipment is acquired which reflects the reality of current research in the private sector.

Employer's Views on Improving Training for Similar Programs in the Future: Employer suggestions for improving training for programs such as the NOF were consistent with those of trainees and PLs. As one employer (who hired a trainee who worked on NOF laboratory equipment examining cellular behaviour) commented: "*we need a new infrastructure fund dedicated to help sustain the infrastructure in the long run*". Approximately two-thirds of employers also stressed the need for more co-op or internship programs.⁴¹ Integrating some level of exposure to industry as a mandatory part of training was also suggested. Other employers commented on communications. For example, one reported on their trainee's experience with NOF-funded infrastructure in robotics technology, pointing to a need for "formal announcements [of NOF projects] ... via the local university to increase employer awareness.

³⁹ However, as several employers noted, this kind of mutually advantageous collaboration or even, co-ownership, was sometimes hampered by the legalities involved in usage rights and responsibilities.

⁴⁰ This question was not posed explicitly, however, 13 trainees did comment on the need for additional student funding when asked about areas for improvement and many mentioned the need for increased funding generally.

⁴¹ Some programs, such as the NSERC Industrial Research Chairs, provide these types of funds. Based on employer comments more communication between the private sector, universities and the government would enhance awareness of these opportunities to train and hire HQP.

Companies also indicated an interest in being kept apprised of other areas of interest to their firm's production/R&D and how the firms might tap into NOF-type projects at local universities." (CTO, An Engineering Controls Company)

Both trainees and employers were highly supportive of the value of a NOF-type program for Canada. Indeed, trainees offered almost unanimous praise for the NOF. Almost all employers also indicated that an infrastructure program such as the NOF is very important for R&D in Canada. (E26) This importance, they argued, points to a need for stronger links to industry.

Conclusions as to the NOF's Impacts on Training: Overall, the evaluation results point towards extremely positive impacts of the NOF in the training of HQP. NOF-funded infrastructure contributed to the overall attractiveness of working with faculty who were in receipt of the award, and were building research teams as a result of the NOF award. This aided development of a positive environment for training, and transferable skills being developed with trainees' experience obtained working with the NOF-funded infrastructure. NOF-funded infrastructure was found to bolster the quality and relevance of trainees' skills and knowledge for today's economy. Key conclusions were:

Importance to Employers: The NOF was a key factor in employers' decision to hire their NOF trainee. In addition, employer interviews revealed that trainees were able to contribute to innovation with their companies, or showed promising debuts in their involvement in their companies' activities. Trainees now working in the private sector were highly valued by their employers and seen to have positive impacts on the development of new products, services, etc.

Improving Linkages for Funding Training: To improve the training of HQP in future NOF-type programs, the CFI should continue its efforts to link infrastructure funding to funding from SSHRC, CIHR and NSERC. For example, the CFI should place greater emphasis on training opportunities in the applicant's research proposals, including details of the type of arrangements which will be made to hire trainees to work on the funded infrastructure, expected budgets or sources of funding for trainees to conduct/carry out this work, plans for supervision, and a commitment to aid trainees' exploration of careers outside of academia, including links to potential employers.

Improving Linkages with Employers: Universities should play a role in fostering a culture of exchange between research and non-academic employers. This could require be aided by internships with individual companies. More effective communications strategies would ensure that universities and private sector companies have a forum for discussion and exchanges. This could include the CFI encouraging the creation of a forum for discussion between SMEs and researchers with NOF-type funding.⁴² Additional information should also be provided to trainees, who need more knowledge of the funding sources for their NOF-type projects.

Research Implications: Overall, these results suggest that successful evaluation of impacts on training requires more systematic tracking of HQP from universities on to their subsequent career paths -- perhaps, in collaboration with other granting agencies and/or Statistics Canada. Such collaboration could be aided by the extension of some Tri-Council (SSHRC, NSERC, CIHR) arrangements), such as their privacy protocol, to cover NOF projects.

Overall, these findings reinforce results of the 2002 Interim evaluation in pointing to the need for improved coordination of the work of the federal granting agencies, and also the need for NOF-type programs to better link trainees to career transitions, to improve information for trainees, and to improve tracking and research, ideally, in collaboration with other federal agencies (see Recommendations).

⁴² The 33 employers interviewed were those most identified by either from PLs or trainees. In general, employers who were interviewed were those whom had recently hired their NOF trainee, and few refusals were encountered.

3.3 Enabling Researchers to Undertake Leading-Edge Research

3.3.1 Project Leaders' Research Accomplishments

Reports by VPRs, Deans and Heads indicated that PLs' research careers have been enhanced by the ability to purchase critical pieces of new equipment and outfit new labs through the NOF. Almost all VPRs, Deans and Heads (99%) asserted that the NOF had increased their institutions' innovation capacity in terms of their ability to produce new products, patents, spin-offs, licenses and other innovations. Many VPRs, Deans and Heads (95%) also addressed the need for a NOF-type program in terms of value to Canada generally, noting specific research and impacts.

Some of these impacts included specific medical and environmental research advances. VPRs and other administrators noted that many of the advancements and discoveries mentioned would not have been possible without the NOF:⁴³ as illustrated by the following comments:⁴⁴ *"We did a survey recently with NOF researchers, and 30% of them said that their funding led to new and improved processes and products. Furthermore, 15% think it could lead to the creation of spin-off companies"; and "NOF has been one of several factors but a significant one in two of our researchers' establishing a spin-off company."*

Project Leaders also reported that the NOF had helped them to develop their careers in ways which would not have been possible otherwise. Over 80% were of the opinion that the NOF award had allowed them to advance their careers in ways that would not have been possible otherwise. Nearly 90% of Project Leaders said that they had become more productive and were able to attract better students (see Display 3.9) as a result of the NOF, while approximately 80% indicated that the NOF had enabled them to add to the body of scientific knowledge and produce better publications. Only 3% of PLs saw the NOF as having "no impact".

Display 3.9

Project Leaders' Response to the question:

**"Which of the following has the NOF award enabled you to do?"
[to advance your career] (Q.26)** (based on 1,506 responses)

(Percentages total more than 100% because more than one answer could be chosen)

Be more productive/attract better students	88%
Advance your career in ways that would not have been possible otherwise	81
Add to the body of knowledge	81
Produce more high quality research publications	79
Receive <i>more</i> funding from other sources	71
Transfer knowledge to other institutions or field	47
None of the above	3

⁴³ As well, many VPRs, Deans and Heads indicated that the full impacts of the NOF program are "too early to assess," in particular, that societal effects of the research are "too soon to tell" -- implying that "more is to come in the future."

⁴⁴ Comments drawn from the Survey of Vice-Presidents-Research, Deans and Heads, Q.15.

Many illustrations positive impacts on careers were noted by NOF Project Leaders:⁴⁵

Obtaining this infrastructure allowed me to move into a new area of research, in which I have found some success and in which I continue to gain recognition. It has resulted in publications, NSERC funding, attracting collaboration and students. ...without the NOF this might not have occurred.

The new infrastructure has made my research program stronger, since now I can prove that I have the equipment required to develop my program. This, in turn, has benefited me when applying (and obtaining) [other awards].

We have made significant progress in research by publishing the top-notch journal papers in my areas: A large number of Masters and Ph.D. students have and are [being] trained.....

This infrastructure grant was the catalyst needed to obtain NSERC funding and has now resulted in funding from other granting agencies as well.

Were NOF Awardees more Productive? To assess the question as to whether NOF awardees were more productive following the receipt of their NOF award, the same indicators of productivity were examined for PLs and non-awardees, in the period following the NOF competition. As can be seen in Display 3.10 below, PLs were significantly higher than non-awardees (who were also accomplished researchers) in several areas including co-publications,⁴⁶ awards and dollar value of grants.

Display 3.10
Differences in Productivity between NOF Project Leaders and Non-Awardees
 (Means) reports of productivity since the time of application for the NOF award
 (based on n = 1,409 cases)

Aspect of Productivity	Non-Awardees	Project Leaders	Significance of Difference (t-test)
Publications (Primary Author)	6.44	6.50	PLs higher, NS
Papers (Co-authored)	5.69	8.07	PLs higher, sig = p<.05
Conferences invited to	4.66	5.69	PLs higher, NS
Books published	.29	.35	PLs higher, NS
Patents approved	.10	.10	PLs higher, NS
National-international awards	.65	.99	PLs higher, sig = p<.05
Dollar value of grants-contracts (in 000's)	\$321.63	\$535.24	PLs higher, sig = p<.05
Total productivity indicator	19.4	23.4	PLs higher, sig = p<.05

As well, when compared on a standardized productivity indicator,⁴⁷ PLs were significantly higher, affirming that they were more productive overall.

⁴⁵ Comments drawn from the Survey of Project Leaders, Q.57.

⁴⁶ Almost all PLs had been the primary author of at least one publication or technical paper prior to obtaining their NOF award, a trend which continued after the NOF award.

⁴⁷ This indicator was developed using factor analysis and z-scores (see Annex C for details).

These results provided objective support for administrators and PLs' subjective assessments that the NOF had improved careers. Recognizing, as noted earlier, that NOF projects were on average less than three years "old", it might be overstatement to say that NOF had an impact in causing greater productivity, but clearly PL productivity was greater following the NOF award.

Conclusions Regarding NOF Impacts on Researchers' Careers: VPRs, Deans, Heads and Project Leaders surveyed all agreed that the NOF had substantial impacts on researchers' careers. The NOF was identified as contributing to researchers' increased productivity, increased levels of collaboration, more publications and enhanced international reputations. The NOF selection process was also positively assessed, indicating the NOF provided additional resources to those with the highest potential to benefit. As well, statistical comparisons using the PL and Non-awardee survey data, indicated significantly higher levels of performance by NOF recipients in publications, grants, etc., as compared to non-awardees. Impacts on training as noted in Section 3.2 and in publishing etc., underline the knowledge transfer value of these results.

3.3.2 Use of NOF Infrastructure

Introduction: The NOF only provided the funding to purchase infrastructure. Release time, maintenance, technician time, and other "operational" items were expenses for which universities (and ultimately provinces) and other funding agencies were responsible. Some operating funding was added in 2001 in the form of an Infrastructure Operating Fund (IOF) in the amount of 30% of the initial award.

The issue as to whether infrastructure was well utilized related not just to the efficiency of universities and PLs, but also the impacts of funding from the other funding agencies. This issue gained importance when considered in light of comments by some senior key informants we spoke to who suggested that in some disciplines and specific universities, infrastructure and research support funding were mis-matched, resulting in underutilization of infrastructure. This issue of balance requires more attention in the future.

VPRs, Deans and Heads reported that NOF infrastructure was well used, in particular, that their institutions had been able to maintain and use their NOF infrastructure in an efficient manner. However, 94% of VPRs, Deans and Heads reported concerns about maintaining their infrastructure over the long-term.

Maintenance Issues: Some of the concerns expressed by administrators included:

We have not been able to effectively [deal with the] ongoing need for maintenance. The LOF is addressing this problem though - and hopefully that is all that needs to be done to remedy the situation.

The cost of maintenance after the warranties expire is ruinous but is often essential since the companies have engineered their instrumentation to require you to use their services. An IOF-like program for NOF would be useful.

There is a need to plan in the longer term for maintenance and upgrade of the infrastructure. There is a need to either add to the federal indirect costs program or maintain the IOF and in some cases, having an "upgrading call for proposals" every 10 years to ensure the equipment does not become too old and non functional (this will be the main challenge in the long term).

The implementation of IOF funds has been very beneficial in maintaining the equipment. However, "using" the equipment requires research grants or contracts. If initial research grants were linked to the NOF, then researchers would become much more productive immediately. The agencies that [give] research grants do not always have the same strategic priority as CFI so on occasion there has been a delay in the start of research with the infrastructure.

Remedies: Many suggestions were put forward as to how the issue of ensuring the ongoing maintenance of NOF infrastructure could be remedied in the future, including additional funding and increasing collaboration with other granting agencies. Some of these suggestions were aimed specifically at the LOF and many noted that more funding is needed to repair and upgrade technology as well as to provide personnel to use and maintain the equipment.⁴⁸ Illustrative suggestions included:

I believe it is going to be a big challenge to maintain the infrastructure once NOF grants have ceased. There are 2 approaches I believe that might mitigate the impact of NOF. 1) To appreciate and utilize the IOF funding that has been expanded over a longer period of time. 2) A greater collaboration between granting councils and CFI - because if and when money runs out, researchers tend to use their discovery grants.

Perhaps LOF could be expanded into a 2-tiered system - one tier to address new infrastructure and the other to address renewal of funds for maintenance. Two tiers with two separate envelopes.

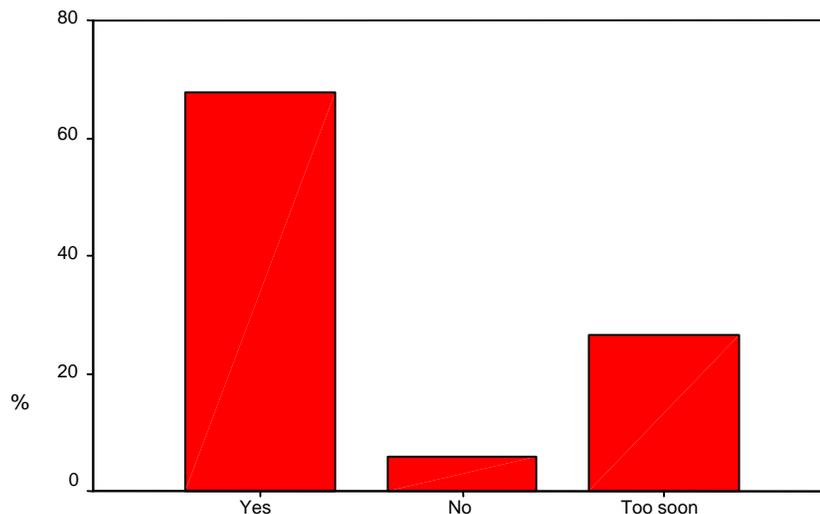
Extend IOF for still active NOF projects beyond 5 years. CFI should understand that research equipment needs to be properly managed and operated. Otherwise, once the equipment starts breaking down, the PL has to rely on the university to help out which is not easy to do.

We are hoping to find increased provincial support to ensure the ongoing maintenance of NOF infrastructure.

⁴⁸ Comments drawn from the Survey of Vice-Presidents Research, Deans and Heads, Q.21.

Project Leaders also saw infrastructure as being well-utilized: Generally, PLs felt that they were able to maintain their infrastructure in an efficient manner.⁴⁹ Over 90% of respondents to this question (excluding "too soon to tell" responses) indicated that they were able to maintain and use the infrastructure efficiently (see Display 3.11). Annual reports also indicated extensive use: in the 2006 annual reports, PLs indicated that over 12,000 post-docs, graduate students and technicians had used NOF infrastructure, and that the infrastructure had been used by over 3,000 researchers from other institutions in Canada and internationally (2006 Annual Reports, Q.5, Q.15).

Display 3.11
Project Leaders' Response to the Question:
"Have you been able to maintain and use the NOF
infrastructure in an efficient manner?" (Q.33)
(based on 1,432 responses)



Operations and Maintenance: In spite of the above positive assessments, open-ended responses to the PL survey pointed to the need for more operating and maintenance funding for projects, including an increase in the level of funding for technicians in order to regularly maintain and operate equipment. Such concerns were expressed by 26% of PLs who provided comments on lessons learned, specifically regarding additional resources for operations, maintenance and funding for students and technicians. These result support the suggestion by at least one senior key informant we interviewed, that imbalances in infrastructure and research funding have occurred.

This issue of "full utilization" might be an area for the CFI and the funding agencies to examine more carefully, particularly as this was an issue which was continually raised by PLs. Many PLs (possibly those who received "early" NOF projects, e.g. 1999-2001) also indicated a need for more funding for administrative tasks and support tasks -- the need to secure adequate operating and maintenance funding for their NOF infrastructure. Provincial officials also long term maintenance as an area of concern, indicating that "downstream" expenditures (ongoing infrastructure maintenance) would likely need to be financed through the provincial post-secondary education funding system.

⁴⁹ However, about one-quarter indicated that it was "too soon to tell" whether the NOF infrastructure had been used in an efficient manner.

Time Use as an Indicator: PLs reported spending about 23 hours a month on research administration of all types⁵⁰, and about 7 hours per month on maintenance of NOF infrastructure. This, however, was highly variable (about half of PLs indicated that they had spent more than 10 hours per week on maintenance of their infrastructure). Other factors mentioned as having a negative effect on research time were the level of bureaucracy reflected in the NOF generally and reporting requirements of the NOF (paperwork required by CFI, such as annual reports). Overall reported time use by PLs was as noted below.

Display 3.12
PLs Reports of Time Use (hours per month), Q.34
 (based on n = 1,419 responses)

Activity	Average Total Hours Per Month	% of Total Hours
Research	76	42%
Research administration	23	12
Maintenance of NOF infrastructure	7	4
Teaching (including preparation etc.)	51	28
Applied work in field	7	4
University administration	17	10

Conclusions Regarding Use of Infrastructure: The introduction by the CFI of the IOF during the operation of the NOF (in July, 2001) makes clear assessment of this issue challenging. Some of the comments provided by PLs clearly reflect the absence of the IOF in the early phase of the NOF. However, the fact that many researchers have to focus their attention away from research in order to undertake maintenance tasks normally performed by a technician or support staff, must mean that the infrastructure is not being utilized to its fullest potential by the researcher because their time is "spread too thin."

While the IOF facilitates in this area, the issue of long-term operating and maintenance costs persists and could be further addressed by the CFI in the future. Aspects of this that merit attention are accounting and perception challenges. The NOF (and the LOF) are basically intended for capital expenditures. It is possible that, in some cases, the NOF/LOF frees up other university capital funds for conversion to operating costs. *[Evaluator's Observation: It also appears, based on a review of survey comments, that some PLs do not completely understand how their university budgeting system works (practices for capital funding, equipment replacement, maintenance, role of various university centers of responsibility, accounting practices etc.). Universities generally do not adopt the same accounting principles as those used in industry, at least for the purpose of maintenance of research equipment, and these practices may not be transparent for PLs.]*

These topics might be ones for the CFI or its partners to investigate further. Potential questions could include: why don't universities set up sinking funds for equipment replacement; and how do they budget for operating costs, particularly technician salaries? Additionally, the CFI and the other funding agencies may wish to consider supporting university research offices or applying other approaches to improve training of researchers on the "business" of managing their research projects (to improve efficiency of use and maintenance). (See *Recommendations*.)

⁵⁰ It is not possible with the PL survey data to determine exactly how much of this time was "NOF-related". However, it seems reasonable to assume that where the time was used for other grant administration, this would usually be for other research awards linked to the NOF infrastructure. This detail could be examined more closely in future studies.

3.4 Aiding Institutions in Addressing Strategic Research Priorities

Overview: Institutions were required to develop SRPs for both the Canada Research Chairs (CRC) and CFI programs. Most universities developed one SRP to meet the funding requirements of both programs. Because of this dual purpose, infrastructure requirements may not have been a focus of these SRPs. This being the case, different universities used very different processes to develop their plans, some top-down, some bottom-up, etc. Some used their SRPs to focus their areas of strategic priorities, e.g. UBC; while others used their plans to completely restructure their faculty complements, i.e., to begin a process of faculty renewal well "ahead of the curve", e.g. Concordia. Others emphasized creating linkages with stakeholders. Some created their SRPs in a pro forma fashion. As a result, SRPs appeared to vary greatly in the range of supporting processes they reflected (e.g. the extent to which SRPs were linked to committees, stakeholders, etc.) (see Display 3.13, next page). As part of examining planning, ability to estimate infrastructure needs was examined in the survey of administrators.

Estimating Infrastructure Needs: University VPRs or their delegates were asked if they could provide an estimate of what the financial costs would be over a ten-year horizon for a NOF-type program (e.g. for maintenance of infrastructure, or for numbers of new hirings). A portion of VPRs or delegates -- about 33% -- were able to provide detailed estimates.⁵¹ Of those who were able to provide an institution-wide assessment, more than half (66%) reported that their institution had not undertaken the challenging task of estimating the dollar cost of its infrastructure needs over the next 10 years. These results suggest that, SRPs aside, the level of planning was varied.

However, those who did provide estimates suggested the need for substantial funds -- 26 who were able to estimate needs indicated a total need for \$212 million for the maintenance of NOF-type infrastructure, and also a need to aid the recruitment of thousands of additional professors (consistent with views of the AUCC that Canadian universities will need to hire more than 20,000 new professors in the next ten years).⁵² Such numbers are seen as underlining the importance of this planning process.

Strengths of the SRP Process: *Broad strategy appeared to be the greatest strength of SRPs.* A large majority of VPRs, Deans and Heads (75%) indicated that the SRP has resulted in more concentration on specific research themes or priorities. As well, 66% indicated that the SRP influences institutional decision-making, and 55% indicated that the SRP influences hiring priorities (see Display 3.13, next page).

These benefits and different roles of SRPs were illustrated in specific comments by administrators such as: "[we] have been able to modify faculty level plans to better compliment the university strategic plan", "[the SRP] helps focus on priority objectives... and hiring", and "the key theme of the SRP is interdisciplinarity." Some administrators also emphasized that the SPR was broader than NOF, that "NOF operates *within* the SRP", that [the SRP is] a plan outside CFI and CRC", and " the SRP is more a statement of principles which don't change rather than an active, changing workplan".

Overall, these results point to good achievements of SRPs, and positive impacts of NOF on them, but as noted below, there is room for strengthening these planning processes, and also for drawing lessons learned from the wide range of SRP practices.

⁵¹ Altogether, 76% were able to assess infrastructure needs on an institution-wide basis, and of these, 29% indicated that the institution had estimated needs in dollars over a ten-year horizon. Using this question and others, an indicator of "amount of knowledge" was created for VPRs and delegates (see *Annex B: Methodology*, for related analysis of this aspect of institutions).

⁵² These numbers correspond with those noted by AUCC regarding the need for new professors during the coming decade, personal communications with AUCC staff.

Overall Development of SRPs: While data from VPRs, Deans and Heads indicated value of SRPs, the evaluators also noted that some characteristics of SRPs suggested uneven implementation. For example, fewer than half of administrators reported that their SRP included long-term plans for infrastructure (35%) or was used to select all NOF applicants (46%).

As well, some indicators of structure illustrated possible areas for strengthening SRPs. Only a small portion of administrators indicated that their SRPs involved regional or industry stakeholders (22%), and only 18% indicated that the SRP involved affiliated institutions (see Display 3.13, below). These may point to areas for development of SRPs in the future.

Display 3.13
Description of Institutions' Current SRP and Processes (A.30)
(based on responses from 132 VPRs, Deans and Heads)

75%	The SRP has resulted in more concentration on specific research themes or priorities
66	The SRP influences institutional decision-making
55	The SRP is being updated now or has been updated in the past 12 months
55	The SRP influences hiring priorities
46	The SRP was a key factor when selecting all NOF applicants
46	The SRP process involves standing university committees or working groups
45	The SRP was in place prior to initial NOF funding
35	The SRP includes long-term goals for the development of specific types of infrastructure
22	The SRP process involves industry stakeholders, including those in the local/regional economy
18	The SRP involves affiliated institutions
16	The SRP has benefitted from the designation of staff to manage the SRP

Views of Project Leaders: A positive aspect of SRPs was that, although SRPs appeared to be unevenly institutionalized, a majority of PLs (just over 60%) reported that they were familiar with their institution's SRP and had linked their research to their institution's priorities. This was seen by the evaluators as a positive factor in spite of great variability in the SRP process generally.

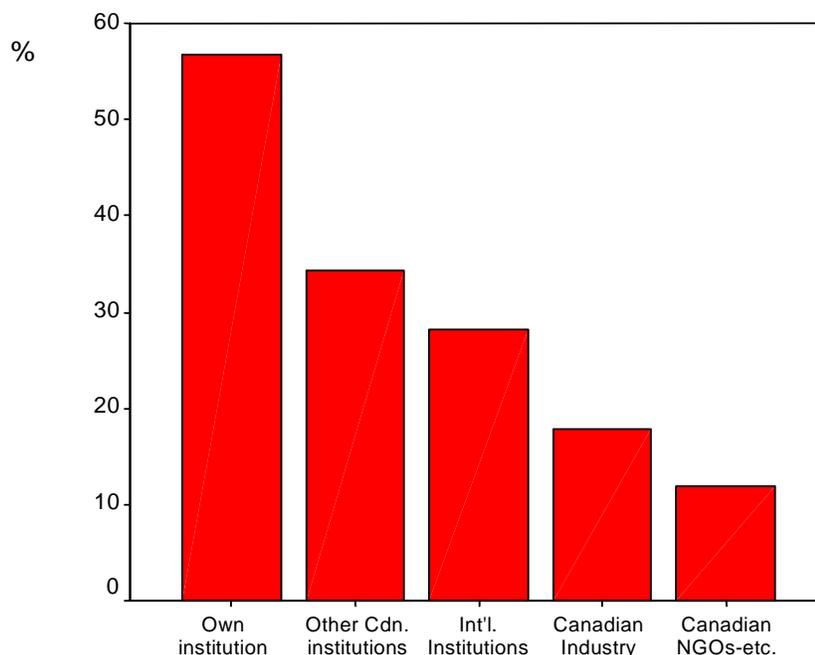
Conclusions Regarding SRPs: VPRs, Deans, Heads and PLs indicated that the NOF aided strategic priorities. As well, SRPs played a significant role in their application to, and administration of, NOF funds to aid strategic priorities in many (but not all) universities. However, the evaluators found SRPs to be unevenly developed and some appeared to be only weakly embedded in institutions' decision-making and partnering structures (e.g. in committees, networks with business and other universities, etc.). Overall, SRPs were found to be highly variable by the criteria examined above⁵³ -- some were excellent and some extremely thin, suggesting some areas for improvements of SRPs to better aiding strategic allocation of funds in the future. This issue of SRPs may require further analysis by institutions, or the CFI in the future, and perhaps even a re-visiting of expectations of universities. (See *Recommendations*.)

⁵³ These criteria were developed by the evaluators, drawing on a number of sources, including ongoing CFI research.

3.5 Facilitating Collaborations and Partnerships

NOF appeared to greatly aid collaboration and partnerships, reflecting the NOF's positive impacts on research generally. VPR views: This was reflected by VPRs and delegates who noted, for example: "Many components of the infrastructure established from the NOF have led to new collaboration and added in a very significant way to the limited equipment we had in the past. We now have almost double the amount of international collaboration." PL views: Nearly all PLs (95%) asserted in our surveys that NOF infrastructure has led to increased collaboration with other researchers at their own institution (see Display 3.14). Similarly, 85% of PLs indicated that NOF-funded infrastructure has led to increased collaboration with other researchers at *other* Canadian institutions, as well as with international institutions (76%). These PLs provided numerous examples of working with specific partners, including private sector companies, universities, hospitals, provincial government agencies, and various industry and equipment suppliers since receiving their NOF awards.⁵⁴

Display 3.14
Project Leaders Responding "to a great extent" to the Question:
"To what extent did NOF infrastructure lead to your increased
collaboration with [researchers in various settings]" (Q.27)
(Percentages exceed 100% because PLs could choose more than one answer)
(n = 1,491 cases, scale is topped at 60% for purposes of graphic display)



Conclusion: The evaluation results indicated that the NOF had good impacts on collaboration, but more information is needed for monitoring results in this area (see *Recommendations*).

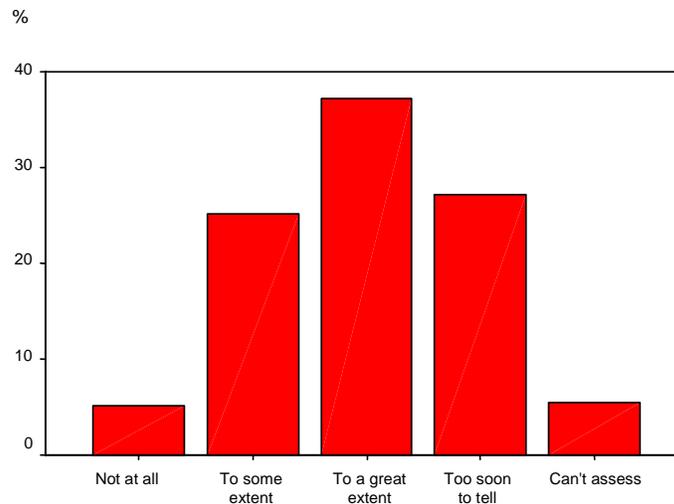
⁵⁴ Data from Annual Reports (Questions 17-19) was supportive of the above survey findings -- PLs indicated that in only 10% of cases did the research not lend itself to a collaborative approach. Rather, 80% reported that the research lent itself to intra and inter-institutional collaboration (80% within Canada, and 60% outside of Canada); 25% reported institutional-government collaboration(s) within Canada; 5% reported Institutional-international public sector organizations (e.g. with the UN); and 30% reported institutional-private enterprise collaboration(s).

3.6 Contributing to Socio-Economic Benefits for Canada

Overview: As noted earlier, impacts of the NOF are unlikely to be fully evident at this early stage of the program. However, business, innovation and social impacts are examined where possible. Administrators provided general assessments, but more extensive data was obtained from PLs.

Assessments of Impacts on Competitiveness and Innovation Capacity: Overall, VPRs, Deans and Heads were very positive about impacts on innovation capacity, 92% indicating positive impacts on their institution's ability to produce new products, patents, spin-offs, licenses and other innovations. PLs also provided very positive assessments of the NOF's impacts in these areas.⁵⁵ This was clearly illustrated by PLs, as approximately 90% of those providing an assessment (categories "too soon to tell" and "can't assess" excluded from the computation of percentages) indicated that the NOF had resulted in positive impacts on international competitiveness and innovation capacity (Display 3.15).

Display 3.15
Project Leaders' Responses to the Question:
"To what extent did the NOF award add to your institution's
international competitiveness and reputation in the area of
innovation capacity (e.g. economic impacts, patents etc.)" (Q.17)
(Based on 1,494 responses)

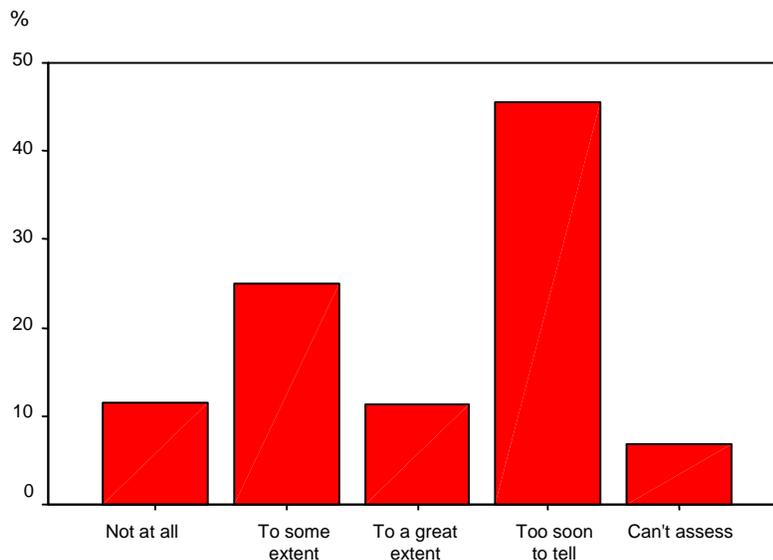


Assessments of Societal and Quality of Life Impacts: VPRs Deans and Heads were also positive about societal and quality-of-life impacts (90% reported positive impacts). PLs, however, were more cautious in this area. Nearly half noted that it was "too soon to tell" whether their NOF project had resulted in significant societal and quality-of-life impacts. Even so, more than 75% of those who provided an assessment of societal and quality-of-life impacts of the NOF reported positive impacts. Many PLs cited their own research and the impact that it has had on Canada, for example, pointing towards the value of their research for new treatments and new medicines that, in turn, contribute to a healthy population.

⁵⁵ Approximately one-quarter of PLs indicated that it was "too soon to tell" whether there had been any economic impacts resulting from NOF because many had argued that the long-term impacts of research could not be evidenced in such a short time period.

PLs also noted the importance of their research in aiding a sustainable environment, enabling educational and training opportunities for undergraduate and graduate students, assisting policy-makers, and providing overall long-term benefits for Canada. Echoing the views of university administrators, PLs emphasized that many advancements and discoveries would not have been possible without the existence of NOF-funded infrastructure (see Display 3.16). *[Evaluator's Note: While self-reporting data, it is important to note that these indications are supported by a number of independent sources, including employers who were interviewed.]*

Display 3.16
Project Leaders' Responses to the Question:
"To what extent did the NOF award contribute to significant
quality of life benefits for Canada as a whole?"(Q.18)
 (based on n = 1,495 responses)



Comments from PLs provided many relevant illustrations of how quality-of-life impacts confirm the value of a program such as the NOF:⁵⁶

Infrastructure has been essential to my research... research results are moving toward applications in [a particular area] which could in the long-term benefit Canadians and the Canadian economy. None of these immediate and long-term benefits of academic research can be realized without infrastructure and government funding and support of that infrastructure.

My NOF grant has allowed me to build an internationally competitive lab and ... to make some important advances in our understanding of the development of [a particular disease]. While it is early for these to have spun off into treatments for Canadians, we have every expectation that they will either directly or indirectly lead to improved health.

Conclusion: The NOF appears to have contributed significantly to innovation both in terms of economic-scientific advances, and advances relevant to quality-of-life. Yet these impacts -- economic and quality of life -- are difficult to measure, particularly in the short-term. These point to needs for a longer-term evaluation perspective and more refined evaluations of returns on investment from NOF-type programs (see *Recommendations*).

⁵⁶ Comments drawn from the Survey of Project Leaders, Q.6.

4. Processes for Implementing the NOF

4.1 Overall Funding and Related Partnerships

4.1.1 Partnerships Between the CFI, Universities and Others: Universities obtained substantial resources (both cash and in-kind contributions) from a variety of sources for NOF projects. To assess this, the evaluators examined a sample of 1979 projects for which the final partner funding information was accessible. These, projects received contributions from: 1,892 provincial governments or agencies; 5,758 corporate partners; 80 eligible federal agencies; 37 voluntary organizations; 29 municipal or foreign governments; and 281 other partners, including private donors. Provincial governments were the most significant of these in terms of cash contributions. Universities (and their foundations/trust funds) also made a substantial contribution. Total contributions (for 1,979 of 2022 projects) are shown in Display 4.1, below.

Dollar Contributions: The contributions of these funders were very substantial, augmenting the CFI's investment roughly by 60%, as planned in the original NOF guidelines (see below). For example in the sample of 1979 NOF projects examined below the CFI's cash contribution of \$306 million was matched by cash and in-kind contributions of just over \$510 million from other funders. It is noted that no official estimate is available as to the dollar value of PL's time contributions to the NOF, but these would be substantial, and represent an important part of the input to the NOF objectives for any assessment of effectiveness, value for money, etc. (See Annex B for details)

Display 4.1

Funding Sources for NOF Projects Chart By Source, In-Kind and Cash
(as reported at the time of project finalization (i.e., when the final budget is submitted and award payments begin, based on 1,979 projects with final financial data)

Source/Type of Contribution	Amount
Partner In-Kind Contributions	
Corporations/firms	\$125,728,542
Federal government departments or agencies	935,002
Institutions, trust funds or foundations	5,068,582
Other	2,877,700
Other Governmental Sources (municipal or foreign)	910,564
Provincial governments (departments or agencies)	1,929,097
Voluntary organization	107,035
<i>Sub-total: Partner In-Kind Contributions</i>	\$137,556,522
Partner Cash Contributions	
Corporations/firms	\$ 4,303,299
Federal government departments or agencies	4,116,620
Institutions, trust funds or foundations	84,061,619
Other	415,717
Other Governmental Sources (municipal or foreign)	915,205
Provincial governments (departments or agencies)	277,460,932
Voluntary organization	1,792,020
<i>Sub-total: Partner Cash Contributions</i>	\$373,065,412
Partner Total Contributions	\$510,621,934
CFI Cash Contributions	\$306,442,225
TOTAL OF ALL FUNDING TO 2007 (for 1,979 projects)	\$817,064,159

4.1.2 Overall Assessments of Administrators and PLs: *Administrators were generally extremely positive in their assessments of NOF and the way in which funds had been distributed to universities/ institutions. For example, 81% indicated that NOF was easy for all institutions to access, and 77% indicated that the NOF's objectives were achieved in a cost effective manner. VPRs, Deans and Heads noted many specific lessons were identified in relation to the specific issues addressed in the evaluation, and a variety of views of positive features of the NOF program (reflecting lessons learned, worth emulating in the future). These included, for example:*⁵⁷

CFI is without a doubt the best-managed grant program I have seen in a long time. There have been some technical difficulties with the on-line forms, but these are just minute...

Overall [NOF worked] well and opened up a lot of options for attracting new faculty.

[The] Process worked well and it should be replicated for future competitions.

Once paper work was completed, transfer of funds was very quick.

The peer review [was] efficient.

One feature that we used a lot was the cluster applications - they were ... effective and efficient.

I like the idea of encouraging future infrastructure ... to come in tandem with IOF as institutional operational funding, which ensures that we can operate the infrastructure we acquire.

We are familiar and comfortable with the entire existing process, and [have] been impressed with the extent to which CFI staff have been available and prepared to engage with our staff in working through various challenges.

PLs' Assessments: *A majority of PLs also saw the program very positively. Some of these views are illustrated by the following comments (drawn from Q.56) and are related to a number of issues raised throughout the evaluation:*⁵⁸

Overall Goals and Positives:

Making [the NOF awards] available to researchers who are working out of Canada at the time of the application is a great way to woo scientists back to Canada.

...these funds ... allowed me to purchase infrastructure that was not present at the institution. I would not have accepted a position at my institution without the possibility of these funds.

The framework of the [NOF] grant was effective; all directives were clear and simple. The process was basically expedient to getting the right equipment and beginning my research.

I thought the mechanism [used by CFI] for allocating funding was relatively smooth and efficient.

Application and Administrative Process:

[The] Online application handled by the institution is a good approach.

[NOF demonstrated] fair evaluation, fair distribution of funding among researchers

The application process and the results were in general a very positive experience including the peer-review process.

The process is fine as-is but a short "guide for professors" should be developed/distributed that clearly and explicitly outlines the rules and regulations of spending the funds.

⁵⁷ Comments drawn from the Survey of VPRs, Deans and Heads, Q.43 and Q.45.

⁵⁸ These are provided in some length here, but are only a sampling of the vast number of comments made by PLs.

However, PLs were far less satisfied overall with NOF processes than were administrators: only 24% reported they were "very satisfied" while 31% of PLs indicated they were "somewhat satisfied" And, as noted earlier, a noticeable minority -- 23% -- were dissatisfied with the overall NOF program delivery process (see Display 4.3, page 45, for details). In particular, PL comments addressed issues regarding obtaining matching funds or delays in project approvals. Many suggestions were provided by PLs as to how these issues could be improved in future NOF-type programs (this issue is discussed in more detail in Section 4.2.3, below).

4.1.3 Provincial Perspectives

Provincial Representatives provided specific additional insights regarding the NOF application process. For example, officials from Atlantic Canada asserted that the requirements to obtain matching funds from industry or other sources had left their institutions at a marked disadvantage because few such sources existed in their region at the time. Some of these same officials also noted that the NOF was less applicable to many smaller universities -- mainly undergraduate institutions -- which do not typically undertake intensive research projects.

Representatives from all provinces also voiced dissatisfaction with the way which the CFI's partial funding of projects has led to the *de facto* requirement of provincial contributions. Some believed that this pressured them to fund projects that were not necessarily in line with provincial research priorities. This viewpoint reflects the need for true national priorities, harmonizing the new Federal S&T strategy with provincial priorities.⁵⁹ (See *Recommendations*.)

Nevertheless, there was great provincial support for the NOF's allocation mechanism that provides funding to institutions, and for its positive impacts. Provincial officials also generally regarded NOF as providing good value for money. Of the 10 Provincial officials interviewed, 4 indicated that it was "too soon to tell" as regards value for money impacts of NOF, but *all six of the those provincial officials who did provide a response indicated that NOF had provided good value for money.*

⁵⁹ In May 2007, the Government of Canada released *Mobilizing Science and Technology to Canada's Advantage*, establishing a Canada-wide Science and Technology (S&T) strategy to take advantage of the research base and develop research applications that will enhance Canada's ability to stay competitive economically. The main objectives of the strategy are to promote private sector investment in S&T, to create the conditions to attract and retain a highly qualified workforce, and to position Canada as a leader in important developments in S&T research. The strategy provides the context for CFI's priority-setting, through fiscal policies and new investments in research and development (R&D). For example, the federal government committed, for the 2007 Budget, to provide \$510 million to the CFI for the next round of awards to take place before 2010. Government of Canada, *Mobilizing Science and Technology to Canada's Advantage*, 2007. [http://ic.gc.ca/cmb/welcomeic.nsf/vRTF/PublicationST/\\$file/S&Tstrategy.pdf](http://ic.gc.ca/cmb/welcomeic.nsf/vRTF/PublicationST/$file/S&Tstrategy.pdf)

Some illustrative comments from provincial officials were:⁶⁰

Providing allocations to institutions help[ed] them plan for hiring effectively. The ability to apply frequently [was] welcomed as it allow[ed] for quicker hiring.

Liked the idea of allocation per universities based on the Tri-council trajectory.

[NOF] was very easy for larger institutions but was problematic for the province's university colleges who usually do not have strong ties with industry.

It was difficult to align with provincial priorities making it difficult to find matching funds from existing provincial programs.

The matching fund policy should take into consideration the availability of industry participants in each region; this could be done by setting the matching fund requirements on a scale where... areas that have little industry participants would be asked to find 10% matching funds from that source instead of the 20% for other areas.

Provincial Representatives' suggestions for future NOF-type programs: In view of the present *de facto* requirement of provincial funding, provincial representatives indicated that they would like to have more input into the planning of future NOF-type programs. This, they felt, would take into account unique provincial and regional characteristics. Some illustrative comments were:⁶¹

More provincial input is required ... as [provinces are expected to match funding].

There needs to be more consultation with the provinces to discuss matching funds capabilities, as this is certainly different in each region.

[Need] Better recognition of the provinces as equal partners.

The lack of provincial cooperation as there were no discussions beforehand and very little contact after the project was launched as most NOF officials spoke directly with the institutions...⁶²

VPRs were generally satisfied with NOF processes. Responses from VPRs, Deans, Heads, PLs, Non-Awardees and Provincial representatives indicate a wide range of views regarding specific methods for allocating NOF funds effectively. It is also clear that there was wide variation in the allocation approaches taken within universities. Many PLs (who were more likely to be dissatisfied than VPRs) voiced strong concerns regarding timing and matching funds (while provincial representatives focused on the need for consultation).

⁶⁰ Comments drawn from the Survey of Government Representatives/Other Federal Funding Agencies, Q.15.

⁶¹ Comments drawn from the Survey of Government Representatives/Other Federal Funding Agencies, Q.30.

⁶² Nine of ten provincial officials interviewed indicated that they were dissatisfied with the level of consultation, coordination and communication by the CFI on the NOF, prior to the establishment of the program.

4.2 Efficiency of the NOF

4.2.1 General Efficiency

Diverse Views on NOF Processes: VPRs, Deans and Heads were somewhat divided on the extent to which the design and delivery of the NOF had been optimally effective. About half (49%) viewed the NOF financial allocation by the CFI as being a limitation of the program and to the research in general (e.g. they could have applied for substantially more funds than the allocation, suggesting that the allocations were "capping" competition. (This was reaffirmed by some PL comments about "caps" on award amounts as low as \$55K, suggesting a rationing strategy within universities). More than half of VPRs, Deans and Heads (56%) indicated that the requirement to obtain matching funds had a variety of impacts on their institution's ability to effectively use NOF funds, some positive (tapping additional funds), and some negative (particularly where provincial or regional matching opportunities were limited or time consuming).

Many PLs (32%) also viewed the requirement to obtain matching funds as a negative feature of the program, because of the impact in creating delays or reducing the financial level of the project. At the same time, while VPRs, Deans and Heads tended to view Provincial matching requirement as restricting, they also saw the provinces as playing a crucial role in providing very substantial matching funds.

The most positive feature of the NOF process reported in comments by VPRs, Deans and Heads was the timely and efficient transfer of funds to institutions. This may be a surprising finding because many PLs indicated that timing was a *negative* feature of the NOF delivery process (see below). This suggests that, in some cases, there may be institutional-level delays in the transfer of funds to their PLs -- pointing to the need for better tracking of timely use of funds for such programs in the future. [*Evaluators' observation:* Based on comments from the PL survey generally, it appears that some PLs do not completely understand the nature of the CFI's overall funding mandate (and mandated matching of funds) and/or that institutions are not effectively communicating the reasons for delays to PLs.]

In spite of positive general assessments, 41% of VPRs, Deans and Heads suggested changes to NOF-type program delivery process. Changes suggested included: increasing the amount of funding for NOF infrastructure; reducing and simplifying the application process; reducing the amount of bureaucracy; providing greater flexibility to institutions; revising the budget approval process; reducing the demands associated with obtaining matching funds; and providing more operational support for infrastructure in general.

A majority of VPRs, Deans and Heads (76%) pointed to the need for more coordination among CFI programs and other federal funding programs to aid the delivery of future programs similar to the NOF. They also mentioned that there are opportunities for streamlining the administration of the NOF such as removing the pre-audit function ("claiming") before funds are released, in favour of a more comprehensive post-hoc audit. (It was noted that for other research funding programs, these post-hoc audits are now carried out by the funding agencies and university research offices, and this process is generally successful for the funding agency accountability requirements.)

Specific comments from VPRs, Deans and Heads regarding the NOF delivery process (some repeating points mentioned above, particularly as regards matching) underlined many of the above concerns, for example:⁶³

Finding money for construction and renovation costs. [CFI] should have a requirement that the university must provide specific matching costs for renovations and construction.

... being a younger university with little reserves. It has been ... difficult to find matching funds for very large projects leading us in a disadvantages versus larger and more established universities.

[The process has been a] negative because of the province's lack of matching dollars for many projects. This has cost the University/Faculty/Department scads [sic] of money and has affected funds for teaching resources and staff [provincial priorities do not match all applications].

[Our particular] Government was not sympathetic to nor co-operative in supplying matching funds, causing extended delays ... and requiring the University to supply the match in many cases.

[NOF processes] likely discouraged new researchers from applying because they didn't have the time to approach partners for matched funding.

The province of Ontario has been good so far. They match every application. But I wish the process of delivering their funds was faster. There have been instances where we have had to take chances and just continue without the money - but it has always come in eventually. Most of our Industry funding was in kind and in discounts, more than 50% for sure.

Views of Project Leaders: In general, PLs were divided on the issue of whether the NOF's objectives could be achieved in a more cost-effective manner (about 25% indicated "yes" and about 35% indicated "no," with nearly 40% responding "don't know" or "cannot assess"). These same PLs also expressed a wide range of views on how the NOF could be made more cost-effective. (Q51)

The following are general comments from PLs regarding the NOF, with an emphasis on issues related to university administration and efficiency:⁶⁴

[There was] A general lack of university support in the application process. This was partly due to a continual change over in staff in the research office. It is also partially due to the research office not being staffed by individuals with experience in research or grant writing.

Neither our university nor our department have a resource person that helps with budget development and provides guidance throughout the application process. When contacted directly, CFI [was] very helpful and was able to compensate for the lack of institutional support.

Our university and department administrators had great difficulty in providing clear answers with regards to the financial details and constraints associated with CFI applications. This persisted, even after the grant was awarded.

Some university support for obtaining quotations, preparing the budget (it was my first grant proposal, I did not calculate shipping costs & had to scramble to find more funds on my own once I received the grant), writing the proposal ... meeting promises of space in a timely manner.

⁶³ Comments drawn from the Survey of VPRs, Deans and Heads, Q.36 and Q.37.

⁶⁴ Comments drawn from the Survey of Project Leaders, Q.38.

Timing issues were a particular area of concern for PLs, affirming the importance of the results noted earlier on time required for the implementation of projects, as revealed by administrative data:

The CFI application and process itself went well. But after Nov 2005, when the award was announced, it took the province 1 year to sign the letter saying they were going to match the funds.... This meant a full year of delay in setting up the infrastructure (I hope to START soon...).

Unlike at other institutions, the university did not want to give me the money right after the project was approved, but waited until the actual money [was] transferred. The university did not handle the operational funds (15% of the CFI component) properly, withholding them for many years.

[Delays were] with the provincial organization (NSRTI) providing the matching funds. I had to wait almost a year before those funds were made available.

When I submitted my NOF application, [Ontario] had a program ... to match CFI funds. By the time the application was being approved, Ontario had discontinued ... [its] matching funds. This delayed ... securing the infrastructure. During the delay, the price of the infrastructure increased. ... I spent a lot of time and energy investigating this barrier ... including pursuing employment ... at [other] universities that already had infrastructure in place.

Provincial Representative's Views on the NOF Process: A significant level of dissatisfaction was expressed by Provincial Representatives regarding the NOF process. The CFI's minimal consultation with the Provinces both *before* and *after* the NOF was launched, was the main area of concern (9 of 10 officials expressed discontent) however, the evaluators also note that some provinces were slow to respond, or uneven in their responses to the NOF when they were consulted). Seven of ten Provincial Representatives also expressed dissatisfaction with the NOF process, as the provincial matching fund mechanism required by the CFI did not always align with Provincial priorities, or did not take into consideration private industry's lack of involvement in some areas. Typical comments included:⁶⁵

No discussions were held before the launching of the program and [we] were only consulted when there was a crisis. In fact, it appeared as if the CFI viewed universities as their partners in this program and not provincial authorities who were matching the funds.

[Our] office was not the contact point even though it was very much involved with NOF matters. [CFI] should not have allowed only one contact point with the provinc[e].

... it would be important to allow for provincial officials to have access to data links built between the institutions and CFI in order to keep the provinces informed as to what was occurring between these two.

The lack of provincial cooperation [was reinforced by the fact that] there were no discussions beforehand and very little contact after the project was launched as most NOF officials spoke directly with the institutions without keeping the provinces informed.

Conclusions Regarding General Efficiency: The NOF in general is assessed very positively as regards efficiency, with most participants expressing a high level of satisfaction. However, views expressed by VPRs, Deans, Heads, PLs and Provincial officials suggest that important concerns existed with the NOF process. It should be noted that some of the comments made were issues with high-level program design (most notably, the requirement to obtain matching funds).

Other comments were related to program administration, either at the provincial level, where provision of matching funds contributed to delays, or at the university level. In addition, some delays attributable to the CFI delivery processes arose from the need to obtain multiple detailed quotes on

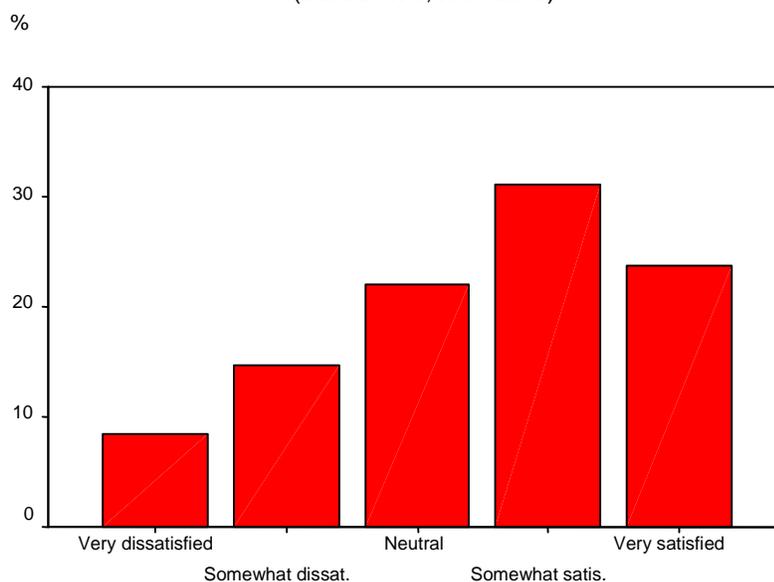
⁶⁵ Comments drawn from the Survey of Government Representatives/Other Federal Funding Agencies, Q.6.

equipment after initial approval and then have these vetted by the CFI through their claim process. *It should be noted that many operational features of the delivery process may have been improved with the implementation of the LOF; however, several areas of concern remain and need to be addressed in future programs and final reports. (See Recommendations).*

4.2.2 Impacts of Apparent Inefficiencies in the NOF (in matching funds, delays, etc.)

PL's Overall Satisfaction with the NOF Process: Most PLs were satisfied with the *NOF application process* -- 55% reported that they were "somewhat" or "very satisfied"; however, a significant sub-group (23%) were dissatisfied (see Display 4.3, below). This group rooted their dissatisfaction in specific NOF issues such as problems obtaining matching funds, delays, and reduced grants, among others.

Display 4.3
Project Leaders' Responses to the Question:
"Overall, how satisfied were you with the
NOF application process?" (Q.37)
(based on 1,456 cases)



Sources of PL's Dissatisfaction with the NOF Process: Among those PLs who expressed dissatisfaction with the NOF, timing was cited as the most important factor in dissatisfaction, along with the challenge of obtaining matching funding: 32% of PLs indicated that the NOF requirement of securing matching funds had reduced the value of their NOF application (Pearson's r significant at $p < .05$). This report was correlated with dissatisfaction (Pearson's r significant at $p < .05$); 32% noted that the requirement of securing matching funds had delayed the start of their projects (see Display 4.5) and, of these, the majority (about 80% of those who experienced delays) felt that these delays had resulted in negative effects on their research (Pearson's r significant at $p < .05$); and 24% of PLs reported that their financial allocation under the NOF had been less than what was needed (see Display 4.5), apparently reflecting a "rationing" decision at some universities, to distribute more limited NOF funds across a larger group of faculty.

Project Leaders underlined the importance of the above factors repeatedly in their comments and also raised the issue of flexibility in the administration of the NOF. For example, among those PLs who were dissatisfied, a notable minority stated that they would have liked to have had greater control over the operational use of funding, to offset delays in the budget approval process and the actual delivery of funds.⁶⁶ While many of these issues were attributed to CFI procedures, many of these issues seemed to be connected with intra-university factors such as administrative knowledge of NOF matters, and the relationship between PLs and university administrators.⁶⁷

Over 75% of PLs felt that the financial allocation for their NOF project was sufficient to allow them to establish infrastructure appropriate for their goals -- a very positive finding. Again, however, 24% felt that their infrastructure was under-funded relative to their goals and was insufficient to allow them to establish infrastructure appropriate for their goals. Under-funding would be a concern if it resulted in incomplete or insufficient projects, as is suggested by results below.

A number of these concerns can be validated: PLs who reported delays, and negative impacts of delays did in fact experience longer times between award and budget finalization; correlations between PL reports of significant delays and CFI administrative data on time between the initial award and the budget finalization were statistically significant, particularly the time to approval of budget (Pearson's r significant at $p < .05$). Other "university" factors had effects on research as well, as noted later in this section, for example the extent of knowledge of administrators was positively correlated with success of projects, where success was measured in terms of researcher productivity following the NOF award.⁶⁸

PLs Views on the Allocation of NOF Funds: The following comments by PLs echoes frequently-noted concern regarding the method of allocation of funds to universities for distribution to researchers, subject to the CFI's approval. Areas of concern centred on timing, obtaining matching funds (in-kind contributions, see next page), and funding flexibility:⁶⁹

*It takes too long before funds are released... funds should be administered in more flexibl[y] (the 10% variance rule is too strict. The CFI ... application requires a writing style which is very political and de-emphasizes science.... society should benefit from science, but, in the long-run, society is best served by ... quality of science and not their *immediate* usefulness.*

... I was frequently frustrated by the ... bureaucratic nature of the CFI process, particularly ... getting quotes over and over again.

The[re] is a tendency to favour few, high profile, big budget projects. Having some funds to enable general upgrades of infrastructure would be helpful as well.

As a new institution, we were extremely limited in the amount of funding its faculty can apply for from CFI, this included the NOF that was awarded.

The application... form ... asks the same thing over again and [has] nothing to do with cutting edge research. ... I submitted my grant two years ago and am only just starting to receive equipment. It is a ... waste of time to have to re-quote everything once initial approval comes through. The 20% in-kind contribution ...[mostly] comes in the guise of [a] vendor-discount.

⁶⁶ Although a statistical estimate cannot be made, it should be noted that this view was expressed by 71 (4%) of all PLs contacted. The evaluators note that a direct question would almost certainly have received a much higher percentage of answers supporting this type of change (see Appendix B).

⁶⁷ For example, a majority of PLs (58%) indicated that university administrators at their institution fully understood their infrastructure needs. However, 28%, disagreed, and where administrators were seen by PLs as lacking knowledge of NOF-related infrastructure needs, satisfaction of PLs was reduced. While 23% of all PLs reported they were dissatisfied with NOF processes, among the 28% who reported administrators did not understand infrastructure needs, dissatisfaction rose to 36%.

⁶⁸ The indicator used for this analysis was a total score on the number of "don't know" answers which administrators gave regarding NOF issues. Analysis of this indicator suggested that there were notable variances across universities.

⁶⁹ Comments drawn from the Survey of Project Leaders, Q.38.

Specific Concerns with In-Kind Contributions: In open end questions to the survey (on reasons for dissatisfaction, lessons learned etc.) a number of PLs raised concerns with in-kind contributions. The extent of these concerns among all PLs could not be estimated, as a direct question on this topic was not posed. However, 30 PLs surveyed were both dissatisfied with NOF processes and noted specific concerns with in-kind contributions from companies. This group reported that in-kind contributions increased the length of time their application took, as well as the amount of accounting and other work they had to put into the NOF application. Of the 30 PLs noting problems with in-kind contributions, 10 noted extreme concerns, including fictitious discounts or in-kind contributions that were simply not followed through on.⁷⁰ Some of these comments included:

"The requirements for 20% external funds is a huge hassle and totally useless. Companies just make up fake discounts adding up to 20%."

"Matching fund from commercial suppliers is sort of bogus. It ended up decreas[ing] the final buying power of the grant."

"Trying to track CFI contributions vs. in-kind funny money has been a constant source of headaches."

The in-kind formula was flawed, the companies inflated their prices and reduced it by the in-kind value to meet the criteria. So the big winners in all this was the companies."

"Abandon matching funds ... or at least the phony in-kind contributions..."

Since these cases presented a very negative assessment of administrative follow-through by universities (which many PLs may have hesitated to make), the evaluators saw this as suggesting a deeper problem to be monitored in future NOF-type programs. The validity of this assessment -- that in-kind contributions are an issue for CFI -- was underlined by a statistically significant negative correlation (Pearson's r significant at $p < .05$) between researcher productivity (measured as previously discussed in terms of post-NOF award publications and grants) and the size of corporate in-kind contributions (see below, next page). Higher in-kind contributions were associated with less research productivity.

Administrative Burden: While CFI's program of monitoring served important goals of accountability, it appeared to represent a burden to many PLs. While 70% of PLs felt that the NOF process was efficient overall, two areas of inefficiency were cited frequently by PLs when the evaluators spoke to them. These centred around NOF paperwork being very time-consuming and PL views of excessive level of NOF "bureaucracy". These assessments were not quantified by the evaluators, but found mainly in discussions and emails about the surveys. These comments often reflected high levels of anger among PLs about "CFI constantly requiring reports", and about information requests as "harassment" [Evaluators note: much of this demand for information, the evaluators note was not directly from CFI, but rather from university research administration offices.] Not surprisingly, PLs often suggested reducing the level of bureaucracy; simplifying the application process; simplifying the reporting process; and increasing flexibility in the management of budgets. This problem, the evaluators noted is one which could be addressed by simplifying aspects of the overall reporting system, and could be monitored by a question in the new, brief annual report form (see recommendations).

Satisfaction with the NOF and Retention: As noted earlier, nearly all PLs -- about 90% -- expressed a strong intention to stay in Canada for the next five years. Interestingly, however, our analysis found a correlation between dissatisfaction with NOF processes and uncertainty about staying in Canada. Those who were more satisfied were more likely to say they intended to stay in Canada, and those who were dissatisfied were decidedly less certain.

⁷⁰ Some of these negative comments about in-kind contributions included: -

As can be seen in Display 4.4 below, PLs who were dissatisfied were less likely to indicate that they intended to remain in Canada for the next five years: the reported probability of staying in Canada dropped from 93% among those who were "very satisfied" with NOF processes, to 75% among those who were "very dissatisfied." This was seen by the evaluators as an important finding for retention.

Display 4.4

Proportion of PLs Indicating that they Intend to Remain in Canada for the Next 5 Years, by Satisfaction with NOF Processes (Q.47), (based on 1,456 cases)

Satisfaction With the NOF Application Process	% Indicating "Yes," will stay in Canada	# of PLs
Very Dissatisfied	75	121
Dissatisfied	88	218
Neutral	86	453
Satisfied	91	316
Very Satisfied	93	348

Other Explanatory Factors: PL's satisfaction with the NOF process was also linked to "university" factors. PLs who use the SRP in their proposals were more satisfied with NOF processes (Pearson's r significant at $p < .05$); PLs at universities with SRPs which were specifically linked to regional networks or other institutions experienced fewer critical delays ($p < .05$); and delays were less likely where university administrators were well informed about the NOF and related processes.⁷¹

A multiple regression analysis of factors impacting on researcher productivity illustrated that quality of research after the NOF award was significantly affected by the structure of project funding (a higher percentage of cash as opposed to in-kind funding was associated with higher research performance);⁷² high corporate in-kind contributions had a significant negative effect on quality of research; merit review in faculties for selection of NOF applicants was associated with higher quality research outputs; VPR level knowledge of the NOF and research funding aided success; time spent on applied research and research administration was associated with success, and higher teaching time reduced research success (all of these regression results were significant at $p < .05$). No evidence was seen of positive effects of SRPs generally, reinforcing the evaluators' view that SRPs are insufficiently effective in aiding research because of their lack of institutionalization, linkages to partners, etc. These and some related results above (e.g. impact of level of administrators knowledge of the NOF) may point towards "lessons indicated" which could be tested more fully by future research or considered in program refinements (see *Recommendations*).

Conclusions: In collaboration with universities, the CFI should find ways to improve the overall efficiency of NOF-type programs, to raise the level of PL satisfaction with the NOF process and remove barriers to good use of time, for example, by streamlining reporting (an area which CFI should be able to respond to with ease), reducing obstacles to project implementation, and improving the quality and timeliness of information provided to PLs (see *Recommendations*).

⁷¹ An indicator of administrator level of information was constructed by tabulating for VPRs, delegates, etc., the number of questions about NOF or university processes they were able to answer with responses other than "don't know."

⁷² This step-wise regression was conducted using SPSS. Overall, regression showed an F significant at $p < .001$, with a multiple R of .30 and an R^2 of .09. A negative coefficient for in-kind contributions ($p < .001$) was seen as supporting discussions above regarding some PLs who felt that some in-kind contributions did not actually occur. The regression analysis included time to implement, and percentage in-kind funding as predictors for researcher productivity after the NOF award (the dependent variable). The logic of this result is that projects which were under-funded by "weak" or disappearing in-kind contributions, had their effectiveness impeded.

4.2.3 Equity Issues

Under-representation of Disciplines: While only open-ended comments were provided on this topic, some 50% of VPRs and delegates indicated that some faculties and disciplines were in fact underrepresented. Among these, the consensus was that under-representation was mainly in the Social Sciences and Humanities.⁷³ Many administrators noted that most NOF funding goes towards "hard" or "pure" sciences. This is not surprising in view of the orientation of the CFI's programs generally -- toward the provision of large-scale research infrastructure -- which is rarely required in the Social Sciences and Humanities or clinical medical projects. This reflects the nature of the CFI's overall mandate and is not about a single program such as the NOF. Comments by VPRs regarding under-representation included:⁷⁴

Perhaps unavoidably, given the emphasis on technology and the current obsessions with market "principles" (i.e., for profit enterprises/partnerships) there seems little room for broad efforts in support of complex but important problems (poverty, global stewardship responsibilities, participatory development of marginalized communities, etc.). These will require more fulsome engagement of the arts and humanities together with the technical and medical sciences but the infrastructure needs are not so easily crystalized into a building or piece of equipment....

We have had very high rates of success ... in the Sciences, Life Sciences and Engineering, but low to moderate rates ... in Humanities and Social Sciences; ... following ... discussion with the candidates, our staff, and staff at CFI, I am convinced that these applicants are ... held to a higher standard than those in the "hard sciences"; e.g. in some reviews, the ability of the researchers to fully make use of "complex" equipment was questioned. We [do not] discourage applicants, it is just that some ... especially Humanities, don't have a handle on making a good case for NOF.

There is a clear bias towards "equipment users" and those in the hard sciences, thus forcing applicants in other areas to try to fit their work into a foreign mold.

Discouraged Researchers: Certain aspects of the NOF process were seen by many administrators as discouraging certain types of potential applicants (in addition to those in the social sciences generally). For example, many of those in the "hard sciences" reported being put off by having to provide "quality of life" benefits arguments to support their proposals, as they saw these as not being applicable to their particular situation. Some illustrative comments include: *"Proving the link of their infrastructure to innovation and societal benefit [is challenging for many researchers]. In some cases, because they are new faculty, they don't necessarily realize their potential for the society".*

Administrators also noted that *"[Finding] Matching funds [is a] huge problem. [and] Definitions of infrastructure [are] inflexible for [humanities and social sciences]."* These comments suggest that some researchers do not understand the nature of the implied contract between researchers and society in general -- so there is clearly room for more information on CFI's mandate and how researchers can work within it. As well, these observations point to a need for more information for researchers; for example, what to expect in the way of delays and how to deal with it.

⁷³ It is noted that this question was not asked directly, rather as part of an open-end question on groups which had difficulty accessing NOF generally. "Were any groups under-represented (e.g. particular faculties etc.). All of those reporting under-representation indicated the social science as a particular area of under-representation. Not all indicated that this was a problem -- for many NOF was seen as a "science" focused program, and accepted as such.

⁷⁴ Comments drawn from the Survey of VPRs, Deans and Heads, Q.26.

Equity Groups: A statistical analysis of the differences between awardees and non-awardees showed no correlation between receiving a NOF award and equity group membership (membership in any of the groups: Aboriginal; visible minorities; persons with disabilities; and women). This analysis cannot be deemed definitive, however, because of the small sample of non-awardees surveyed (n=77). Future research is recommended, particularly to examine the access to NOF-type funding among the broader population of new university "hires", who could not be identified and surveyed for this evaluation.

Conclusion: The CFI's basic mandate of providing research infrastructure consisting of "state-of-the-art equipment, buildings, laboratories, and databases required to conduct research" tends to limit somewhat the disciplines which the CFI supports. Core program design elements such as the requirement of matching funds reinforce this, since matching funds in the social sciences and humanities are limited. As well, new faculty members require assistance in recognizing the potential benefits to society of their research (see *Recommendations*).⁷⁵

4.2.4 Participants' and Stakeholders' Views on Value-for-Money of the NOF

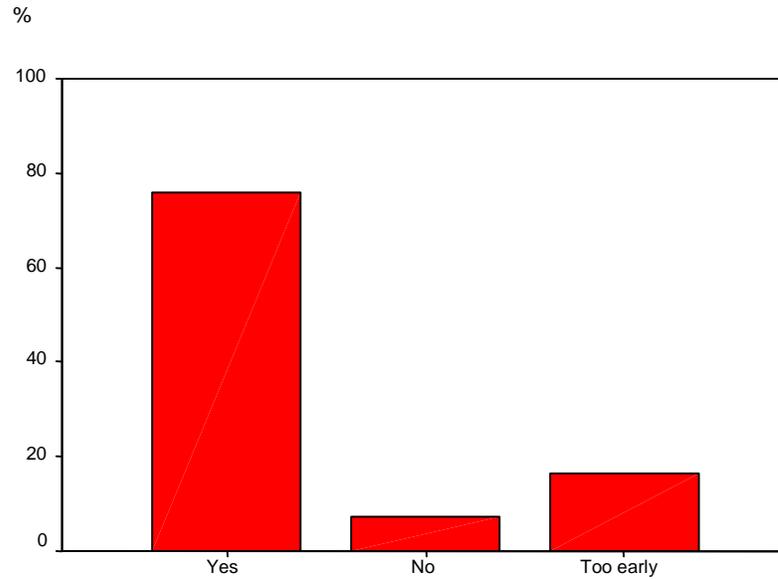
Assessments of VPRs and Other Administrators: VPRs, Deans and Heads were virtually unanimous (96%), in indicating that the NOF had provided good value-for-money for Canada. In particular, the NOF investment was viewed by administrators as having had a positive impact, both domestically and internationally. The amount of effort that institutions had expended in obtaining NOF funding was also seen as being commensurate with the benefits obtained and the overall benefits of NOF infrastructure were judged to have been vastly greater than their cost. As noted earlier, VPRs, Deans and Heads also indicated that without NOF funding, most of their HQP would not have been hired. Universities in receipt of NOF funding felt that it had provided them with a competitive edge and increased recognition.

Views of Project Leaders: PLs also overwhelmingly regarded the NOF as providing valuable benefits for the amount of effort required to obtain NOF funding. For example, almost 90% indicated that the amount of effort which they had expended in obtaining NOF funding was commensurate with the benefits which were obtained (see Display 4.5). In addition, PLs were almost unanimous in their view that NOF provided good value-for-money for Canada overall (see Display 4.6). Even so, approximately 45% of PLs did suggest ways in which NOF's objectives could have been achieved in a more cost-effective manner.⁷⁶

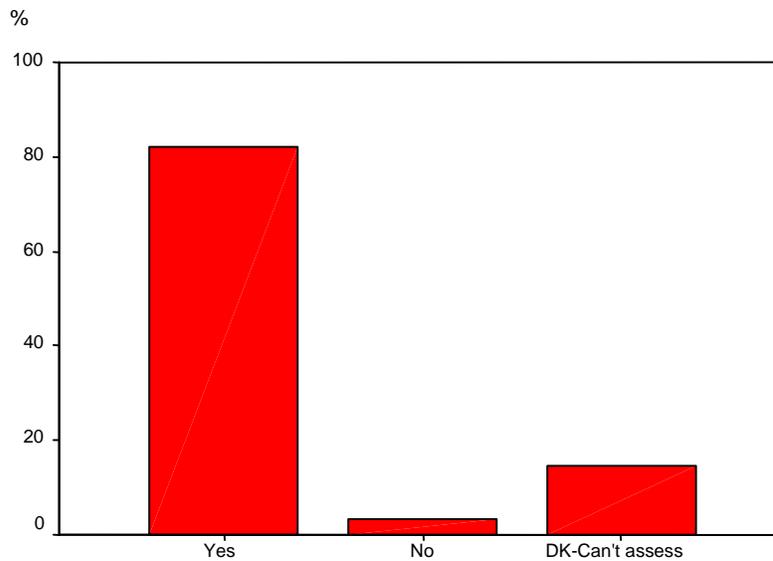
⁷⁵ The evaluators note that issues of access can only be fully understood through studies which would examine access to NOF-type programs at the university level (prior to applications being submitted to CFI). Such studies which would require additional cooperation from universities in creating comparison groups etc. (see *Recommendations*).

⁷⁶ As noted above, these suggestions included reducing the level of bureaucracy, simplifying the application and reporting processes, and increasing the flexibility of funding.

Display 4.5
Project Leaders' Response to the Question:
"Was the amount of effort *you* expended to obtain the NOF funding
commensurate with the benefits that you obtained?" (Q.46)
 (based on 1,470 cases)



Display 4.6
Project Leaders' Response to the Question:
"In your assessment, has NOF provided good
value-for-money for Canada overall?" (Q.50)
 (based on 1,488 cases)



Provincial Assessments: Six of the Provincial representatives who provided an assessment indicated that the NOF had provided value-for-money (VFM), an interesting finding given provincial dissatisfactions with the overall NOF process.⁷⁷ Comments included: *"Very important program for [us] as it offered a good incentive for young researchers to be coupled with the positive quality of life factors in the province (could attract them by saying that they would not have to compromise their careers in order to live in a nice setting)."* *"Absolutely... we've reversed the brain drain and made it attractive for people to be here"*. *"Very good program to attract HQP to the Atlantic Provinces as it allowed for small institutions to obtain in-kind collaboration from industry."*

Employer Views on the NOF's Value: When employers were asked (based on their experiences with their trainees) whether this demonstrated the "value of such funding to Canada and Canadian research and development," 82% of this exploratory sample indicated "yes".

Conclusions: Across all groups surveyed for the evaluation, the NOF was deemed to provide good value-for-money. This view was shared by participants in NOF projects and by individuals with a more independent basis for assessment -- provincial representatives and employers. Even so, the assessment of value would have been strengthened and made more definitive by additional data on costs and benefits, as no formal cost benefit analysis was possible for this evaluation. This points to the need for more comprehensive and longer-term assessments of value-for-money, and likely return-on-investment studies (see *Recommendations*).

4.3 Differences Between Larger and Smaller Institutions

Overall Use of NOF Funds: As noted in Section 2, smaller universities received very small allocations from the NOF, based on their small historical research funding. Some of the smaller institutions indicated that they were at a disadvantage when using the NOF -- not only by smaller financial allocations (some would have liked to bid for more), but also by the lack of matching funds available in their region (particularly in Atlantic Canada). These views were echoed by Provincial officials, who often spoke on behalf of smaller institutions. As several Provincial officials noted: *"[NOF] was very easy for larger institutions, but was problematic for the province's university colleges who usually do not have strong ties with industry or (from a regional perspective)."* and *[it was] "Difficult to find matching funds in Atlantic Canada due to a lack of industry opportunities. This usually delayed the process of getting projects underway."*

Importantly, the analysis of productivity data did not show larger universities to be more productive per CFI dollar invested. PLs from small universities were actually slightly more productive in publications and gaining grant dollars. Thus a good case could be made for enabling smaller universities access to additional research funds -- a circumstance that could accompany greater competition among universities for NOF type funding. (e.g. this suggests the main advantage of the larger universities is their ability to distribute large amounts of funding easily).

Conclusion: Smaller institutions and other institutions that do not have a strong research mandate were not major recipients of NOF support, which is consistent with the CFI's mandate to support world-class research and technology development. Yet, in the evaluator's assessment, the smaller universities may warrant greater support, as part of the "feeder" system for researchers generally, and may be equally or more productive, particularly where they are highly specialized. More importantly, it is suggested that they should have the opportunity to compete with larger universities, with fewer constraints. (This points to a need to modify the "block funding" approach.)

⁷⁷ However, four of the Provincial officials who were interviewed indicated that they could not provide an assessment of VFM -- which is understandable in view of their distance, both physically and administratively, from the locus of the infrastructure -- that they would not have day to day observations on outcomes of projects.

4.4 Non-Awardees' Views of the NOF

Non-awardees: A survey of 77 non-awardees provided additional insights regarding the allocation of NOF funding (note that about 10% of all applications to the NOF program were unsuccessful). A number of issues were raised by non-awardees in the web survey and during telephone interviews.

Most non-awardees reported that they were dissatisfied with the NOF application process -- over 70% indicated that they were dissatisfied with the explanation provided to their institutions as to why their NOF application had not been approved. (NA10) Some also felt that there were too many criteria being applied -- e.g. particularly that criteria which were more relevant for science, engineering and health applicants -- were being applied to social science applicants. They also expressed concern about the requirement for an "innovative" project. Some felt that the reviewers were "too conservative", while others expressed the opposite sentiment -- that the reviewers found their project to be not innovative enough. In addition, several non-awardees indicated that they received no feedback at all (an assertion which the evaluators cannot validate).

Other non-awardees voiced specific dissatisfaction with the level of university support and internal review in the application process (although some felt that the university research office had provided a great deal of support). Some specific biases perceived by non-awardees included a tendency for CFI to favour: larger universities; and larger single-item equipment; and to support science researchers generally over social sciences, and also over clinicians (in medical fields). Non-awardees suggested streamlining the NOF application process, harmonizing requirements with other funding agencies, citing the challenge of finding enough time to complete the application, considering their teaching load, and time required for research and administrative work.

Most non-awardees remained at the same institution and the same position despite not having received the NOF award (92%), with about half having been offered jobs elsewhere (NA19, NA20). As well, about 40% of non-awardees received other types of grants for the same infrastructure requested in their NOF application -- a majority from NSERC Research Tools and Instruments grants (RTI); however, more than 60% reported that they could not cover all of their infrastructure needs (NA16, 17). Nearly all non-awardees expressed the desire to remain in Canada and at their same institution, suggesting that retention was not negatively affected by lack of success in the NOF competition.

Suggestions for Future NOF-type Programs: Several suggestions for future NOF-type programs were put forward by non-awardees, including: de-emphasizing cutting-edge technology and instead evaluating the usefulness of the overall goals of the project. Several respondents also emphasized that the CFI should take into account the different types of career paths (including those of some women) for up and coming researchers. As one non-awardee commented: "Newcomers from outside of North America have often extended post-doc times, due to differences in University systems (e.g. in some countries, there is no real equivalent for an assistant/associate professor, with corresponding supervisory privileges).... Criteria for NOF eligibility need to be flexible enough to account for that." The most frequently-cited suggestion by non-awardees was to establish an appeals process, enabling an opportunity to respond to the reviewers, or request a reassessment.

Conclusion: Non-awardees were often very successful researchers in spite of not receiving a NOF award (see Section 3). As valued members of the research community (and sometimes successful re-applicants for NOF-type programs or CRC) they should receive as much feedback as possible from the CFI regarding their applications, including the opportunity to ask questions of their reviewers.

4.5 Links to Other Federal Granting Agencies

Overview: As noted earlier in this report, better coordination of NOF-type programs with those of other agencies was seen to be a significant unmet need, even though this issue was first raised in the 2002 evaluation of the NOF. Efforts are reported to be underway now, to coordinate these programs, with exploratory co-review process under way with SSHRC, CIHR, and NSERC. It should be emphasized that while this should result in better coordination of research funding, an implication for the CFI is that its system of allocations to universities could need to be modified (since funding could to an extent be driven by the Tri-council applications). As the evaluators note in *Section 5, Lessons from other Jurisdictions*, this could be a good first step towards a more competitive process.

University administrators argued for greater integration and synergy of these programs, and provided a number of comments on linkages of NOF to other programs:

There could be greater synergy between CFI and other granting agencies in terms of synergy between infrastructure funding and operations funding - it is great to get funding for infrastructure; however, we need to be able to operate that infrastructure. At the same time, we need infrastructure funding in order to get operations funding - the two are very much connected. CFI and SSHRC are discussing this at the moment and may be working it out.

There could be more discussion between CFI and granting agencies. As well, if CFI developed a more focused program for young faculty, things would work better -- for example, putting together a package that allows them to apply only once would be great, because young researchers spend far too much time writing grant applications when they should be conducting their research. Also, it would be useful to have infrastructure funding in the future. As well, it would help if CFI and granting agencies could get together and create recruitment packages.

More allocation of operating costs for the infrastructure, i.e. from NSERC. The MFA program helps some institutions but not all.

I don't see the need for synergy so much among CFI funding [programs] but more the Tri-council programs. I find that there are researchers who get CRC funding but no operating funding from the Tri-councils. It would be nice if there were an ongoing link between operating costs and infrastructure costs within the Tri-councils. If we don't have funding from both sides then it is not the most optimal use of our infrastructure. Funds that provide money more broadly for 'programs' are much more holistic and useful....

I believe there could be more synergy within the application process. Every funding agency has its own requirements - but if they could design a common model for CFI and CRC then it would be much more productive for the researcher and the university. This also goes for reporting – each agency has different forms to fill out in terms of reporting progress; however, both agencies are asking the same questions. Therefore, if there could be a universal mode or model to report back to both funding agencies then that would really help research productivity.

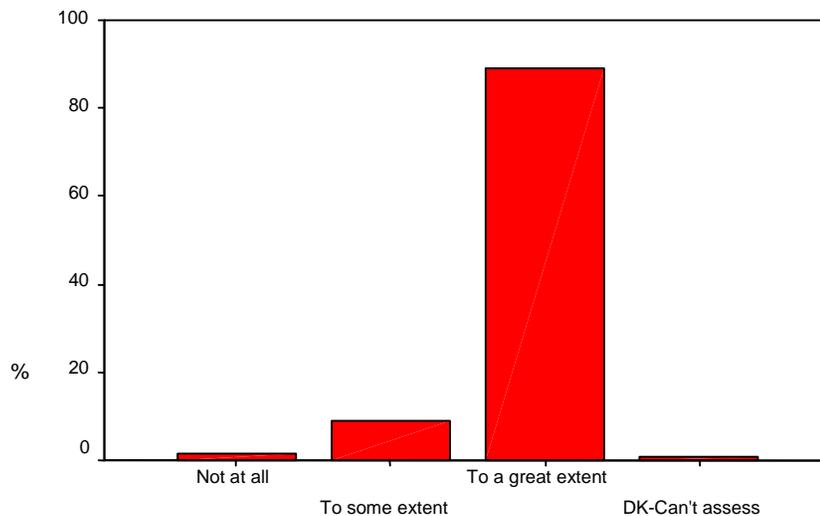
PL's Perspectives: PLs expressed similar views -- that more coordination was needed -- particularly regarding simplifying the application process and accessing funds for research operations (students, post-docs, etc.).

Conclusion: There is great room for improvement in the effectiveness and efficiency of overall funding of research infrastructure acquisition and operation via coordination of programs between the CFI and the three federal funding agencies. Such coordination would greatly benefit future NOF-type programs (see *Recommendations*).

4.7 Sustainability of Infrastructure

Lessons From "Older" NOF Projects: Projects completed as of 2006 provided additional perspective on use of infrastructure. Among those PLs who had submitted their final reports at the time of this evaluation, 90% indicated that their NOF infrastructure is being fully utilized.

Display 4.7
Project Leaders' Response to the Question:
"To what extent is your NOF infrastructure being fully utilized today?" (Q.13)
(Asked only of those who had submitted their final project reports)
(based on 451 responses)



Conclusion: Despite concerns regarding operating and maintenance costs, most PLs who had submitted their final reports (generally projects 5 years old or older) overwhelmingly indicated that their infrastructure was fully utilized. This is especially noteworthy since these are mostly early recipients of NOF awards for which IOF funds were not available. Clearly, the researchers and/or their institutions were able to provide adequate funds to keep the infrastructure available to enable a high rate of utilization. Such experiences of more mature projects should be closely examined.

5. International Lessons

Overview: A separate international sub-study was undertaken as part of the evaluation. The goal of the international component was to identify strategies which have provided added value for research infrastructure programs in other jurisdictions, and to assess the impacts of specific program practices on competitiveness and attraction and retention of HQP. In particular, emphasis was given to the identification of "best practices" that might be relevant to CFI.

Methodology: The research was undertaken using a combination of web-search strategies, a document review, telephone interviews, and E-mail exchanges with selected contacts in five countries (UK, Germany, Australia, the U.S. and Japan) and the European Union. Over 35 major programs (many of these incorporating numerous other programs) were examined, with data obtained from over 30 agencies.⁷⁸ (See Annex E). Results were compiled into detailed profiles for the six jurisdictions, and key issues and directions were subsequently discussed with senior officials and academic experts in each of the six jurisdictions. The findings were compiled into broad descriptions, in particular, lessons learned, which were viewed as being of potential value to the CFI in strategizing for the development of future NOF-type programs. At key points in the research, the emerging results were reviewed by Dr. Aldo Geuna, of the University of Sussex, SPR's Consultant on International Research Programs.

Limitations: A number of challenges were faced during the research. A key limitation was that no programs quite like the NOF were identified for comparison. Numerous infrastructure and HQP programs were identified and studied, but no significant programs which combined the goals of attraction with infrastructure development. Another key limitation was that, when trying to identify lessons learned in the other jurisdictions, few evaluations of past or ongoing programs actually identified specific major (or minor) lessons learned. As well, many programs were relatively new and therefore could not be assessed (although the rapid development of programs was itself a lesson). *Therefore, lessons learned had to be identified through program directions (assuming a new direction represented "learning"), or from direct interviews.* Another limitation was that certain detailed data on historic funding, numbers of researchers, or program details could not be provided by the agencies contacted, was not comparable over time, or was not available for recent years.⁷⁹

Strengths: In spite of Canada's uniqueness (and the fact that many others would like to learn from the NOF), this comparative research paints a broad strategic picture, with a number of important strategic lessons drawn from the wide experience of senior officials and policies in the other jurisdictions, particularly as regards grants strategies and the role of well-developed science and HQP policies. These lessons should inform future NOF-type programs.

Key Findings: One key finding, as noted above, was the absence of significant programs such as the NOF which combine infrastructure funding with HQP attraction goals. The fact that the *NOF appears to have been highly successful, suggests that the CFI has created a good "niche" for this type of program.* In this respect, the NOF reflected well on Canadian leadership in research funding.

More generally, the apparent rapid growth in international programs designed to develop, attract and retain HQP suggests that NOF-type recruitment packages and the Canadian universities which make these offers will face far greater competition in the near future.

⁷⁸ See Annex E for a complete list of programs examined.

⁷⁹ Also, language was a barrier in some cases, e.g. Japan and Germany, where English materials were not as prevalent or were available only as summaries.

The full extent of this challenge has been documented in the recent U.S. National Academies report, *Rising Above the Gathering Storm*.⁸⁰ Increasing competition from abroad points to the need to strengthen NOF-type programs, for example, with an allowance for larger awards and greater funding. It also emphasizes the fact that Canada needs to be more focused in its NOF-type program criteria, so that CFI resources can be applied to those areas where Canada will have the best competitive advantage. Other key lessons included:

- **Growth of Funding and Initiatives:** One key finding was that many programs in other countries were being expanded or were newly-established. Many of Canada's key competitors are rapidly increasing their investments in research infrastructure and many new programs were found to be aimed at the development of HQP. Overall, the research environment suggests a rapid increase in investment in most jurisdictions from 2000 to 2006, with substantial increases scheduled for the coming years. Examples of new or expanded programs included steady growth of infrastructure programs in the UK, such as the Science Research Investment Fund, and German HQP programs such as the "*Strategy for Promoting Young Researchers*", and the new "*Initiative for Excellence*" which will provide 1.9 billion Euro from 2006 to 2011. Similarly, the "*New High-Tech Strategy*" promises another 6 billion Euro from 2006 to 2009. German documents note that this represents "the largest increase in research funding in the history of the Federal Republic of Germany [and that] a total of some €15 billion will be allocated for cutting-edge technology through the year 2009."⁸¹ Similar initiatives were noted such as the US "*American Competitiveness Initiative*," which promises \$5.7 billion for infrastructure and HQP programs beginning in 2007. Similarly, the European Research Council will allocate €7.5 billion over the next seven years for HQP through the *Starting Independent Researcher Grant Scheme*.⁸²
- **Centering Programs on Science and Technology Policy:** In the UK, Australia and the EU, the development of comprehensive investment strategies has been a priority for the past five years. Thus, programs are not developed independently, but rather linked to national goals in innovation, science policy, and HQP. These initiatives can be seen in a number of major national reviews and policies. Although all of the jurisdictions indicate that they are committed to allocating funding based on merit, they nevertheless are concerned with ensuring that their limited resources are offered to R&D which is deemed to be the most worthwhile. Consequently, these jurisdictions have given priority to adopting a research priority model that targets certain agreed-upon fields of research. (An implication for Canada is that Canada's new S&T policy should provide guidance for NOF-type programs.)
- **The Growing Prominence of Competition:** Across nearly all of the jurisdictions examined, a trend was seen towards a merit-based model -- requiring institutions to compete for funding. Most jurisdictions have instituted competitive approaches⁸³ that are underscored by evaluation schemes to reward excellence, potential for economic impacts, and relevance to socio-economic needs. All jurisdictions reflected this growing emphasis on competition, but Germany was particularly notable. During the 1990's, Germany began to adopt a much more competitive funding process. In this process, institutions are no longer entitled to historic "shares" of national research funding. Rather, institutions or clusters must compete for all major funding.

⁸⁰ *Rising Above the Gathering Storm: Engineering and Employing America for a Brighter Future*. Committee on Prospering in the Global Economy of the 21st Century (National Academies), 2007.

⁸¹ See: *Information Society*, <http://www.bmbf.de/en/398.php>

⁸² Japan, while not increasing investments in research overall (because of an economic downturn), has been greatly restructuring its research programs and reforming its higher education system, in particular, to retain HQP.

⁸³ Applying either peer or metric-based evaluation approaches.

Other lessons learned include the widespread development of comprehensive national HQP policies, development of attraction programs (and programs to retrieve emigrated HQP) along with strong "home grown" HQP strategies; initiatives to enhance work with clusters and develop stronger academic-business ties; initiatives to improve co-management of research investment with educational institutions; and growing concern with evaluation and return-on-investment.

National Policies Set the Stage: Many of the findings from the international review relate to broad national strategies for Canada rather than the CFI specifically and thus some of the recommendations provided at the end of this report are aimed at the Federal government more generally -- in the CFI's case -- Industry Canada.

Conclusions: Most of the following conclusions affect the CFI specifically, but some also require working with stakeholders (such as universities) or broader consultations, to introduce and/or bring about changes. Many of these conclusions also echo those made earlier in the report:

The CFI should seek extended and increased funding for NOF-type attraction efforts to better compete for HQP internationally. However, the CFI should, in the evaluators assessment affirm its attraction goals as giving equal weight to the goal of keeping Canadian HQP in Canada rather than over-emphasizing obtaining "internationally recognized" HQP (e.g. from high-level foreign universities). This conclusion reflects the evaluators' assessment that "home grown" talent will often be as good or better than that provided by international institutions.

The CFI should promote mechanisms for more efficiently recruiting or repatriating Canadian HQP, particularly from the U.S., after the fashion of a German program which tracks and endeavours to repatriate German scholars who have emigrated (see *Annex A* for details). Such a program could be developed with the cooperation of DFAIT and Canadian universities.

The CFI should develop a mechanism for the refinement of the management process for awards between (and among) the CFI and its institutional partners, including the development of standards and best practices in universities' administration of NOF-type awards. (Several examples of efforts of this type were noted in the UK.)⁸⁴

Research initiatives among key bodies in other jurisdictions such as the UK Research Councils point towards opportunities for the CFI to share research knowledge with other nations who are dealing with the same issues in managing research funding. Partnerships with such agencies should be fully explored by the CFI.

Discussion: For the CFI to pursue such goals with maximum effect, for example, as regards HQP, improved policies need to be pursued in the areas of education and research at the national level. This could call for the CFI to be "at the table" when issues are discussed which affect the CFI's investments in future research infrastructure.

⁸⁴ In the UK, these challenges have been recognized and new ways of dealing directly with university administrations have been considered, most importantly, strategizing and sharing good administrative practices. To this end, the UK Research Council has attempted to create mechanisms "for better universities" to share best practices with those that have a harder time organizing their research administration (through conferences etc.).

6. Conclusions and Recommendations

6.1 Key Conclusions

6.1.1 The NOF Operated as Planned and Was a Very Successful Program

Overview: *In spite of its being a relatively "new" program, the NOF achieved its intended goals and objectives and was highly successful in distributing infrastructure funds to Canadian universities/institutions. Administrative data on costs, including contributions of other funders, and interview and survey data suggest that the NOF did indeed achieve what it initially set out to do. University administrators, PLs and trainees all voiced strong support for the program, as did Provincial representatives. Key indicators of success are provided below:*

- The NOF improved Canadian universities' competitiveness in appointing new faculty, even in the face of strong international competition. The NOF was successfully integrated by universities into their recruitment strategies and significantly raised the level and quality of Canadian university faculty appointments;
- The NOF helped to enhance the infrastructure base for university research;
- The NOF significantly contributed to the production and retention of HQP (post-docs, graduate students and technicians), and provided very high quality training, as attested to by trainees and employers;
- Universities mobilized a vast array of funding partners who provided hundreds of millions of dollars for NOF-funded infrastructure, to aid putting extensive state-of-the-art infrastructure in place;
- Employers who hired NOF graduates pointed to a strong business case for NOF-type programs (a result of exploratory research which should be assessed more thoroughly as CFI programs mature); and,
- The NOF was widely regarded by all participants and stakeholders, including provinces and employers, as providing good value-for-money.

6.1.2 Canada Needs NOF-Type Programs

A Continuing Need: All participants and stakeholders touched by the NOF expressed the view that there was a continuing need for programs such as the NOF. Indeed, even those provinces who were the major co-funders of the NOF strongly supported the value of the NOF, in spite of some dissatisfaction with the extent to which they had been consulted by the CFI.

The National Case for Greater Investments: *The main case for continuing or expanding NOF-type programs and investments is the growth of international competition and the need for Canadian universities to replace faculty over the next 10 years, as aging faculty retire (see AUCC reports). This presents a window of opportunity for Canadian universities to "stock-up" on researchers over the coming years, a strategy which all levels of government should support.*

6.1.3 Improvements for NOF-Type Programs

The need for a NOF-type program should not detract from efforts to improve program efficiency, particularly in streamlined administration and reporting requirements, improved approaches to matching funds, reduced university and CFI administration time for approval of awards, and should be seen in improved satisfaction with NOF-type processes by PLs.

While VPRs and virtually all stakeholder groups viewed the NOF process as worth replicating in similar programs in the future, they did suggest some areas for improvement (e.g. the need for greater co-ordination with the three federal funding agencies, and the CRC, as well as simplification of the application and post-award processes to create a more efficient and streamlined program). As well, positive training impacts were reported by trainees (in skills, employability, etc.), but these could be further improved in order to better attract, retain and train the significant numbers of HQP which will be needed in the next 10 years to maintain and increase Canada's capacity for innovation.

It would also be desirable for CFI to encourage increased access for researchers in the humanities and social sciences and other areas that require infrastructure support. There could be potential advantages in having the CFI partner more closely with universities and others in order to improve the efficiency of program delivery. Improved support for small universities could also be a particularly significant change. Such program improvements will enhance the breadth of the CFI's impacts. As well, a variety of areas were noted where additional research or performance data would have been useful for the NOF -- pointing to future evaluation and research needs. One key area would have been that the evaluation would have been strengthened and made more definitive by additional data on costs and benefits, which could be developed for future evaluations.

6.2 Recommendations

Overview: Recognizing the wide range of stakeholders who invested in the NOF, the evaluators' recommendations address issues of concern to all of these stakeholders. The recommendations are mainly directed to the CFI, although many include the *CFI strengthening* cooperative efforts with the universities, and governments and their agencies. It should be noted that some recommendations are made in areas where the CFI is already endeavouring to bring about improvements, such as coordination with the federal funding agencies. It should also be emphasized that many of the recommendations would require additional administrative resources to be applied by the CFI which, to-date, have been implemented with extremely low administrative costs.

The recommendations begin with those relating to the overall need for, and operation of, future NOF-type programs or investments. These are followed by ways in which the CFI could improve processes and administration, including communications, links to business and targeting and strategic research priorities. Recommendations are also offered regarding CFI's collaborations with the universities, other funding agencies, the provinces, and research and evaluation. We conclude with broad recommendations for the consideration of other stakeholders. References to rationale and data sources supporting the recommendations is provided for each set of recommendations in Annex F, but the data itself is not repeated in detail from the main body of the report.

The evaluators emphasize that while many recommendations for administrative and other improvements of NOF-type programs are offered within a continuous quality improvement framework, the evaluation indicates that the NOF has been highly successful and a program which has set a standard, both nationally and internationally.

Recommendations for the CFI (see Annex F for details)

1. **Expand NOF-Type Programs For Attraction:** Additional funds should be re-targetted to new NOF-type attraction efforts, possibly within the LOF. This would recognize Canada's anticipated need to hire 20,000 new university faculty over the next ten years. This unique window of opportunity to renew the nation's universities and to respond to the growing rate of professors' retirements should be sufficiently funded to allow Canada to remain internationally competitive.
2. **Improve Administrative Processes, by:** reducing the time required for start-up of NOF-type projects; improving proposal evaluation criteria and processing; emphasizing relevance to business, training, financial adequacy of proposals, and improved feedback to non-awardees; simplifying annual reporting; improving maintenance strategies; improving communications/information; building stronger collaborations with and among universities; and enhancing support and recognition for PLs.
3. **Improve Targeting of NOF-Type Programs:** by considering goals of the new Federal S&T policy, and improving access for the social sciences and smaller universities. Such changes may require expanding the eligibility guidelines for infrastructure and modifying the financial formulae for smaller institutions.
4. **Build More Competitive Processes Between Universities:** Noting the international trend to greater competition among universities for research funding, the CFI should modify its block NOF-type allocations to universities to increase competition for NOF-type grants. This could be achieved with a sliding "floor" for historic allocations for universities, perhaps 90% for larger universities, to 95% for smaller universities, with the balance of funds in a pool for open competition.
5. **Better Coordinate Applications with Funding Agencies:** The CFI should continue to seek comprehensive coordination with the three federal funding agencies. Current initiatives to coordinate applications should lead to a much higher level of co-application processing, with improved results for researchers, utilization of infrastructure, and training of HQP.
6. **Strengthen Provincial Consultation for Future Programs:** The CFI should enhance its processes for consultation with Provinces in the future. CFI could achieve this goal by establishing an ongoing informal discussion or advisory group with the Provinces (after the model of the CFI's Stakeholder Advisory Network). This could greatly improve the way CFI and provincial goals intertwine (e.g. in the matching of funds).
7. **Build CFI Research and Evaluation Capacity** through longer-term evaluations; expanded benchmarking (noting the need to moderate reporting demands placed on PLs); new collaborations with Statistics Canada, improved leveraging of research by academia; strengthened international research collaboration; and strengthened internal CFI research and evaluation capacity.

Recommendations for CFI Stakeholders

8. **Universities and Their Associations** should respond to this report, and discuss ways in which collaborative efforts with CFI and among universities (perhaps through AUCC or CAUBO or CAURO) might aid in the refinement of processes for future NOF-type programs (reducing time delays in establishing infrastructure, enhance PL satisfaction, etc.)
9. **The Provinces** should review implications of the evaluation with the CFI, to identify ways in which future NOF-type programs could be implemented in a more effective and efficient manner. *This might be accomplished through an informal discussion or advisory group which the provinces or the CFI could convene periodically, perhaps with officials at the ADM level.*
10. **The Federal Government** should consider: New Funding for Attraction Efforts, harmonizing Federal and Provincial S&T Priorities to aid CFI's response to both levels of government; and enhancing the HQP programs outlined in the Federal S&T Strategy, including increased funding for graduate students and post-docs to ensure Canada's competitiveness with nations which have emphasized and strengthened HQP programs.

