

**OVERALL PERFORMANCE EVALUATION OF
THE CANADA FOUNDATION FOR INNOVATION**

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LIST OF ACRONYMS

APCF	Automotive Partnership Canada Fund
BBMD	Bell Browne Molnar & Delicate Consulting Inc.
C2MI	Centre de Collaboration MiQro Innovation
CAMS	CFI Award Management System
CFI, the	The Canada Foundation for Innovation
CIHR	Canadian Institutes of Health Research
CIIF	College-Industry Innovation Fund
CLS	Canadian Light Source
CREAIT	Core Research Equipment and Instrument Training Network
CRKN	Canadian Research Knowledge Network
HQP	Highly qualified personnel
IOF	Infrastructure Operating Fund
IP	Intellectual property
JELF/LOF	John R. Evans Leaders Fund (Leaders Opportunity Fund)
LEF/NIF	Leading Edge Fund/New Initiatives Fund
MSI	Major Science Initiatives
NSERC	Natural Sciences and Engineering Research Council of Canada
O & M	Operating and maintenance
OMS	Outcome Measurement Study
OPE	Overall Performance Evaluation
OPEA	Overall Performance Evaluation and Value-for-Money Audit
PDF	Postdoctoral Fellow
PERAF	Performance, Evaluation, Risk and Audit Framework
PL	Project Leader
POMS	Platform Outcome Measurement Study
PPR	Project Progress Report
PU	Principal User
R&D	Research and development
RHF	Research Hospital Fund
S&T	Science and technology
SEIA	Socio-Economic Impact Assessment
SNOLAB	Sudbury Neutrino Observatory laboratory
SRP	Strategic Research Plan
SSHRC	Social Sciences and Humanities Research Council
TRAAM	Tool for Risk Assessment and Management
VFMA	Value-for-Money Audit

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KEY MESSAGES/HIGHLIGHTS

This Overall Performance Evaluation responded to the requirement in the Canada Foundation for Innovation's (CFI) 2010 Funding Agreement that the Foundation carry out an evaluation of its activities and projects. The objective of the evaluation was to "measure the overall performance of the Foundation in achieving the objectives of its Activities". Activities are defined as "the providing by the Foundation of grants to Ultimate Recipients to support Eligible Projects".

To answer the evaluation questions, information was gathered through a review of corporate documents, a meta-analysis of the CFI's Outcome Measurement Studies (OMS) and other relevant studies, an analysis of Project Progress Reports (PPR) submitted for funded projects as well as project-level administrative data, interviews with key informants (representing institutions, provinces, other funding agencies, and the CFI Board and management), and a survey of project leaders and principal users.

Relevance – Continued Need: During the evaluation period 2009-2013, the CFI clearly met a continued need, and its mandate, role and approach to doing so are acknowledged and appreciated by stakeholders throughout the research support ecosystem and the research and development (R&D) communities. Given the broad range and ongoing nature of needs and changes in the context, the observation was made that the CFI should continue to remain attuned and responsive to the needs and expectations of its range of stakeholders, as well as to any shifts or changes in the landscape of the research support ecosystem.

Performance – Achievement of Expected Outcomes: The CFI continued to build upon its earlier successes and had strong performance for each of the outcomes in its logic model and for each of the Expected Results in the 2010 Funding Agreement. This included both long-term outcomes - research and technology development at recipient institutions, as well as knowledge and technology transfer to end users - and the outcomes leading up to them. A recommendation was made that, to help make its already strong performance story even stronger, the CFI should consider adding to its logic model outcomes that more directly align with the Expected Results in its funding agreements and that reflect what the CFI achieves for other stakeholders, not just for recipient institutions.

Performance – Demonstration of Efficiency and Economy: The CFI has a proven track record of efficiency and economy over many years. Further, its design and delivery, and overall business model, were strongly endorsed by stakeholders across the research support ecosystem. Its merit-review process and its stakeholder consultation approach were especially highly valued. These have enabled the CFI to adapt to changing priorities, as reflected in its Funding Agreements, while remaining true to its mandate and its focus on excellence. Several issues related to challenges, barriers and opportunities for improvement were raised as being important for institutions and the CFI. Most are already being addressed. However, the OPE team made an observation emphasizing the importance of the CFI's advocacy agenda, especially with regard to the CFI continuing to advocate for long-term stable funding for its support to enhancing the capacity of institutions, as well as its own ongoing operations. The OPE team also made another observation highlighting that the CFI should continue to stay abreast of the larger picture of funding needs and funding gaps through use of its strong ongoing stakeholder engagement and interactions with the federal funding agencies.

EXECUTIVE SUMMARY

BACKGROUND

The Canada Foundation for Innovation (CFI) was created in 1997 for the purpose of making research infrastructure grants to strengthen the capacity of Canadian universities, colleges, research hospitals, and non-profit research institutions to carry out world-class research and technology development. Of the \$5.490 billion in funding the CFI has received from the Government of Canada during its history, \$1.250 billion was provided between 2009 and 2013.

The CFI funds priority research infrastructure needs identified by eligible institutions across all research disciplines, as well as across a wide range of types of infrastructure. Up to 40% of the capital costs of these projects are funded by the CFI; the balance comes from recipient institutions and their partners, such as provincial governments and the private sector.

The 2010 Funding Agreement included an expectation that the funding of research infrastructure would enhance the capacity of Ultimate Recipients to:

- (a) attract and retain the world's top research talent;
- (b) enable researchers to undertake world-class research and technology development that lead to social, economic and environmental benefits for Canada;
- (c) support private sector innovation and commercialization; and,
- (d) train the next generation of researchers.

EVALUATION MANDATE, OBJECTIVES AND SCOPE

This Overall Performance Evaluation responded to the requirement in the CFI's 2010 Funding Agreement that the Foundation carry out an evaluation of its activities and projects. The objective of the evaluation was to "measure the overall performance of the Foundation in achieving the objectives of its Activities". Activities are defined as "the providing by the Foundation of grants to Ultimate Recipients to support Eligible Projects".

As per the CFI's Performance, Evaluation, Risk and Audit Framework (PERAF), the evaluation examined three of the five core evaluation issues specified in the Treasury Board's Directive on the Evaluation Function. The three issues are: Relevance – Continued Need For Program; Performance – Achievement Of Expected Outcomes; and Performance – Demonstration Of Efficiency and Economy. The two other core issues – Alignment with Government Priorities and Alignment with Federal Roles and Responsibilities – are being evaluated by Industry Canada in a separate evaluation.

The OPE focused on the period from 2009 to 2013. However, given the elapsed time that occurs between implementing research and development (R&D) infrastructure and realizing outcomes, a meaningful analysis meant looking at funding awarded prior to the 2010 Funding Agreement. This funding came from earlier funding programs, under the Consolidated Funding Agreement, for which projects continued and/or outcomes were realized during the 2009 to 2013 time period of this evaluation.

The OPE team began by reviewing and synthesizing existing materials. Evidence was gathered by means of: a Review of Corporate Documents; a Meta-analysis of Outcome Measurement Studies (OMS) and Other Studies; and an Analysis of Project Progress Reports (PPR) and Administrative Data. The evidence gathered through these methods influenced the choice, design and tools used for the collection of additional data. These methods consisted of: Key Informant Interviews; and Survey of Project Leaders and Principal Users (PLs/PUs).

CONCLUSIONS AND RECOMMENDATIONS

Relevance – Continued Need

The evaluation team concludes that the CFI has met a continued need, and its mandate, role and approach to doing so are acknowledged and appreciated by stakeholders throughout the research support ecosystem and the R&D communities. The importance of continuing to do so, given the broad range and ongoing nature of needs and changes in the context, leads to the following observation.

Observation 1: As it is now doing, the CFI must continue to remain attuned and responsive to the needs and expectations of stakeholders, including Ultimate Recipients, other funders and end users including the private sector, as well as to any shifts or changes in the landscape of the research support ecosystem, that may affect the achievement of overall R&D outcomes, the CFI's contribution to them, and the CFI's approaches to addressing them.

Performance – Achievement Of Expected Outcomes

Overall, during the evaluation period, the CFI continued to build upon its earlier successes and has had strong performance for each of the outcomes in its logic model and for each of the Expected Results in the 2010 Funding Agreement. This included research and technology development and underlying research and development capacity at recipient institutions, as well as knowledge and technology transfer to end users. The 2010 Funding Agreement made the linkage with the private sector more explicit through its inclusion in the Expected Results (i.e., reference to private sector innovation and commercialization), and allocation of funding to what was launched as the College-Industry Innovation Fund (CIIF). For this OPE, it was still early days in terms of expecting or assessing progress on outcomes from the CIIF. At the same time, this is not a new area for either institutions or the CFI, as there has been an indirect linkage to end users (including the private sector) over many years, embedded in institutions' knowledge and technology transfer activities.

Making the Expected Results more visible and the CFI's performance story even stronger leads to the following recommendation.

Recommendation 1: In developing its next Performance, Evaluation, Risk and Audit Framework (PERAF), the CFI should consider including all aspects of the Expected Results in its funding agreements in the logic model, performance measurement framework and evaluation framework. Further, the CFI should consider adding to its logic model some immediate outcomes which go beyond "enhancing capacity" of recipient institutions, and

add what the CFI achieves for its other stakeholders as well. Such outcomes could be derived from aspects now in the CFI's Strategic Roadmap.

Performance – Demonstration Of Efficiency and Economy

The CFI has a proven track record of efficiency and economy over many years. Further, its design and delivery, and overall business model, were strongly endorsed by stakeholders across the research support ecosystem. Its merit-review process and its stakeholder consultation approach were especially highly valued. These have enabled the CFI to adapt to changing priorities, as reflected in its Funding Agreements, while remaining true to its mandate and its focus on excellence. Several issues, many of them ongoing and addressed in the CFI's corporate risk profile, are important for institutions and the CFI. Three of these issues would appear to warrant special attention..

- Need for long-term stable funding for the CFI's support of Ultimate Recipients;
- Ongoing operational funding for the CFI beyond the current approximate five-year window;
- The scope and amounts of funding currently available throughout the research support ecosystem, for the full range of capital and operating requirements, including those for research infrastructure.

This leads to OPE team to make observations.

Observation 2: The CFI's advocacy agenda is important and the CFI should continue to advocate for long-term stable funding for its support to enhancing the capacity of institutions, as well as for its own ongoing operations.

Observation 3: Linked to our first observation, the CFI should continue to stay abreast of the larger picture of funding needs and funding gaps through its strong ongoing stakeholder engagement and interactions with the federal funding agencies.

1. INTRODUCTION

This report presents the results of the Overall Performance Evaluation (OPE) of the Canada Foundation for Innovation (the CFI) conducted during the period September 2013 to November 2014. The OPE is part of the Overall Performance Evaluation and Value-for-Money Audit (OPEA) commissioned by the CFI's Board of Directors to meet its obligations under its 2010-11 to 2016-17 Up-Front Multi-Year Funding Agreement with the Government of Canada (hereafter referred to as the 2010 Funding Agreement). The Value-for-Money Audit (VFMA) was prepared and submitted as a separate report.

The requirement for the OPE is stipulated in Section 5.5.2 of the 2010 Funding Agreement. It was to be an evaluation of the CFI's activities and projects, and "measure the overall performance of the Foundation in achieving the objectives of its Activities". It was also to be carried out according to the CFI's Performance Evaluation Risk and Audit Framework (PERAF) and the report is to be made public and a copy sent to the Minister of Industry.

The OPE was conducted by Bell Browne Molnar & Delicate Consulting Inc. (BBMD), with guidance provided by a Steering Committee and support provided by the CFI's Evaluation and Outcome Assessment group.

To provide context for the reader of this evaluation report, a brief profile of the CFI is provided in the next section. More information about the CFI can be found on its website www.innovation.ca.

Section 3 goes on to describe the evaluation in more detail. The next three sections review the findings for each of the major focus areas of the evaluation. Findings related to Relevance – Continued Need are presented in Section 4; those related to Performance – Achievement of Expected Outcomes are in Section 5; and those for Performance – Demonstration of Efficiency and Economy are in Section 6.

Findings are summarized, and conclusions and recommendations are given in Section 7.

2. ABOUT THE CANADA FOUNDATION FOR INNOVATION

2.1 Background

The CFI was created in 1997 for the purpose of making research infrastructure grants to strengthen the capacity of Canadian universities, colleges, research hospitals, and non-profit research institutions to carry out world-class research and technology development. Initial funding allocated to the CFI in 1997 was \$800 million; a further \$4.690 billion was allocated in subsequent federal budgets (1999, 2000, 2003, 2006, 2007, 2009, 2012, 2013) and via Bill C-17 in 2001. Of the grand total of \$5.490 billion, \$1.250 billion was provided between 2009 and 2013.

The terms and conditions under which the CFI administers and invests the funds received from the Government of Canada are captured in two funding agreements and one contribution agreement:

- Consolidated Funding Agreement, for funds allocated during the period 1997 to 2009. This includes the original funding agreement and eight amendments. A total of \$4.3 billion in allocations is covered by this funding agreement;
- 2010 Funding Agreement (i.e., Up-Front Multi-Year Funding Agreement) for \$600 million; and,
- 2014 Contribution Agreement for \$499.85 Million in connection with the 2012 Budget announcement.

Each funding agreement has specific objectives and expected results for the CFI.

There are five main categories of federal extramural academic research support. The CFI makes a specific and unique contribution to the first category related to infrastructure.

- Infrastructure and its operation and maintenance
 - The CFI is the main provider of federal funding.
- Direct Support for Research
 - This includes what are referred to as operating grants (covering variable eligible expenses including, but probably not limited to, trainees, research staff, consumables etc.).
 - The tri-council¹ and Genome Canada are the main federal funders.
 - Some is also delivered through tri-agency funding programs (e.g. Networks of Centres of Excellence (NCE)).
- Direct Salary Support for Researchers
 - The tri-council (including tri-agency programs i.e. CRC, CERC) is the main federal funder.
- Direct Support for Research Trainees
 - The tri-council (including tri-agency programs i.e. Canada Graduate Scholarship Program, Vanier, Banting) is the main federal funder.
- Indirect Costs of Research
 - The tri-agency through the Indirect costs program is the main federal funder

In addition, institutions, provinces, and not-for-profit foundations provide support to varying degrees across these five main categories.

2.2 Objectives and Expected Results

The objectives of the CFI, as defined in the funding agreements, have evolved since 1997. The Expected Results in the 2010 Funding Agreement are that the CFI "enhance the capacity of ultimate recipients to:

¹ The tri-council comprises Natural Sciences and Engineering Research Council of Canada (NSERC), Social Sciences and Humanities Research Council (SSHRC), and Canadian Institutes of Health Research (CIHR)

- Attract and retain the world's top research talent;
- Enable researchers to undertake world-class research and technology development that lead to social, economic and environmental benefits for Canada;
- Support private sector innovation and commercialization; and
- Train the next generation of researchers."

These Expected Results have similar intent but some differences in emphasis compared to the National Objectives outlined in the earlier funding agreement. The National Objectives are to "enhance of the capacity of ultimate recipients to:

- Increase Canada's capacity to carry out world-class scientific research and technology development;
- Expand research and job opportunities through research infrastructure for the development of highly qualified personnel;
- Promote productive networks and collaboration among Canadian post-secondary educational institutions, research hospitals and the private sector; and
- Support economic growth, job creation, as well as health and environmental quality."

The CFI's cross-walk between the Expected Results in the 2010 Funding Agreement and the National Objectives in the earlier funding agreement is shown in Appendix 1. Similar Objectives and Expected Results are contained in the 2014 Contribution Agreement.

The CFI's current logic model is shown in Appendix 2. This logic model depicts how the CFI contributes to the achievement of ultimate impacts, long-term outcomes, intermediate outcomes and immediate outcomes, through the activities it undertakes and the outputs it produces. It should be noted that the CFI "enhances the capacity" of recipients (shown as a layer in the logic model) to achieve the outcomes. Also, since the development of the logic model preceded the 2010 Funding Agreement, the activities, outputs and outcomes in the logic model are tied to the National Objectives.

During 2011, the CFI updated its strategic plan. The plan – *CFI Strategic Roadmap 2012-17* – was finalized in 2012 and lays out the directions that CFI has adopted to meet the challenges of the economic environment and to help boost Canada's capacity for innovation. An overview of the Roadmap is shown in Appendix 3.

2.3 Funding Model and Funds

The CFI funds priority research infrastructure needs identified by eligible institutions across all research disciplines, as well as across a wide range of types of infrastructure. Support ranges from projects to attract or retain leading researchers, to team-led innovative projects that have a structuring effect for an institution or a region, and large-scale national projects.

Only eligible institutions, and not individual researchers, can submit proposals to the CFI. A prerequisite for submitting a proposal is an institutional Strategic Research Plan (SRP) that has been submitted to the CFI. Proposals must be aligned with the institutional SRP.

Selection of proposals is through a merit-based review process (which varies depending upon the specific fund). Up to 40% of the capital costs of these projects are funded by the CFI; the balance comes from recipient institutions and their partners, such as provincial governments and the private sector.

As an independent foundation, the CFI is able to fund multi-year capital investments in research facilities and equipment independently of the government's annual appropriation cycle.

Since its inception, the CFI has designed and managed sixteen (16) funds. Over the years, the funding architecture has changed to reflect institutional and government priorities and the expected results or objectives in the CFI's funding agreements.

Between 2009-10 and 2012-13 the CFI had six funds from which awards were made. Three of these were introduced in 2009-10 or 2010-11. Four of the funds are focused on supporting capital costs:

- **Leading Edge Fund/New Initiatives Fund** (LEF/NIF) – capital costs – invests in innovative infrastructure projects that sustain and enhance areas of activity in which the CFI has already invested and provide support to explore promising new research directions.
- **John R. Evans Leaders Fund (Leaders Opportunity Fund)** (JELF/LOF) – capital costs – helps universities attract or retain world-class researchers by funding infrastructure to enable cutting edge research. In June 2013, the CFI changed the name of the Leaders Opportunity Fund to the John R. Evans Leaders Fund. References to the JELF are interchangeable with references to the LOF.
- **College-Industry Innovation Fund** (CIIF) – capital costs – funds state-of-the-art, industry-relevant research infrastructure to foster partnerships between colleges and the private sector. (Introduced in 2010-11.)
- **Automotive Partnership Canada Fund** (APCF) – capital costs – funds research infrastructure in support of collaborative research and development (R&D) intended to benefit the Canadian automotive industry under the umbrella of the Automotive Partnership Canada led by the Natural Sciences and Engineering Research Council of Canada (NSERC). (Introduced in 2009-10.)

The two funds focused on supporting operating and maintenance (O&M) costs are:

- **Infrastructure Operating Fund** (IOF) – funds a portion of the operating O & M costs of CFI-funded infrastructure.
- **Major Science Initiatives** (MSI) – contributes to the O & M costs of CFI-funded large scale research facilities. (Introduced in 2010-11.)

As well, there were funds such as the Research Hospital Fund (RHF), from which disbursements were made for projects awarded prior to 2009-10.

2.4 Governance, Organization and Resources

The CFI was established as an independent, non-governmental organization with a Board of Directors. The Board of Directors reports to Members. Members form a higher governing body similar to a company's shareholders, but representing the Canadian public. Members receive audited financial statements, appoint auditors, and approve the annual report at their annual meeting. In addition, a widely publicized annual public meeting is held each year.

The Board of Directors is made up of 13 individuals, six of whom are appointed by the Government of Canada and seven of whom are appointed by the Members. It meets three to four times per year. Its responsibilities include making final decisions on the portfolio of projects to be funded², setting strategic objectives, approving annual plans and objectives, reviewing outcomes, reviewing issues from a risk management perspective, and setting the CFI's overall compensation policy and management compensation. There are three committees of the Board – Audit and Finance Committee, Investment Committee, and Governance and Nominating Committee.

The CFI itself has approximately 70 staff. Under the President and CEO, there are three groups – Programs and Planning, Finance and Corporate Services, and External Relations and Communications – each led by a Vice-President. The CFI's organization chart is shown in Appendix 4.

The CFI's own operating costs during the period from 2009-10 to 2013-14 ranged from approximately \$12.5 million to \$14.1 million per year.

² The Board carefully reviews the process followed in arriving at the recommendations and typically relies upon the recommendations that come from the bodies involved in the merit-based project selection process.

3. ABOUT THE OVERALL PERFORMANCE EVALUATION

3.1 Objective and Scope, including Evaluation Issues and Questions

This Overall Performance Evaluation responded to the requirement in the CFI's 2010 Funding Agreement that the Foundation carry out an evaluation of its activities and projects. The objective of the evaluation was to "measure the overall performance of the Foundation in achieving the objectives of its Activities". Activities are defined as "the providing by the Foundation of grants to Ultimate Recipients to support Eligible Projects". Both Ultimate Recipients and Eligible Projects have precise definitions (see Appendix 5) in the 2010 Funding Agreement. For the CFI, the "objectives of its Activities" are the Expected Results from its 2010 Funding Agreement cross-walked to the National Objectives in the CFI logic model, as shown in Appendix 1.

As per the CFI's PERAF, the evaluation examined three of the five core evaluation issues specified in the Treasury Board's Directive on the Evaluation Function. These issues and related questions are shown in Appendix 6.

- Relevance – Core Evaluation Issue #1: Continued Need For Program
 - Assessment of the extent to which the CFI continues to address a demonstrable need and is responsive to the needs of Canadians
- Performance – Core Evaluation Issue #4: Achievement Of Expected Outcomes
 - Assessment of progress toward expected outcomes (immediate, intermediate and ultimate) with reference to performance targets, program reach and program design, including linkage and contribution of outputs to outcomes
- Performance – Core Evaluation Issue #5: Demonstration Of Efficiency and Economy
 - Assessment of resource utilization in relation to the production of outputs and progress towards expected outcomes.

The two other core issues – Alignment with Government Priorities and Alignment with Federal Roles and Responsibilities – are being evaluated by Industry Canada in a separate evaluation.

The OPE focused upon the period from 2009 to 2013. However, given the elapsed time that occurs between implementing R&D infrastructure and realizing outcomes, a meaningful analysis meant looking at funding awarded prior to the 2010 Funding Agreement. This funding came from earlier funding programs, under the Consolidated Funding Agreement, for which projects continued and/or outcomes were realized during the 2009 to 2013 time period of this evaluation.

3.2 Approach and Methods

The overall approach to the OPE consisted of three phases – start-up, planning and development of tools and templates; data collection and synthesis by method; and analysis and reporting. In conducting the three phases, the evaluation team sought to build and then draw findings from a robust body of evidence gathered through multiple methods and data sources,

make use of and leverage previous work to the extent possible, and coordinate activities with the Value-for -Money Audit component of the OPEA, where possible and beneficial.

Based upon this overall approach, the evaluation team began by reviewing and synthesizing existing materials. Evidence was gathered by means of: a Review of Corporate Documents; a Meta-analysis of Outcome Measurement Studies (OMS) and Other Studies; and an Analysis of Project Progress Reports and Administrative Data. The evidence gathered through these methods influenced the choice, design and tools used for the collection of additional data. These methods consisted of: Key Informant Interviews; and Survey of Project Leaders and Principal Users (PLs/PUs). Each of the methods is briefly described in the following sub-sections.

3.2.1 Review of Corporate Documents

The review of corporate documents was an important source of information, especially to address the core issue of "Continued Need for the Program" related to Relevance, as well as to provide contextual information. The review of corporate documents focused upon the CFI funding agreements, annual corporate plans, annual reports, and other documents such as the PERAF and the Strategic Roadmap.

3.2.2 Meta-Analysis of Outcome Measurement Studies (OMS) and Other Studies

The Outcome Measurement Studies (OMSs) conducted by the CFI were an important source of data for the evaluation, especially related to effectiveness (i.e., achievement of expected outcomes). Each of the 28 OMSs examined a particular theme at an institution, and as such considered a number (typically 10 to 20) of projects, involving a number of Project Leaders and Principal Users, funded often from different CFI funds and other sources, over a period of time. For each OMS, institutions prepared institutional reports. An independent Expert Panel then conducted a site visit and produced an Expert Panel report for each OMS case.

The first sixteen OMS cases were analyzed in the 2010 OPEA report and information from that report was brought into the meta-analysis. More detailed information was extracted from the Expert Panel reports for the most recent twelve OMS cases completed in late 2009, 2010 and 2011. Information was mapped to the relevant evaluation questions and issues for this OPE. A similar process was followed to bring several other studies/reports³ into the meta-analysis.

3.2.3 Analysis of Project Progress Reports and Administrative Data

Annual project progress reports are used by the CFI to collect data on the implementation, operation and maintenance of the funded infrastructure, and the results of funded projects and their linkages to the attraction and retention of researchers, development of highly qualified

³ Platform Outcome Measurement Study of the Canadian Research Knowledge Network; Pilot Socioeconomic Impact Analysis of CFI and CIHR Funding: Medical Imaging R&D; and CFI study titled *Understanding the role of CFI-funded infrastructure in intersectoral linkages*.

personnel (HQP), formation of research partnerships and collaborations, conduct of research and development, and knowledge and technology transfer.

The analysis of data from these project progress reports provided information especially useful to address the core issue of "Achievement of Outcomes". Analyses were carried out on the annual project progress reports submitted to the CFI between 2008-09 and 2012-13 for infrastructure projects funded under the CFI's LEF/NIF and JELF. Separate analyses were done so that results for the 177 larger and more complex LEF/NIF projects included in the analysis were not obscured by the results for the 2,422 JELF projects.

The questions asked in the project progress reporting questionnaire were aligned to the performance indicators in the OPE evaluation matrix. The analysis for each performance indicator then looked at the breakdown of project data by reporting year with the intent of comparing results for projects at comparable points in their implementation and operation. This approach recognized the time required to ensure equipment is functioning correctly and calibrated as well as the time required to generate and analyze data before any research outputs can be reported. The alternative approach, of comparing results by fiscal year, was not used because the data for each fiscal year would contain a mix of projects of different ages and thus disguise the trends in performance over the initial life cycles of the funded projects.

3.2.4 Key Informant Interviews

Key informant interviews were conducted with selected respondents across a number of stakeholder groups. The interviews for each stakeholder group focused upon gathering information to fill gaps and/or validate information from the previously described methods. Interviews with sixty-two key informants were completed, distributed as follows:

- Canada Foundation for Innovation – 12 interviews with CFI Board Directors (current and previous), CFI President and Vice-Presidents and CFI Directors;
- Institutions – 28 interviews with Presidents, Vice-Presidents of Research, and heads of Industrial Liaison Offices at 17 universities, 2 research institutions and 3 colleges;
- Provinces – 8 interviews with representatives from 8 provinces;
- Federal funding agencies – 4 interviews with NSERC, Social Sciences and Humanities Research Council (SSHRC), Canadian Institutes of Health Research (CIHR) and Genome Canada;
- Government of Canada – 2 interviews with Industry Canada; and
- Private sector and other end users – 8 interviews.

3.2.5 Survey of Project Leaders and Principal Users

An online survey gathered feedback from the users of the CFI-funded infrastructure. As such the survey included both Project Leaders (PLs) and Principal Users (PUs). The survey consisted of key questions pertaining to the impacts of CFI-funded infrastructure in several areas (e.g., attraction and retention, research excellence, socio-economic impacts) as well as on certain other evaluation/audit issues (e.g., design and delivery). Several questions were included from the

survey conducted for the previous OPEA so that comparisons could be made between the two points in time.

The survey included all PLs and PUs associated with all approved projects for the following funds and years: LEF/NIF: 2006, 2009 and 2012; and JELF: 2006-2012. While the OPE focused on the 2009 to 2013 period, it was recognized that it would be necessary to include projects that were approved in prior years, so that sufficient time would have passed for benefits/impacts to materialize.

Just over 6000 invitations were sent to PLs and PUs to participate in the online survey. The overall response rate was 25% (1,470 responses) which exceeded the target response rate of 20%, which was achieved for the survey in the previous OPEA. The response rates were 31% for those who were only PLs, 17% for those who were only PUs, and 26% for those who were both (i.e., PLs who were also PUs but on different projects).

3.3 Limitations

Most evaluations face constraints that may have implications for the validity and reliability of evaluation findings and conclusions. This section lists the limitations in the design and methods for this particular evaluation. Further discussion of these limitations and associated mitigation strategies is provided in Appendix 7.

- Analysis of Project Progress Report data: There were changes made by the CFI to the project reporting requirements for the 2011-12 reporting year, with reporting starting after the infrastructure funded by a project becomes operational, rather than when the award is finalized. In addition, modifications were made to some questions in 2011-12. This affected the comparability of data for some questions in the reporting questionnaire pre- and post-changes. As a result, the evaluation team analyzed and reported some data separately.
- Key informants Interviews: Key informants for interviews were selected across a range of stakeholder categories in order to reflect the stakeholder community rather than to be a representative sample. Depending upon their stake in the CFI, for example, representing a recipient institution, their responses may be positively biased towards the CFI.
- Survey of PLs/PUs: The survey repeated some questions from the survey conducted as part of the previous OPEA. In a few instances, the wording of the questions from the previous OPEA survey was changed in order to improve clarity or to address a specific research issue; these changes and the implications for the comparisons are noted in the relevant sections of the report.
- Financial data at the level of outputs and outcomes was not available, since it is not mapped by the CFI to the outputs and outcomes in its logic model. Such a mapping is also not considered appropriate since the CFI's business cycles are driven by its periodic funding agreements and funding programs therein rather than by annual transactional activities. As a result, questions related to efficiency and economy were considered more in whole-of-the-CFI context and more qualitative evidence was gathered.

While not strictly a limitation, the reader should note that the rating scales used in different data sources were not always consistent. For example, a rating of "important" in data from the OMS studies may be on a different scale than a rating of "important" in a PPR or in the PL/PU survey. In the analysis in this report, no attempt was made to make the rating scales consistent.

4. FINDINGS FOR EVALUATION ISSUE – CONTINUED NEED

4.1 Demonstrable Need

Evaluation Question: Does the CFI's mandate continue to address a demonstrable need?

Findings: The CFI's mandate, basically unchanged since the CFI's creation in 1997, has continued to address a demonstrable need, up to the present and into the foreseeable future. It is tied to supporting, building and applying the knowledge base essential for a sustainable and competitive economy. Data collected in this OPE suggest that investment in research infrastructure and the CFI's role in it are considered to be crucially important parts of the research support ecosystem, and that requests from institutions for CFI support will continue unabated into the future.

The CFI's mandate is "to make grants to eligible (ultimate) recipients for eligible projects to increase Canada's capability of carrying on high quality research". This mandate was initially stated in the *Budget Implementation Act, 1997* in section 5 on the Objects and Purposes of the Foundation. It was restated in the CFI's original Funding Agreement in 1997 and remained unchanged through eight amendments up to 2009, and continued unchanged (with the exception that eligible recipients became ultimate recipients) in the 2010 Multi-Year Funding Agreement.

The original rationale for the creation of the CFI and its mandate was to address a demonstrable need. The 1997 Budget Plan stated that, "The ability of Canadians to carry out leading edge research and technology development will depend not only on their research skills, but also on increasingly sophisticated infrastructure". It also noted that the "research facilities at many Canadian universities and research hospitals have not been keeping pace with the demands of world-class research and higher education, and require new investment". Further it suggested outcomes, such as attraction and retention, highly qualified graduates and integrated systems of research and research infrastructure, that resonate with the key objectives today.

The 2010 OPEA emphasized the "strong continuing need for, and continued relevance of the CFI". It also noted "... strong need for new and/or upgraded projects and facilities (with both high technical and operational capabilities) in order for Canadian research to stay competitive with global efforts."

The importance of "excellence in science, technology and innovation" in driving success in the 21st century was also emphasized in the opening paragraph of the 2012 State of the Nation

report produced by the Science, Technology and Innovation Council, entitled *Canada's Science, Technology and Innovation System: Aspiring to Global Leadership*.

Key informants interviewed for this OPE, and coming from institutions, provincial jurisdictions, other federal funding agencies, and the CFI itself, noted the importance of and need for funding, both of capital and O&M, for research infrastructure. They pointed out that across all sectors, demand for infrastructure and hence infrastructure funding exceeds available funding. They also noted that funding pressures have increased in a number of provinces, due to fiscal restraint and/or provincial funding priorities.

Many of the respondents to the PL/PU survey, who provided comments, also identified the ongoing demand for funding for infrastructure acquisition, renewal, and operations and maintenance. The PPR analysis of LEF/NIF and JELF projects showed that renewal needs are ongoing. As is discussed in sections 5.1.1 and 5.14, over time both the quality and useful life of CFI-funded infrastructure was reported to decrease. Further, as the infrastructure base upon which the CFI has a footprint has increased over the years, there is an increasing ongoing cost to the operations and maintenance funds, as well as renewal. This was recognized in the 2010 Funding Agreement which states that the monies allocated to the LEF/NIF were for a new competition "with the primary focus on keeping previous investments of the Foundation leading edge".

Respondents to the PL/PU survey confirmed that they anticipate continuing to look towards the CFI to support infrastructure funding. Findings suggest that a substantial level of requests from institutions could be anticipated over the next five years. For example, 59% of respondents indicated that, during the next five years, their institution would likely ("definitely" or "probably") submit an application to the CFI for renewal of infrastructure. 71% indicated that their institutions would likely submit an application for new infrastructure. While these findings are the opinions of individual researchers who were respondents to the survey, they represent a total of 120 unique institutions. Almost all of these institutions had at least one PL/PU who anticipated that their institution would submit an application to the CFI over the next five years.

4.2 Responsiveness to Needs

Evaluation Question: Is the CFI responsive to the needs of the R&D community?

Findings: Within the boundaries set by its mandate and its 2010 Funding Agreement, the CFI has been responsive to needs of the R&D community. It has implemented the 2010 Funding Agreement as well as reviewed and adjusted funds and competitions based upon consultations. It has also continued to apply its independent merit-review processes to competitions. However there are a number of needs that fall outside of the coverage of the 2010 Funding Agreement and still others that fall outside the mandate of the CFI. Such needs, while remaining unfilled, may affect achievement of overall R&D outcomes, and point to the importance of the CFI's ongoing stakeholder engagement and interactions with other federal funding agencies.

During the evaluation period, the CFI implemented the 2010 Funding Agreement, and continued to implement its previous funding agreement (with amendments). The 2010 Funding Agreement

contains an Expected Results statement, as well as a specification of funds and dollars allocated to each. The Expected Results statement appears to be strongly influenced by the three Advantages in the S&T Strategy. For example, "attract and retain the world's top research talent" maps to the People Advantage and Knowledge Advantage, while "support private-sector innovation and commercialization" maps to the Entrepreneurial Advantage. The specification of funds lists the LOF (JELF), LEF/NIF, IOF and MSI funds and dollar allocations to each of these, as well as an allocation to what was set up as the College Industry Innovation Fund (CIIF).

The 2010 Funding Agreement, therefore, set out boundaries for the CFI in terms of the scope of the needs of the R&D community to which the CFI is expected and funded to respond. Within these boundaries, the CFI has a suite of funds responding, as described in section 2.3, to both capital and O&M funding needs. In addition to the funds supporting capital expenditures, the need for O&M funding has been addressed through the IOF which provides O&M funding support for projects funded from LEF/NIF, JELF and CIIF.

The MSI fund was implemented to support O&M expenditures for major national facilities. Key informants and the recent audit report of the MSI suggest that sustainability of the MSIs remains an issue, and that only a limited number of such initiatives are now receiving funding. Sustainability and institutional capacity related to major initiatives (including MSIs) are both institutional/operational risks in the CFI's corporate risk profile.

During the period under evaluation, the CFI has made adjustments to the specified funds to respond to stakeholder needs. For example, based upon stakeholder consultation, in 2010-11 the JELF was adjusted to aid smaller institutions with attraction and retention. The LEF/NIF was reviewed following the 2009-10 competition in consultation with stakeholder groups. The development of the MSI fund involved consultation with the stakeholder community and Industry Canada. Further, the development of the CIIF included consultations with stakeholders such as colleges, college associations and provinces and territories in order to ensure alignment.

The independent merit-review processes employed by the CFI in its competitions were noted by many key informants as an important response by the CFI to the needs of the R&D community. In fact, the merit-review process was widely praised in terms of promoting excellence and ensuring fairness and transparency. It was considered to be a major strength of the CFI's project selection approach and a key benefit provided by the CFI.

In the course of key informant interviews, as well as from the PL/PU survey, a number of often quite specific needs were identified by respondents. Some of these needs fall within the CFI's mandate and the parameters of the 2010 Funding Agreement. These include process improvements, such as those being addressed already by the CFI in its CFI Award Management System (CAMS) renewal, reduced burden initiative and implementation of the Tool for Risk Assessment and Management (TRAAM).

Other needs relate to research infrastructure but are beyond what can be addressed by the CFI within the parameters of the 2010 Funding Agreement. Examples of such needs related by many key informants included greater support for O & M funding (which was a need expressed by many key informants) and higher levels of funding of both new and renewed infrastructure. Some more specific examples were cited by those respondents to the PL/PU survey who commented on gaps in the current suite of CFI funds. They most often suggested the needs for:

more funding for O & M, including equipment and core facilities (i.e., in addition to the CFI-funded infrastructure); funding of small/medium cost infrastructure; and more funding of staff to operate and maintain the infrastructure. Several key informants further noted that some expenditures that are important for humanities and social science research (examples given included cloud based computing power and people to create databases through, for example, public opinion research) are not considered to be eligible expenses under the current funding criteria.

Even more broadly, respondents spoke of needs that were beyond the current mandate of the CFI, such as the need for more R&D in the private sector.

5. FINDINGS FOR EVALUATION ISSUE – ACHIEVEMENT OF EXPECTED OUTCOMES

5.1 Immediate Outcomes

Evaluation Question: What contributions has the CFI made to the achievement of its immediate outcomes?

Findings: The CFI made important contributions to the capacity of Ultimate Recipients to achieve the immediate outcomes.

- *State-of-the-art infrastructure continued to be acquired and operationalized by institutions, and utilized by a wide range of internal and external researchers. This CFI-funded infrastructure was also important in terms of contributing to the quality of the research and training environment. The infrastructure has a useful life, and over time, it became less state-of-the-art, suggesting the need for its renewal or replacement.*
- *Researchers were attracted and retained (with the balance shifting to retention in recent years). The CFI-funded infrastructure was one of the most important factors in the mobility decisions of researchers, both for those already in Canada and those attracted from other countries. There were other factors also at play, such as the general research environment, general quality of life, availability of research funding and the critical mass of researchers, which also affect the competitiveness of Canadian institutions in attracting and retaining researchers.*
- *The CFI-funded infrastructure was a catalyst for linkages and helped create an environment conducive to networks and collaborations.*

5.1.1 State-of-the-Art Infrastructure Acquired and Operationalized

The CFI has provided funding support to institutions for projects to acquire and operationalize infrastructure. As shown in Exhibit 5.1, LEF/NIF competitions took place in 2006-07, 2009-10 and 2012-13, all of which led to infrastructure being acquired and operationalized during the 2009-13 period under evaluation. There were JELF competitions every year. There were two CIIF competitions, in 2011-12 and 2012-13. Four MSI projects were funded for operating costs in 2011-12. APCF projects were approved in 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14..

Exhibit 5.1: Project Approvals (Number and Dollar Value) by Fund

Funds		2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Leading Edge/New Initiatives	#	86			133			75	
	\$	\$324.9M			\$513.1M			\$166.0M	
John R. Evans Leaders Fund	#	509	562	437	493	426	466	397	330
	\$	\$80.0M	\$87.1M	\$70.0M	\$84.2M	\$74.7M	\$85.6M	\$61.2M	\$84.6M
College Industry Innovation Fund	#						17	17	
	\$						\$11.8M	\$9.6M	
Major Science Initiatives	#						4		
	\$						\$178.6M		
Automotive Partnership Canada Fund	#				1	2	4	2	4
	\$				\$0.4M	\$1.6M	\$2.9M	\$0.5M	\$3.7M

The projects that were selected for awards then moved ahead in their life cycle, towards awards finalization, implementation and completion (i.e., operational infrastructure). Based upon our analysis of PPR data for LEF/NIF, 177 fully or partially operational projects reported (i.e., submitted a project progress report) at least once between 2009 and 2013. Of these 79 were from the 2006 competition and 98 from the 2009 competition.

Moving through the project life cycle takes time. For example, for JELF, the median time from initial approval to award finalization was 9.7 months, and from award finalization to end or revised end date (including projects with post-2012 end dates) was 15.7 months. For LEF/NIF, the periods were longer, as would be expected for larger more complex projects, at 14.1 months and 41.7 months respectively.

The meta-analysis of the 12 most recent OMS studies showed that "technical and operational capability" increased between pre-CFI and the OMS study date in all 12 OMS cases, with some having improved to "state-of-the-art", including 3 cases for which the starting point was a rating of "obsolete". The PPR analysis of LEF/NIF projects led to similar findings. For example, for the 2009-11 Project Progress Reports, over 90% of PLs rated the funded infrastructure as "state-of-the-art" during the first three reporting years. By the fourth reporting year, the rating was just over 80%. Similar patterns were observed when focusing in on differing types of infrastructure. However, the initial ratings (post-CFI funding) and rates of change varied by type of infrastructure. For example, specialized research equipment and computing hardware or software were more likely to be rated state-of-the-art but then have their ratings drop more

quickly than did non-specialized equipment, buildings and research space. Similar patterns emerged from the JELF analysis but the drop-off in ratings was faster for the smaller less complex JELF projects.

Further, the PPR analysis pointed to the infrastructure not just being operationalized, but also being used by a large number and broad range of researchers. The PPR analysis of LEF/NIF projects showed that overall utilization increases over time, from 79% fully utilized or oversubscribed in the first reporting year to 86% in the fifth reporting year. The average number of internal researchers (i.e. those within the institution) using the CFI-funded infrastructure ranged from 18.4 to 26.1 per project over the five reporting years. The average number of external researchers (i.e., those outside the institution) ranged from 44 to 133 per project over the reporting years. Most external researchers (76-91%) were university or college-based, and these were almost equally divided by local area/province, elsewhere in Canada and international.

The PPR analysis of JELF projects showed a similar pattern as for LEF/NIF projects regarding utilization. Fully utilized or oversubscribed increased from 81% in the first two reporting years to 90% in the fifth reporting year. The analysis indicated that the average number of internal researchers using the CFI-funded infrastructure was 4.2 to 4.9, while the average number of external researchers was 4.5 to 6.0. Again, most external researchers were university and college-based (70-85%), with those outside Canada and those in the local area being the largest groups.

5.1.2 High Calibre Researchers Attracted and Retained

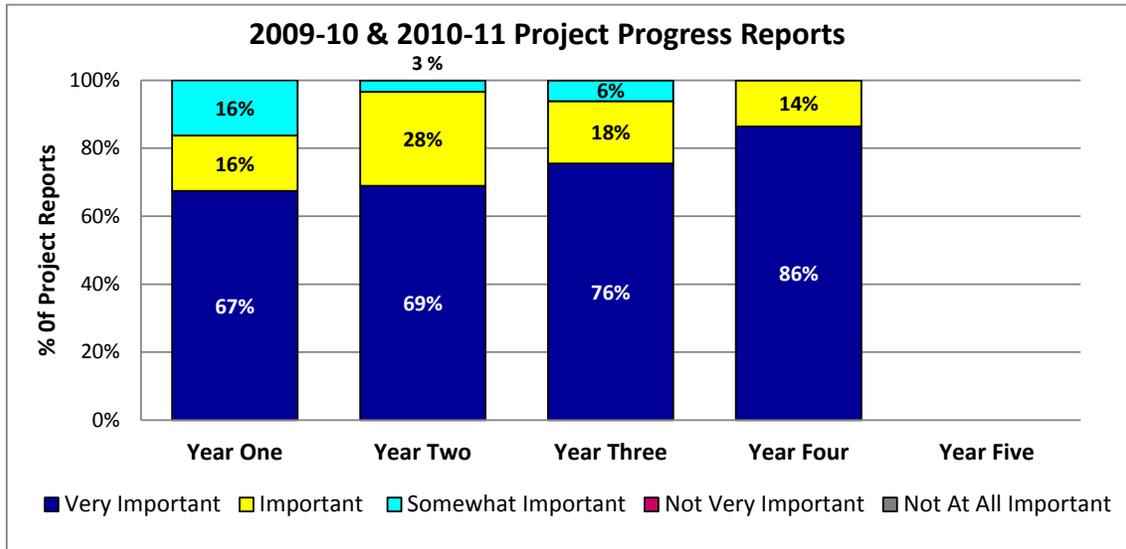
This immediate outcome has a particularly close linkage to the Expected Results in the 2010 Funding Agreement which focuses on "Enhance the capacity of Ultimate Recipients to attract and retain the world's top research talent", and to the statement therein about the JELF, which specifies a \$140 million allocation to JELF for funding in 2012-13 and 2013-14 to ensure Canada continues to attract and retain world-class researchers through funding of Research Infrastructure. The CFI emphasized to the evaluation team that prioritizing between attraction and retention is determined by institutions rather than the CFI.

The evidence suggests that the CFI has helped institutions to attract and retain high calibre researchers. An analysis of a CFI-provided data file showing JELF projects mapped to either attraction or retention indicated that during the period from April 1, 2009 to November 30, 2013, there were a total of 1,089 "attraction" projects and 1,338 "retention" projects, or a ratio of 45:55. Of the "attraction" projects, 47% were for researchers within Canada, 37% from the U.S., and 16% from elsewhere. Over the longer time period from 2006-07 to 2013-14, the percentage of attraction versus retention in the JELF portfolio shifted, from 66% attraction in 2006-07 to 49% in 2009-10 and 43-44% from 2010-11 to 2013-14 (partial year).

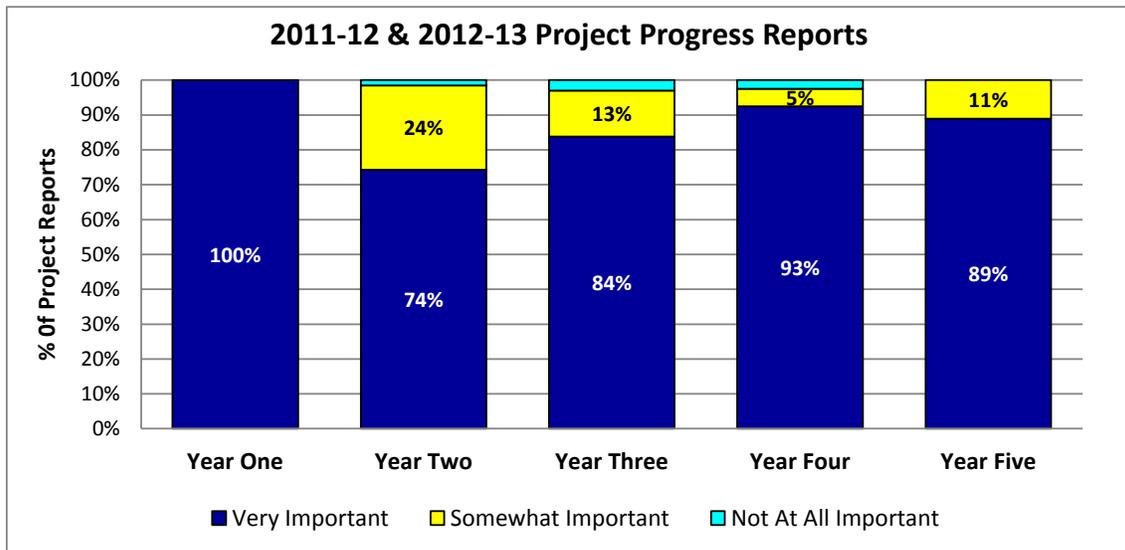
Evidence was also seen from the OMS cases, including the 12 most recent ones. For most of the OMS cases, a high to very high impact on recruitment and retention, and also a medium to very high impact of attracting faculty from abroad, including repatriations, was reported.

The PPR analysis of LEF/NIF projects further demonstrated the importance of CFI-funded infrastructure on PLs' decisions to stay at their institutions. As shown in Exhibit 5.2, the importance generally increased over reporting years. Over the five reporting years, between 94% and 100% rated it as "very important" or "important / somewhat important".

Exhibit 5.2: Importance of CFI-funded infrastructure to PLs' decisions to stay at their institutions (LEF/NIF projects)



Note: Year 1, n=43; Year 2, n=29; Year 3, n=49; Year 4, n=44



Note: Year 1, n=1; Year 2, n=132; Year 3, n=297; Year 4, n=160; Year 5, n=315

The PPR analysis of JELF projects showed lower ratings than for LEF/NIF projects. The ratings had ranges of 51-58% "very important" and 35-41% "important / somewhat important" over the five reporting years in the 2009-10 and 2010-11 reports, and 60-71% and 21-32% respectively for the 2011-12 and 2012-13 reports. Again the differences between the findings for the two

funds is not surprising, given the relative sizes of the CFI-funded projects in each, and the shorter "state-of-the-art" lifespan of JELF projects (as per section 5.1.1).

The survey of some 1,470 PLs and PUs revealed that 33% had either changed job positions or obtained their first faculty position during the previous five years. Although there was a change in the design of the question, in the opinion of the OPE team, this attraction rate represents a slight increase compared to the previous OPEA survey which reported a figure of 28%.

Of the PLs/PUs who had changed research positions or obtained their first faculty position, there was significant attraction from outside Canada: 33% from the US and 14% from another country. A total of 51% had come from a training position (either from the same institution, a different institution in Canada, or from the US or another country).

Turning to retention, 32% of PLs/PUs had considered taking another job position within the past five years, a decline from 44% as reported in the previous OPEA survey.

The importance of the CFI funded infrastructure in affecting the decision to either remain in the current position or to move to a new position was confirmed in the PL/PU survey, as 78% of respondents rated it important. This was the second most important factor, following the general research environment (83% rated it as important). Other important factors were general quality of life, availability of funding for research, and critical mass of researchers.

Key informant interviews with the CFI Board directors and management and with institutions suggested that the economic conditions in Canada relative to other countries, such as the U.S., during the past five years have helped with recruitment and retention. With economic recovery occurring in the U.S., this advantage is no longer evident and, in fact, there may be reverse flows and challenges in maintaining the gains that have taken place.

5.1.3 Enhanced Environment for Productive Networks and Collaborations

The evidence suggests that the CFI has contributed to enhancing the environment for productive networks and collaborations. This includes networks and collaborations within institutions, across institutions in Canada and internationally and with private sector and other end users. The last is closely linked to that part of the 2010 Funding Agreement's Expected Results that focuses on "enhance the capacity of the ultimate recipient to support private sector innovation and commercialization".

The intersectoral linkages study⁴ conducted by the CFI concluded that infrastructure is a catalyst for linkages within and across sectors, that CFI projects have acted as nodes and bridges, and that larger and more mature projects are more likely to have collaborations and linkages.

In the PL/PU survey, 78% of PLs/PUs rated CFI-funded infrastructure as being important for fostering collaborations with other academic researchers within the same institution and 76% rated it important for fostering collaborations with academic researchers at other institutions. A

⁴ *Understanding the role of CFI-funded infrastructure in intersectoral linkages*

lesser percentage, 59%, rated it as important for fostering collaborations with end users outside of academia. It was not possible to arrive at a definitive explanation for the lower impact on collaborations with end users outside of academia; further research would be required. However, the OPE team did review the focus of research for a sample of PLs who gave low ratings to the importance of CFI-funded infrastructure in fostering collaborations with end users outside of academia. Their research projects were at the basic rather than applied end of the R&D spectrum, and thus it would be premature for industrial collaborations, for example, to be considered.

Industry representatives interviewed as key informants noted that the attraction for collaboration was not only in access to specialized equipment that they would not have been able to access on a commercially viable basis, but also to the academic expertise (that is, faculty, post doctoral fellows, graduate students and technical staff) affiliated with the CFI-funded infrastructure to resolve their particular issue or area of interest.

The CFI's Research Facilities Navigator has been built in order to facilitate connecting private sector and other end users to research infrastructure available in institutions. It provides a searchable inventory of research infrastructure including capabilities. The Research Facilities Navigator was launched in November 2013, and was a focus of a special information feature in *The Globe and Mail* newspaper on November 29, 2013. It is prominently displayed on the home page of the CFI website. As of August 2014, over 360 laboratories and facilities at 63 institutions across Canada are included. The impact of this service was not assessed in this OPE since it was still early days in its implementation.

5.1.4 High Quality Research and Training Environment

The evidence suggests that the CFI has helped institutions to create high quality research and training environments. The quality of these environments is at least partially affected by the quality and useful life of the underlying research infrastructure, including that which has received support from the CFI. In section 5.1.1, the CFI's impact on the quality of the infrastructure (e.g., state-of-the-art) and on its reach in terms of the number of internal and external researchers using the infrastructure was described. Over time, the quality of the infrastructure, in terms of being state-of-the-art was shown to diminish. This suggests that maintaining an overall environment which is high quality requires ongoing investment.

Similarly, the PPR analysis of LEF/NIF projects indicated that there is a useful life for research infrastructure, and it varies by type of infrastructure. As shown in exhibit 5.3, computing hardware/software, not surprisingly, was expected to have a relatively short life. Buildings used for research purposes were at the other end of the scale.

Similar findings came from the analysis of JELF projects.

Exhibit 5.3: Average Expected Useful Life of Research Infrastructure (LEF/NIF Projects)

Type of Infrastructure	Average Expected Future Life (yrs)		Change Over Five Years
	Year One	Year Five	
Buildings ¹	22.6 ²	19.6	-3.0 (-13%)
Research Space ¹	17.3 ²	16.0	-1.3 (-8%)
Non-specialized research equipment	9.1	5.9	- 3.2 (-35%)
Specialized research equipment	7.9	8.0	+0.1 (+1.1%)
Computing hardware/software	4.4	2.7	-1.6 (-37%)

(1. Based on project progress reports submitted in 2011-12 and 2012-13.

2. Year Two, as there was only one Year One project in the progress reporting for 2011-12 and 2012-13.)

With regard to the training environment, several sources pointed to the CFI as having had an important impact. The 12 OMS studies reported that the CFI had a high or very high impact on the quality of training and the reputation for competitiveness of training programs. The PPR analysis of LEF/NIF projects, as well as that of JELF projects, showed that a large majority of PLs rated the quality of the infrastructure for training purposes as being "world class" or "excellent" in the 2008-09 to 2010-11 reports, and the impact of the infrastructure on the quality of the training environment as "very high" or "high" during 2011-12 and 2012-13. Key informant interviews with institutional respondents confirmed the high impact that the CFI-funded infrastructure has had on the training environment.

It should also be noted that the CFI has provided funding support to projects such as the Canadian Research Knowledge Network (CRKN) which, as a horizontal initiative, has sought to improve the research environment for institutions across Canada. The 2012 Platform Outcome Measurement Study (POMS) of the CRKN rated this project very highly in terms of its reach, cost saving, utilization, enablement of research (both quantity and quality) and training of highly qualified personnel (including quality). As an example, the CRKN suggested, in its report submitted to the expert group assembled by the CFI for this study, that "CRKN is paying about 30-40% of what institutions would pay if licensing the content on their own".

CRKN is a partnership of Canadian universities which is dedicated to expanding digital content for the academic research enterprise in Canada. It undertakes large-scale content and acquisition and licensing initiatives to build knowledge infrastructure and research capacity in Canada's universities. It began as a pilot project in 2000 after an award of \$20 million from the CFI. It received another award of \$19.1 million from the CFI in February 2007 under the National Platforms Fund to help in the expansion of digital content in social sciences and humanities disciplines. By 2012, its membership had grown to 75 institutions.

The CRKN's 2012 report to the POMS Expert Panel described the CRKN as "one of the largest and most impressive examples of universities collaborating to reduce institutional and regional disparities, and to share vitally important research infrastructure at the national level". The 2012 Expert Panel Report stated that "the investment in CRKN by the CFI and its provincial government partners was essential, timely and catalytic and has been returned many times over". It further noted that "through CRKN's license agreements with publishers, estimated savings to members have totalled \$1.43 billion since 2001".

Finally, this outcome is closely connected to the immediate outcome of attraction and retention of high-calibre researchers. For example, the "general environment for research" was identified in the PL/PU survey as the most important factor affecting a PL/PUs' decision regarding moving to their current position or staying in their current position. Therefore, maintaining the high quality environment also would appear to be critical for building and maintaining a critical mass of researchers (itself, another important recruitment and retention factor).

5.2 Intermediate Outcomes

Evaluation Question: What contributions has the CFI made to the achievement of its intermediate outcomes?

Findings: Through its contributions to immediate outcomes (see section 5.1) as well as its focus, through its competitions and award criteria, the CFI also made important contributions to the capacity of Ultimate Recipients to achieve the intermediate outcomes.

- *Support for increased capacity to carry out internationally competitive research and technology development was evidenced by the impact that the CFI had on helping institutions attract funding, the growth in the number of researchers in theme areas, and the research outputs in terms of publications and conference presentations.*
- *Support for networks and collaborations was evidenced by the increasing incidence of collaborative agreements as projects matured, as well as the diversity in the types of networks and collaborations and the collaborators/partners themselves.*
- *Support for increasing the number of highly qualified personnel (HQP) developed by institutions was evidenced by the attraction that CFI-funded infrastructure had for Postdoctoral Fellows (PDFs), Doctoral (PhDs) and Masters students, and the significant role that the infrastructure had in their research.*

5.2.1 Increased Capacity to Carry Out Internationally Competitive Research and Technology Development

The successful progress made on the four immediate outcomes all point to Ultimate Recipients having increased capacity to carry out internationally competitive research and technology development. Further evidence was found in terms of the attraction of funding and awards, research capacity and research impact.

The attraction of funding was seen as a lagging indicator of the institution's capacity and competitiveness, that is, funding is likely to be more attracted to institutions that have a stronger capacity to carry out internationally competitive research and technology development. The CFI has helped institutions attract funding. The 12 OMS studies indicated that the CFI had a high or very high impact on sponsored research funding and funding per PL/PU. The PPR analysis of LEF/NIF projects, as well as that of JELF projects, showed that CFI funding was considered to have a major impact on the ability to attract additional funding from other sources including the federal and provincial governments, corporations/firms, not-for-profit organizations and institutions. For LEF/NIF projects, funding from corporations/firms and

voluntary organizations tended to be higher in reporting years 3 and 4 suggesting that PLs/PUs may wait until they have research results to promote to end users, and/or less risk tolerance (a bit of wait and see) from these organizations.

The 12 OMS studies reported that, for most of these cases, the CFI had a high or very high impact on the number of PLs/PUs associated with each theme, although not all of them had yet reached critical mass. As was noted in section 5.1.1, technical and operational capability was seen to have increased between pre-CFI and the study data in all 12 OMS cases, with some improving to "state-of-the-art", from "obsolete" in 3 cases. Further, the CFI's impact on the quantity and quality of research ranged between medium and very high across the 12 OMS cases.

Further, high impact research suggests that capacity, as per this outcome statement, was built. For example, the PPR analysis of LEF/NIF projects showed that the percentage of LEF/NIF projects with research publications (e.g., peer reviewed publications, conference presentations, books, technical reports) increased in each project reporting year, from 70% in year 1 to 98% in year 4, for 2008-09 to 2010-11, and from 84% in year 2 to 97% in year 5 (year 1 not included because there was only 1 report) for 2011-12 and 2012-13. The number of conference presentations were higher than the number of peer reviewed publications in the first two project reporting years, which probably reflected the time required for many peer reviewed publications to be prepared, reviewed and published. "Other" publications were also relatively high during the project reporting years 1 and 2.

The PPR analysis of JELF projects showed similar findings. The proportion of projects with research outputs (e.g., peer reviewed publications, conference presentations, books) increased as projects aged – from 75% of projects in reporting year 1 to 94% in reporting years 4 and 5 for 2008-09 to 2010-11, and from 88% in reporting year 1 to 96% in reporting year 5 for 2011-12 and 2012-13. The total number of conference presentations exceeded the volume of peer-reviewed publications in every project reporting year.

Finally, the CFI's funding approach has helped to improve strategic research planning in institutions. Findings from the 12 OMS cases and the 2010 OPE, as well as key informant interviews for this OPE, all point to Strategic Research Plans (SRP) as having helped integrate planning and priorities at the institutional level, and communicate these with internal and external stakeholders. Institutions noted that SRPs have helped to improve their strategic research focus and supported the development of networks, collaborations and partnerships within and between universities, colleges, research hospitals and the private sector. They have also provided a more transparent process and clearer direction for both researchers (in submitting proposals) and institutional stakeholders in focusing research efforts.

5.2.2 Increased Number of Productive Networks and Collaborations

The evidence indicates that the CFI, beyond only helping to enhance the environment for productive networks and collaborations (see section 5.1.3), also has helped to increase their number.

The 12 OMS cases showed high to very high degrees of external networking and collaborations and high to very high ratings of their value added. This included formal and informal networks. The cases also reported a high to very high level of sharing of infrastructure within institutions (this is consistent with the large numbers of internal users described in section 5.1.1), although a lower level of sharing – "low" in a couple of cases – with those outside.

The PPR analysis of LEF/NIF projects demonstrated that, as the larger more unique projects funded through LEF/NIF mature, there is higher incidence of formal collaborative agreements, going from 63% in the first report year and 55% in the second reporting year, to 61%, 73% and 72% in the three subsequent reporting years. This suggests that these projects are significant enough in themselves to enhance the environment around them for collaborations. In contrast, the smaller JELF projects, with their shorter life cycles, have lower incidence of formal collaborative agreements, ranging between 29% and 39%, without an apparent pattern, in the five reporting years.

Institutional respondents cited increases in the number of collaborative and productive networks facilitated by the CFI funded infrastructure, such as ArcticNet, Ocean Network Canada, and the Core Research Equipment and Instrument Training Network (CREAIT).

Many of the other institutional respondents cited an increase in the number of interdisciplinary collaborations within their institution as well as inter-university collaborations on larger projects. A few institutions identified multi-organization collaborations involving the institution, provincial agencies, federal agencies and other research organizations (private sector or not for profit).

The Centre de Collaboration MiQro Innovation (C2MI) at the University of Sherbrooke has 8 Universities, 2 federal government departments, 32 private sector companies and 8 not for profit associations involved in collaborating on specific research projects using the CFI funded infrastructure.

The Canadian Wheat Board Centre for Grain Storage Research at the University of Manitoba has collaborative projects with Agriculture and Agri-Food Canada, the Canadian Wheat Board, the Grain Research Laboratory of the Canadian Grain Commission, the Canadian International Grains Institute and the Canada Grains Council plus international collaborations with China, India, Israel, Poland, Scotland, and the United States.

The networks and collaborations also had attributes that would suggest that they are productive or at least have the potential to be so. The PPR analyses demonstrated a range of types – from collaborative research agreements to research contracts, consultancy service agreements and other types of agreements. For projects funded through JELF, collaborative research agreements were the most common type of agreement. The type and location of partners, such as other institutions and private sector organizations, varied depending upon whether collaboration involved an agreement, a peer-reviewed publication, a conference presentation, an award or grant application. Collaboration with the private sector appeared to depend on the institution and its approach and culture vis-à-vis working with the private sector.

Attraction of funding was another indicator of productive networks and collaborations. The PPR analysis of LEF/NIF projects, as well as that of JELF projects, showed that CFI funding was

considered to have a major impact on the ability to attract additional research funding from other sources, including the federal and provincial governments, corporations/firms, voluntary organizations and institutions.

In the OMS cases, differences in financial contributions from end user organizations, including industrial partners, were explained by the composition and maturity of the private sector for the theme in question, as well as the theme itself and the types of partners it would naturally attract. However, despite any differences, the CFI's impact on end user partnerships and contributions was rated very high in 11 of the 12 cases.

5.2.3 Increased Number of Highly Qualified Personnel (HQP) Developed

This intermediate outcome has a particularly close linkage to the Expected Result in the 2010 Funding Agreement which focuses on "Enhance the capacity of Ultimate Recipients to train the next generation of researchers".

The evidence suggests that the CFI has had an impact on the number of HQPs developed by institutions. For the 12 OMS cases, the impact on the total number of research trainees varied from low to very high, but at least a medium impact on at least one type of research trainee – that is, Masters students, Doctoral (PhD) students or Postdoctoral Fellows (PDFs). The differences in level of impact appear to be due to the type of programs developed around the theme, which in turn, were influenced by funding availability and criteria, institutional priorities and faculty preferences. The differences may also have been due to the quality of data that institutions were able to gather and present about HQP. These findings for the 12 OMS reports were consistent with those presented in the previous OPE report.

High proportions of LEF/NIF PLs and JELF PLs reported that the availability of their CFI-funded infrastructure was an important factor in attracting PDF, PhD and Masters students. PDFs tended to be attracted from foreign and other Canadian institutions, whereas PhD students were attracted from home institutions and Canadian and foreign institutions, and Masters students from home institutions and other Canadian institutions. This was fairly consistent when comparing LEF/NIF and JELF projects.

For LEF/NIF projects, the CFI-funded infrastructure played a significant role in the research work undertaken by PDFs, PhDs and Masters students. The percentage increased from 84% of projects in their first reporting year to 100% by their fourth reporting year. For JELF projects, the trends were different. Again CFI-funded infrastructure played a significant role in research work, but the percentages decreased from 86% in the first reporting year to 78% in fifth reporting year. The differences were likely due to the shorter lifespan/project cycle for the JELF projects.

The PPR analyses also showed that a large majority of PLs also reported technical training on the operation and maintenance of their CFI-funded infrastructure, especially during the early years of its operations. Technical training was not defined in PPR templates for earlier years, but was modified in the 2011-12 template to give the examples of training recipients as technicians, research associates and engineers, but not students or PDFs.

The importance of this outcome and the contribution made by the CFI in increasing the numbers of PDFs, PhDs and Masters students was also confirmed in key informant interviews.

5.3 Long-term Outcomes

Evaluation Question: What contributions has the CFI made to the achievement of long-term outcomes?

Findings: Through its contributions to immediate outcomes (see section 5.1) and intermediate outcomes (see section 5.2), the CFI also made important contributions to the capacity of Ultimate Recipients to achieve the long-term outcomes.

- *Support for institutions having the capacity to carry out world-class research and technology development was evidenced by the positive impacts ascribed to the CFI's infrastructure investments upon the quantity and quality of research and institutional performance.*
- *Support for institutions to increase knowledge and technology transfer was evidenced by the incidence of PLs/PUs who looked at exploring practical applications for research, and the linkages of projects to intellectual property (IP) actions, licensing and company creation.*

5.3.1 World-class Research and Technology Development

The evidence suggests that the CFI has helped institutions achieve world-class research and technology development. As was noted previously in section 5.2.1, the 12 OMS cases pointed to the CFI's impact on the quantity and quality of research as ranging from medium to very high. In 8 of the 12 cases, the theme was ranked to be of international calibre, 3 were ranked to be national calibre, and 1 mixed national/international calibre. The 12 OMS cases also identified, in most cases, a high to a very high impact on each institution's overall competitiveness.⁵

The majority of key informants recognized that the CFI-funded infrastructure has had a great impact on overall institutional R&D performance. They explained that the impact occurred in large part due to the advantage that state-of-the-art infrastructure has given institutions in their recruitment of researchers (compared, in their opinions, to the R&D infrastructure they had experienced themselves and/or understood to be available in other countries). Institutional respondents also pointed to the world-class status, in their opinions, of various facilities that have benefited from CFI funding. Examples cited where there has been direct support from CFI funding were SNOLAB (Sudbury Neutrino Observatory laboratory) and CLS (Canadian Light Source). These facilities are recipients of Major Science Initiatives funding. Another example was TRIUMF which itself is not an eligible recipient for CFI funding. However, member universities of its ownership consortium have received CFI awards for infrastructure which they have sited at

⁵ This rating, like others in the OMS studies, was self assessed by the institution, and then reviewed by an independent expert panel. The results from the expert panel report are those reported in this report.

TRIUMF. There follows short descriptions of these three examples to provide a sense of their magnitude and sophistication.

SNOLAB is a world-class deep underground science facility. The science program at SNOLAB is focussed on sub-atomic and astro-particle physics and is located approximately two kilometres underground at the operational Vale Creighton nickel mine in Lively, Ontario. It is the deepest large-scale international facility in the world, and its extreme "cleanliness" allows for the study of extremely rare interactions and weak processes. The vision for SNOLAB is to be the location and partner of choice for deep underground science, delivering world-class science and benefit to Canada and her international partners...

(Source: Extracted from the Report to Senate, Advisory Review Committee on the SNOLAB Institute, Queen's University at Kingston, March 2013))

Canadian Light Source: The CLS is Canada's national synchrotron research facility, where intense beams of light are generated to probe the nature and structure of matter. The only synchrotron in Canada, CLS offers research techniques that provide exceptional insight into materials, along with innovative commercial-research access, strong intellectual-property policies and industry-sector-specific scientific experts. By increasing our understanding of chemical bonding and structure, we gain powerful insights into substances as varied as soils, mine wastes, catalysts, ores and minerals, biological tissues, functional foods and nutrient supplements, forensic evidence and manufactured materials, such as metals and alloys, ceramics and polymers.

(Source: Information provided by the CLS on the CFI's Research Navigator)

TRIUMF is a subatomic physics laboratory conducting research in several different research areas, including nuclear and particle physics, nuclear medicine, molecular and materials science, and accelerator science and technology. These research areas require large-scale, expensive facilities for experimentation. As such, TRIUMF maintains unique scientific infrastructure to be accessed by members of the Canadian and international scientific communities on a quid pro quo basis...as international researchers access TRIUMF facilities, this provides an avenue by which Canadian researchers may access other international facilities.

(Source: Extracted from the Evaluation of the NRC's Contribution to TRIUMF, Final Evaluation Report, March 27, 2014)

Key informants were of the opinion that such facilities and the R&D being undertaken were recognized as being world-class with numerous countries participating in the projects or benefitting from the data produced through the research projects.

The PL/PU survey also indicated that CFI funding has had positive impacts on the quality and quantity of research (these results are very similar to those for the survey done for the previous OPEA):

- Quality of research – using a 1 to 5 rating scale (where “1” is “poor” and “5” is “world class”), the mean rating increased from 3.5 to 4.1 when the situation prior to CFI

- funding was compared to today. The percentage of respondents giving a rating of 4 or 5 increased from 53% prior to CFI funding to 79% today.
- Quantity of research – the mean rating increased from 3.3 to 3.8 when the situation prior to CFI funding was compared to today. The percentage of respondents giving a rating of 4 or 5) increased from 37% prior to CFI funding to 67% today.

5.3.2 Increased Knowledge and Technology Transfer

The evidence suggests that the CFI has helped institutions to increase knowledge and technology transfer.

The PL/PU survey showed that 70% reported that they had actively explored practical applications of the research conducted using the CFI-funded infrastructure. Of these, 61% had explored direct technology transfer for new or improved industrial products, processes or services, and 58% had explored indirect technology and knowledge transfer.

Knowledge and technology transfer took place through various modes – e.g., IP actions / rights, licensing, company creation, and movement of HQP. Looking at the OMS themes showed that transfer took place, but the extent to which each mode was employed depended upon the theme.

The PPR analysis of LEF/NIF showed that between 21% and 38% of projects reported on between 2008-09 and 2010-11 were linked to IP actions in any particular project reporting year. Projects were most likely to involve patent filings and invention disclosures. For the year 1 projects, 16% involved invention disclosures and 9% patent filings. In subsequent project reporting years, 24-25% of projects had at least one filing, and 13-23% had at least one invention disclosure. Incidence rates for other forms of IP (patents granted, licensing agreements and other IP rights) were much lower, varying from 0% to 8%, depending on the type of IP and the project year.

For 2011-12 and 2012-13, between 19% and 30% of LEF/NIF projects were linked to the filing or granting of one or more IP rights in each of the project reporting years (excluding the single year one project report). Projects were most likely to be linked to the granting of provisional or full patents. Between 18% and 28% of projects obtained one or more provisional patents, and between 3% and 13% obtained at least one full patent, depending on the project reporting year. A total of 115 provisional patents, and 37 full patents, were issued over the five project reporting years.

As might be expected for the smaller JELF projects, the PPR analysis of JELF projects showed lower linkage rates to IP actions. Rates were 11% to 13% in the 2008-09 to 2010-11 period, and 7% during 2011-12 and 2012-13. However, for the 2011-12 and 2012-13 reports, the larger number of JELF projects yielded a total of 287 provisional patents and 81 full patents over the five reporting years.

The PPR analysis of 2011-12 and 2012-13 reports showed licensing agreements for 21 LEF/NIF projects and 61 JELF projects. 114 companies were created – 43 related to LEF/NIF projects and 71 for JELF projects. Of the 43 spin-off companies for the LEF/NIF projects, almost 40% were

based in Toronto, 14% in Montreal, and the remainder spread across the country. 35% were in the engineering sector, while 30% were in the health sector, 28% in the science sector, and 7% in social sciences and humanities.

Knowledge and technology transfer also took place through the movement of HQP. The PPR analysis showed that HQP moved on from LEF/NIF projects to other Canadian universities, colleges or hospitals, foreign institutions, or Canadian private sector (more likely for Masters students).

5.4 Ultimate Impacts

Evaluation Question: What contributions has the CFI made to the achievement of ultimate impacts?

Findings: Benefits for Canada was a selection criterion applied in all of the CFI competitions. However, there was not a broad and deep evidence base existing about the contribution that CFI made to institutions being able to contribute to social and economic benefits for Canadians. Information about the types of benefits or impacts was available and reported at the project level in the project progress reports and at the theme level (i.e., a group of projects at an institution) in the Outcome Measurement Studies. However, the benefits/impacts themselves were not typically fully quantified. The Socio-Economic Impact Assessment (SEIA) pilot project of medical imaging R&D was a step taken by the CFI, in partnership with CIHR, to quantify benefits, and demonstrates leadership by the CFI.

5.4.1 Social and Economic Benefits for Canadians

Benefits for Canada is a selection criterion applied in all of the CFI's competitions. Although there is not a broad and deep evidence base existing about the contribution that the CFI has made to Ultimate Recipients being able to contribute to social and economic benefits for Canadians, some analysis has been done. These suggest that the CFI has helped Ultimate Recipients contribute to a broad range of social and economic benefits, and where quantification has been done, a high level of impacts has been demonstrated.

The 12 OMS cases provided some example of areas of impact but did not provide details. This reflects the fact that most institutions do not do impact assessments of their own R&D activities and outputs. In three of the OMS cases, employment, new company creation and industrial sector development were described as benefits.

The PPR analysis of the annual LEF/NIF project reports submitted between 2008-09 and 2010-11 indicated that two types of benefits – new/improved products, processes, services (30% to over 50%); and, improved health care protocols, diagnostics, etc. (27% to over 55%) – exhibit rising trends, suggesting that knowledge and technology transfer increased as results linked to the infrastructure accumulated from year 1 to year 4 of project operations. Benefits, in the form of new/improved public policies and programs (approximately 28%); environmental benefits (approximately 30% after year 1); cost savings (13-16%); and, best practices (13-20%) – exhibited lower and more stable incidence rates.

For reporting in 2011-12 and 2012-13, there were differences in the types of benefits being asked. Those with the highest incidence rates were as follows: incidence of new or improved process, procedure, protocol, method (e.g., manufacturing process, detection method, or technique, treatment protocol, professional practice) went from 37% in the year 2 reports to 55% in year 5; New or improved products; 16% in year 2 to 31% in year 5; and Public education and awareness initiative – 19% in year 2 to 27% in year 5. Incidence rates for the other types of benefits were lower with several also exhibiting rising trends – new or improved services (7% to 17%), and cultural or intellectual enrichment (e.g., documentary, multimedia presentation, performing arts, visual arts, creative writing, etc.), (3% to 11%).

The PPR analysis of JELF projects showed considerably lower reporting rates of benefits, which might be attributable to the smaller scale of these projects. For reporting between 2008-09 and 2010-11, the most commonly reported types of benefits were: new or improved products, processes and services, which were cited by between 10% and 15% of PLs, depending on the project year; environmental benefits – between 12% and 15%; and, improved health care protocols, diagnostics, prognostics, therapeutics, etc. – between 10% and 13%. For reporting in 2011-12 and 2012-13, the types of benefits with the highest incidence rates were: new or improved processes, procedures, protocols, methods; which were cited by between 16% and 24%, depending on the project year; public education or awareness initiatives – between 9% and 10%; new or revised concepts, models, frameworks, plans, strategies – between 8% and 9%; and new or improved products – between 6% and 7%.

The PL/PU survey provided the following results from the 70% of PLs/PUs who reported that they had actively explored practical applications of their research conducted using the CFI-funded infrastructure. These results are similar to those from the PPR analysis when adjusted to the full survey population.

- 61%: Direct technology transfer for new or improved industrial products, processes or services
- 58%: Indirect technology and knowledge transfer for new or improved industrial products, processes or services
- 46%: New or improved health care protocols, diagnostics, prognostics, therapeutics, etc.
- 44%: Other societal benefits (e.g., better teaching methods, community planning, social structure, economic reform, justice system, etc.)
- 38%: New or improved public policies or programs
- 40%: Environmental benefits
- 33%: Enhanced best practices in healthcare, manufacturing strategies, organizational structure, marketing, etc.

As noted at the outset of this section, where organizations have taken steps towards quantification, high levels of impacts have been demonstrated.

A strong example is the CFI's own recent Socio-Economic Impact Analysis (SEIA) study, conducted jointly with CIHR, of medical imaging R&D. It was conducted, as a pilot, to develop a basis for quantifying net benefits, and put them into perspective within the larger portfolio of projects supported through the CFI's funds.

The case study for the SEIA study was computed tomography perfusion (CTP) which is an advanced imaging procedure used for diagnosis in acute stroke. Sophisticated but easy to use tools were developed using CFI infrastructure and CIHR support. The research was commercialized by a private company. The study showed net economic benefits attributable to the CFI/CIHR and partners as being \$42 million to \$86 million, which represented a benefit-to-cost ratio of between 1.5 to 1 and 2.3 to 1.

(Source: Pilot Socioeconomic Impact Analysis of CFI and CIHR Funding, Medical Imaging R&D, March 2013, Prepared by RTI International)

As another example, in its 2013 evaluation of TRIUMF, the National Research Council (NRC) reports a "significant" short term return on investment for Canada⁶. For clarity, it is again emphasized that TRIUMF has not received CFI-funding; rather members of its ownership consortium have received CFI-funding for infrastructure projects that have been located at TRIUMF.

TRIUMF has contributed to the achievement of economic benefits by Canadian firms. TRIUMF's short term ROI to Canada is estimated to be at least 1.7 dollars for every dollar invested, which is significant considering its fundamental research mandate. TRIUMF's research has led to several health benefits, the most notable being the production of medical isotopes using non-reactor technologies.

Key informants, both external and internal to the CFI, spoke of some additional examples of benefits, although these were not elaborated or quantified. The broad range of benefits and beneficiaries is notable.

Numerous clinical trials in health care that have and may lead to improved outcomes for patients (e.g. clinical trial relating to medical allergies, heart and stroke health protocols, vaccines etc.) resulting from research undertaken with CFI funded infrastructure.

Expansion of an existing biomass refining and paper moulding facility at an institution to develop products that replace foam packaging (e.g. iPad packing material) reducing the overall impact on the environment.

A spin-off company from a research project that is remediating mine tailings through a new process to benefit the environment.

Development of an application for smart phones to promote tourism that provides architectural and historical descriptions of buildings and locations (Old Quebec City and the Port of Montreal district).

The gap in the quantification of benefits was recognized in the 2010 OPEA, as well as identified as a corporate risk for the CFI and built into the CFI's corporate plans. Quantification of benefits is a challenge not just for the CFI but other funders in Canada and in other countries. The various players in the results chains leading to ultimate outcomes, the lengthy time period to move from investment in research, to discovery and then to innovation and commercialization, as well as

⁶ http://www.nrc-cnrc.gc.ca/eng/about/planning_reporting/evaluation/2013_2014/triumf.html

the difficulties in gathering data, all add to the complexities, and associated costs and time associated with quantifying benefits. The SEIA pilot study described above is an example of leadership that the CFI is providing, together with partners such as the CIHR, in addressing the quantification of benefits.

6. FINDINGS FOR EVALUATION ISSUE – DEMONSTRATION OF EFFICIENCY AND ECONOMY

6.1 Resource Utilization and Allocation

Evaluation Questions: What and how are resources used by the CFI? How are those resources related to the achievement of outputs? How are those resources related to the achievement of outcomes? Has resource use been minimized given the results achieved and contextual factors?

Findings: The CFI has maintained its operating costs at a low % of disbursements for many years. Its operating costs as a % of disbursements compare favourably with those of other federal granting agencies.

The CFI's total operating costs during the period from 2009-10 to 2013-14 are shown in Exhibit 6.1 below. They ranged from approximately \$12.5 million to \$14.1 million per year.

The CFI did not break out its operating costs by the Activities or Outputs in the logic model. The reason is that, while all Activities and Outputs did take place, the relative emphasis on each of the different activities and outputs changes over the course of the life cycles of funds and associated competitions, rather than following an annual business cycle. For the same reason, and also because outcomes accrue over many years, operating costs were not broken out by the CFI for the Outcomes in the logic model, or the Expected Results in the 2010 Funding Agreement. At the same time, the 2010 Funding Agreement specified the allocation of dollars to funds and those funds were closely aligned with the Expected Results. CFI operated within those parameters for grants made under the 2010 Funding Agreement. Funds and competitions, as well as the merit-review process, were designed to enhance the capacity and maximize the likelihood of recipients to achieve the outcomes.

Also as shown in Exhibit 6.1, over the 2009-10 to 2013-14 period, the CFI's operating expenses as a % of disbursements ranged from 2.4% to 3.4%. An analysis conducted by the 2007 Evaluation of Foundations by Treasury Board came up with a similar figure (3%).

The 2007 Evaluation of Foundations report also stated that "the average share of operating and administration costs in the total expenses of CIHR, NSERC and SSHRC over the last six years was between 5% and 6%". Examination of annual reports indicated that operating costs as percentage of grants and awards in 2011-12 for CIHR, NSERC and SSHRC were 6.4%, 5.5% and 4.6% respectively. Further, data from the 2013-14 Reports on Plans and Priorities revealed that, over the period from 2010-11 to 2013-14, "Internal Services" as a percentage of total expenditures ranged from 2.8% to 3.3% for CIHR, 2.3% to 2.5% for NSERC and 2.2% to 2.5% for

SSHRC. Internal Services are a subset of operating expenses and do not include direct program costs. However, program costs are included in the CFI operating expenses.

In making comparisons across the funding agencies, it is noted that there are differentiating factors such as the average size and number of grants and contributions provided by each agency that also influence these percentages. However, the comparisons do point to the CFI's operating expenses as a percentage of disbursements continuing to compare favourably with the same percentages for CIHR, NSERC and SSHRC.

Exhibit 6.1: The CFI's Operating Costs as a Percentage of Grant Funds Disbursed

	F09-10	F10-11	F11-12	F12-13	F13-14
Operating costs	13,040,979	12,519,725	14,112,567	12,952,516	12,984,778
Disbursements	379,369,095	460,104,290	427,219,788	549,812,706	406,899,214
Operating Expenses as % of Disbursement	3.4%	2.7%	3.3%	2.4%	3.2%

Source: Provided by the CFI, September 19, 2014

6.2 Program Design and Delivery

Evaluation Questions: Are there cost-effective alternatives to current program design and delivery, or resource consumption approaches? How could the design and or delivery of the CFI or individual funds be improved? With respect to the achievement of expected outcomes, what challenges and or barriers were encountered by the CFI, and what has been done to address them? With respect to efficiency and economy, what challenges and or barriers were encountered by the CFI, and what has been done to address them?

Findings: There was a strong endorsement of the current CFI model by stakeholders interviewed as key informants. This follows the positive endorsement provided in the 2010 OPEA.

At the same time, several challenges, barriers and opportunities for improvement were identified by external and internal stakeholders. They are: the lack of long-term stable funding for the CFI's support of Ultimate Recipients, as well as for its own operations; addressing needs of Ultimate Recipients for both more and a broader scope of operating and capital support; moving forward on new initiatives such as MSI and CIIF introduced in the 2010 Funding Agreement; uncertainties around other funding sources; and measuring and communicating the impacts of the CFI investments.

The challenges and barriers appear to be well understood, not just by the CFI, but also by stakeholder groups. In most cases, they are addressed in the CFI's corporate risk profile and corporate plans. Mitigation actions have been taken by the CFI. However, the following are highlighted as being of particular importance to external and internal stakeholders and because addressing them also implicates parties outside of the CFI:

- *Need for long-term stable funding for the CFI's support of Ultimate Recipients;*

- *Ongoing operational funding for the CFI beyond the current approximate five-year window;*
- *The scope and amounts of funding currently available throughout the research support ecosystem, for the full range of capital and operating requirements, including those for research infrastructure.*

The design and delivery of the CFI's core funds – LEF/NIF and JELF – were highly rated by PLs. Some suggestions for improvements were made specific to these funds. These concerned both process improvements and institutional funding. Examples of process improvements included: shortening the length of time between an award decision by the CFI and when equipment can be purchased; streamlining the application, review and delivery processes; and more flexibility to update the original project budget. Examples of funding needs were similar to those identified as overall gaps.

6.2.1 Stakeholder Support for Current Program Design and Delivery

Key informants, both external and internal to the CFI, interviewed during this evaluation supported the current CFI model. There was support expressed for it being an independent funding agency focusing on infrastructure, although the need for ongoing coordination with the other funding agencies was emphasized (this is a risk included in the CFI's corporate risk profile). They noted that having one organization (the CFI) accountable for funding support for research infrastructure means that it can develop a strong depth of knowledge and allows it to be flexible and responsive to changing stakeholder needs. Some key informants, both inside the CFI and in institutions, noted that the CFI model is working well within the Canadian research support ecosystem, better than the models with which they have experience that are used in other countries (although the usefulness of other countries' models as comparators was questioned by some given significantly different ecosystems).

A positive endorsement of the program design and delivery of the CFI was also a finding of the 2010 OPEA.

6.2.2 Challenges, Barriers and Opportunities for Improvement related to Current Program Design and Delivery

While supporting the current program design and delivery, a number of challenges and barriers, as well as opportunities for improvement to overall program design and delivery, were identified by key informants as well as in the PL/PU survey. Many of these coincide with key risks in the corporate risk profile and addressed through mitigation measures and activities in the CFI corporate plans. Many also mirror challenges identified in the study *Qualitative Evaluation of the Views of Stakeholders towards the Canada Foundation for Innovation, 2011*.

Lack of long-term stable funding for the CFI's support of Ultimate Recipients.

The lack of long-term stable funding with which the CFI can support ultimate recipients was a key challenge / issue identified by all categories of key informants. It presents difficulties for the CFI in terms of its own sustainability, with implications for human resource planning. It also has

impacts for provinces being able to plan their funding support and institutions being able to develop strategic research plans. At the same time, long-term stable funding needs to be distinguished from A-base type funding, which would make the CFI look more like a government department. This challenge is listed as a strategic risk in the CFI's corporate risk profile. As noted in the CFI's 2013 Corporate Plan, it was being addressed through ongoing discussions with the Government of Canada and other funding agencies on the CFI's role, programs and level of funding provided, as well as ongoing initiatives to understand stakeholder needs, challenges and expectations, to inform stakeholders of the CFI's strategic directions (e.g., Strategic Roadmap), and to communicate with stakeholders. The importance attached to this issue by all stakeholder groups points to the need for ongoing risk mitigation, including discussions and advocacy, by the CFI.

Operational funding for the CFI

From its inception and initial funding agreement and subsequent additions, the CFI funded its operating expenses from the investment income from the monies it was granted by the Government of Canada. With the move to Up-Front Multi-Year funding in the 2010 Funding Agreement, the CFI does not continue to have this source of funding for its own operations. Rather it has been provided with an allocation for operating expenses sufficient for approximately five years of operations. This allocation came from unallocated interest from investments made using funds from the previous funding agreement. This issue was raised as a concern by CFI key informants. It is not currently explicit within the CFI's corporate risk profile. Its importance for the viability and sustainability of the CFI, especially in the context of long-term stable funding for the CFI's support of ultimate recipients, also points to the need for ongoing discussions and advocacy by the CFI.

Amount and scope of funding available from the CFI and other sources

The amount and scope of research infrastructure funding, as well as the bigger picture of funding across the research support ecosystem, were issues raised by many key informants. It was previously discussed, with specific examples given, in sections 4.1 and 4.2. These issues go beyond what the CFI can address by itself. However, the CFI has continued to be active through its stakeholder engagement as well as its regular interactions with the federal funding agencies.

New initiatives introduced through the 2010 Funding Agreement

Key informants from the CFI highlighted the challenges that they faced in two areas and the way in which they were addressed as examples of funding program development, in support of efficiency and economy, as well as effectiveness. In the case of the MSI, the CFI addressed the challenge of a new area by conducting research on best practices internationally, building internal expertise, launching the MSI fund, and carrying out an internal audit to gather lessons learned and identify opportunities for improvement. The CIIF fund was launched after consultation with colleges. Experience was also brought onto the Board of Directors. Currently, similar challenges are being addressed regarding the cyber infrastructure initiative.

Funding from Other Sources

The design of the CFI's funding programs depends upon funding also coming from other sources, such as institutions and their funding partners - e.g., provinces, private sector, other funders. Other funders may have difficulties in committing to matching funding or meeting their funding obligations as economic conditions change or their priorities change. This is identified as a risk in the corporate risk profile where risk mitigation measures are described. However, this challenge is also linked to the issue of long term stable funding for the CFI which would reduce uncertainty concerning amounts and timing of funding commitments for other funders.

Demonstrating and communicating the impacts of the CFI funding

Many years can go by between a CFI award for a project to the associated infrastructure being implemented and outcomes such as societal benefits being realized. This challenge of measuring, tracking, analyzing and reporting on impacts is a strategic risk in the CFI's corporate risk profile. The CFI has invested in developing and testing approaches and methodologies such as the OMS, Platform OMS and SEIA studies, including how to capture the contribution that the CFI, through its support for infrastructure, makes to the downstream impacts of R&D. The CFI has also made impact/benefit stories a key focus of its communications strategy and activities. In doing so, it was noted by CFI key informants that the CFI is one of many organizations competing for people's attention. The CFI has addressed this through the use of social media platforms and other communications vehicles appropriate for various audiences.

6.2.3 Design and Delivery of LEF/NIF and LOF/JELF

The survey of PLs/PUs showed that the design and delivery of LEF/NIF and JELF were highly rated by PLs, as shown in the following table. In the survey, design referred to "the basic elements of the CFI's funds such as objectives or eligibility criteria", while delivery referred to "the basic administration of the funds by the CFI, the information provided for the preparation of applications, the granting, payment, and control of contributions through the transparency of the decision-making process".

Exhibit 6.2: Rating of the Design and Delivery of LEF/NIF and LOF/JELF

	Mean Rating	% rating 4 or 5	% rating 1 or 2
Rating of Design			
LEF/NIF	3.8	70%	8%
JELF	4.0	78%	4%
Rating of Delivery			
LEF/NIF	3.7	63%	12%
JELF	3.7	65%	14%

Scale: 1 to 5, where 1=poor and 5=excellent.

The PL/PU survey was also a useful source of opinions on opportunities for improvement. When asked whether they had any suggestions for improvement, 61% of all respondents (PLs and PUs) made one or more suggestions. The main suggestions (made by more than 5% of respondents) were as follows (% of all respondents (1,470) in parentheses):

- Length of time between CFI award decision and when equipment can be purchased needs to be shortened (12%) – Delays in obtaining the provincial matching contribution was frequently cited as the main cause of the delays – an issue which is largely beyond the CFI’s control. This issue of delays is exacerbated in cases where the CFI award was part of a recruitment package for a new faculty, as the delays have negative repercussions on the researcher’s ability to set up a new lab and begin research – placing the researcher at a competitive disadvantage compared to researchers in other countries and also affecting their prospects for tenure.
- More funds needed for O & M of equipment (10%) – The main comment under this category was that there is insufficient funding to hire HQP to operate the CFI-funded infrastructure as well as for maintenance/repairs. Some suggested raising the IOF percentage and others stated that IOF provides funding for only the first five years whereas some equipment will be used much longer than that (CFI noted that the IOF is not restricted to five years). Other issues included: insufficient funding for O & M of core facilities (i.e., in addition to the CFI-funded infrastructure); and complaints that some universities do not allocate the IOF funding (which is an institutional-level fund) to the CFI-funded projects, or place a surcharge on the IOF allocation, which reduces the amount of funding going to the researcher.
- Streamline application, review and delivery processes (6%) – Comments included: applications are overly long, complex (particularly for new faculty) and repetitive, and there are too many forms; application criteria are too vague; preparing the budget is too complex/more information needed on eligible costs; a need to reduce the elapsed time for review and approval; a suggestion to combine the CFI and provincial application and review processes; too much time spent writing reports, obtaining new equipment quotes, etc., which reduces the amount of time available for research; a webinar and a live chat function on the website are needed to explain the application process and to answer questions in real time.
- More flexibility to update the budget (6%) – More flexibility needed to permit modifications of the original budget due to the long timeframe between application, award and purchase of equipment, as equipment/technology and prices change over time. Some respondents noted this was a minor issue compared to the issues described above.

These suggestions are included in this report because they should provide useful input to the CFI when it reviews and considers improvement opportunities for these specific funds.

6.2.4 Other Suggestions for Improvements

Many of the opportunities for improvement suggested by key informants were similar to those noted from the PL/PU survey. Some others, such as the need for stable funding, the amount and scope of funding for O & M, and benefits tracking, were linked to the challenges and barriers

discussed in section 6.2. Some key informants in institutions also noted issues that they were facing:

- Improving industry access to facilities to encourage their contributions to funding;
- Limited institutional resources to prepare submissions to both Tri-Council agencies and private sector organizations for research funding, which might have impacts upon their CFI allocations; and
- Establishing a basis for provincial shares when there are multiple provinces involved in a major initiative.

Issues such as these suggest it is important that the CFI continue to be attuned and responsive to the needs and expectations of stakeholders.

7. CONCLUSIONS AND RECOMMENDATIONS

This section summarizes the findings of the OPE with respect to each evaluation issue, draws conclusions and presents the study's recommendations.

7.1 Continued Need

Summary of Findings: The CFI's mandate, basically unchanged since the CFI's creation in 1997, has continued to address a demonstrable need up to the present and will likely continue to do so into the foreseeable future. It is tied to supporting, building and applying the knowledge base essential for a sustainable and competitive economy. Data collected in this OPE suggest that investment in research infrastructure and the CFI's role in it are considered to be crucially important parts of the research support ecosystem, and that requests from institutions for CFI support will continue unabated into the future.

Further, the CFI has been responsive to the needs of the R&D community, within the parameters set by its mandate and its 2010 Funding Agreement. It has implemented the 2010 Funding Agreement as well as reviewed and adjusted funds and competitions based upon consultations with stakeholders. It has also continued to apply its independent merit-review processes to competitions. These merit-review processes are highly respected by the Canadian research community.

At the same time, there are a number of needs that fall outside of the coverage of the 2010 Funding Agreement (e.g., greater support for O & M funding) and still others that fall outside the mandate of the CFI (e.g., more R&D in the private sector). Staying abreast of such needs points to the importance of the CFI's ongoing stakeholder engagement and interactions with federal funding agencies. Further, as the relationships of institutions with the private sector and other end users develop, evolve and mature, there may be new and emerging context, such as changes in institutional funding approaches or different needs for access to facilities, which may have implications for the CFI's current approaches.

Conclusion: Based upon these findings, the evaluation team concludes that the CFI has met a continued need, and its mandate, role and approach to doing so are acknowledged and appreciated by stakeholders throughout the research support ecosystem and the R&D communities. The importance of continuing to do so, given the broad range of needs and changes in the context, leads to the following observation..

Observation 1: As it is now doing, the CFI must continue to remain attuned and responsive to the needs and expectations of stakeholders, including Ultimate Recipients, other funders and end users including the private sector, as well as to any shifts or changes in the landscape of the research support ecosystem, that may affect the achievement of overall R&D outcomes, the CFI's contribution to them, and the CFI's approaches to addressing them.

7.2 Achievement of Expected Outcomes and the Expected Results in the 2010 Funding Agreement

Summary of Findings: In this summary, the findings for each outcome (as per section 5) in the CFI's logic model are recast against the Expected Results in the 2010 Funding Agreement. The cross-walk used to map findings between the logic model and the Expected Results is provided in Appendix 8.

- Enhance the capacity of Ultimate Recipients to: (a) Attract and retain the world's top research talent.
 - Researchers were attracted or retained (with the balance shifting to retention in recent years). The CFI-funded infrastructure was one of the most important factors in the mobility decisions of researchers and, hence, their attraction and retention. There were other factors also at play, such as the general research environment, general quality of life, availability of research funding and the critical mass of researchers, that also affect the competitiveness of Canadian institutions in attracting and retaining researchers.
- Enhance the capacity of Ultimate Recipients to: (b) Enable researchers to undertake world-class research and technology development that lead to social, economic and environmental benefits for Canada
 - State-of-the-Art Infrastructure was acquired and operationalized by institutions. Further, it was put to use, by a wide range of internal and external researchers. The CFI-funded infrastructure has helped create an environment conducive to networks and collaborations. It has also helped institutions improve the quality of their research and training environments. These institutional outcomes have led them to having increased capacity for internationally competitive research and technology and increased networks and collaborations. Further, there are examples of types of benefits for Canada in a number of areas, although these are not generally quantified.
- Enhance the capacity of Ultimate Recipients to: (c) Support private sector innovation and commercialization
 - The CIIF directly focuses upon helping colleges enhance their capacity to support private sector innovation and commercialization. This fund is still in its early days meaning that it is premature to assess outcomes. More generally, the

CFI-funded infrastructure has helped create an environment conducive to networks and collaborations, and helped to increase their numbers, including between institutions and the private sector and other end users. Support for institutions to increase knowledge and technology transfer was evidenced by the incidence of PLs/PUs who looked at exploring practical applications for research, and the linkages of projects to IP actions, licensing and company creation.

- Enhance the capacity of Ultimate Recipients to:
 - (d) Train the next generation of researchers
 - The CFI-funded infrastructure was important in terms of the quality of the research and training environment. The CFI-funded infrastructure helped institutions attract post-doctoral fellows, and doctoral and masters students, and played a significant role in their research.

Conclusion: Overall, during this evaluation period, the CFI continued to build upon its earlier successes and has had strong performance for each of the outcomes in its logic model and for each of the Expected Results in the 2010 Funding Agreement. This included research and technology development and underlying research and development capacity at recipient institutions, as well as knowledge and technology transfer to end users. The 2010 Funding Agreement made the linkage with the private sector more explicit through its inclusion in the Expected Results (i.e., reference to private sector innovation and commercialization), and allocation of funding to what was launched as the College-Industry Innovation Fund. For this OPE, it was still early days in terms of expecting or assessing progress on outcomes from the CIIF. At the same time, this is not a new area for either institutions or the CFI, as there has been an indirect linkage to end users (including the private sector) over many years embedded in institutions' knowledge and technology transfer activities.

Making the Expected Results more visible and the CFI's performance story even stronger leads to the following recommendation.

Recommendation 1: In developing its next Performance, Evaluation, Risk and Audit Framework (PERAF), the CFI should consider including all aspects of the Expected Results in its funding agreements in the logic model, performance measurement framework and evaluation framework. Further, the CFI should consider adding to its logic model some immediate outcomes which go beyond "enhancing capacity" of recipient institutions, and add what the CFI achieves for its other stakeholders as well. Such outcomes could be derived from aspects now in the CFI's Strategic Roadmap.

7.3 Demonstration of Efficiency and Economy

Summary of Findings: With regard to resource utilization and allocation, the CFI has maintained its operating costs at a low percentage of disbursements for many years. Its operating costs as a percentage of disbursements compare favourably with those of other federal granting agencies.

There was a strong endorsement of the current overall CFI model by stakeholders interviewed as key informants. This follows the positive endorsement provided in the 2010 OPEA.

At the same time, several challenges, barriers and opportunities for improvement were identified by external and internal stakeholders. They appear to be well understood, not just by the CFI, but also by stakeholder groups. In most cases, they are addressed in the CFI's corporate risk profile and corporate plans. Mitigation actions have been taken by the CFI. However, the following are highlighted as being of particular importance to external and internal stakeholders and because addressing them also implicates parties outside of the CFI:

- Need for long-term stable funding for the CFI's support of Ultimate Recipients;
- Ongoing operational funding for the CFI beyond the current approximate five-year window; and
- The scope and amounts of funding currently available throughout the research support ecosystem, for the full range of capital and operating requirements, including those for research infrastructure.

The design and delivery of the CFI's core funds – LEF/NIF and JELF – were highly rated by PLs. Some suggestions for improvements were made. These concerned both process improvements and institutional funding. Examples of process improvements included: shortening the length of time between an award decision by the CFI and when equipment can be purchased; streamlining the application, review and delivery processes; and more flexibility to update the original project budget. Examples of funding needs were similar to those identified as overall gaps.

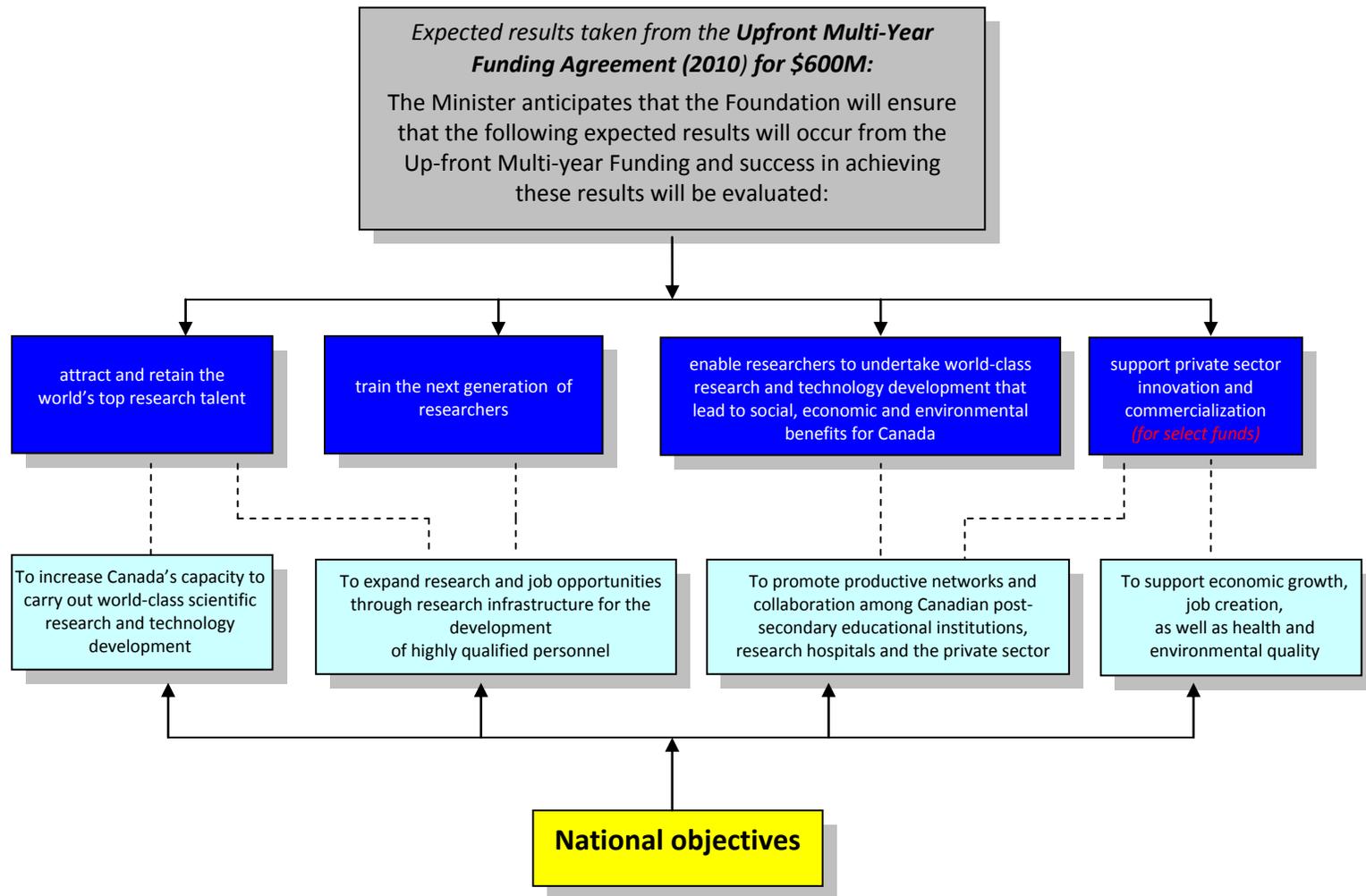
Conclusion: The CFI has a proven track record of efficiency and economy over many years. Further, its design and delivery, and overall business model, were strongly endorsed by stakeholders across the research support ecosystem. Its merit-review process and its stakeholder consultation approach were especially highly valued. These have enabled the CFI to adapt to changing priorities, as reflected in its Funding Agreements, while remaining true to its mandate and its focus on excellence. Several issues, many of them ongoing and addressed in the CFI's corporate risk profile, are important for institutions and the CFI. Three of these issues would appear to the OPE team to warrant special attention and lead to the following observations.

Observation 2: The CFI's advocacy agenda is important and the CFI should continue to advocate for long-term stable funding for its support to enhancing the capacity of institutions, as well as for its own ongoing operations.

Observation 3: Linked to our first observation, the CFI should continue to stay abreast of the larger picture of funding needs and funding gaps through its ongoing stakeholder engagement and interactions with federal funding agencies.

APPENDIX 1: CROSS-WALK BETWEEN EXPECTED RESULTS IN THE 2010 FUNDING AGREEMENT AND NATIONAL OBJECTIVES IN EARLIER FUNDING AGREEMENT

(Source: The CFI's 2012-13 Corporate Plan)

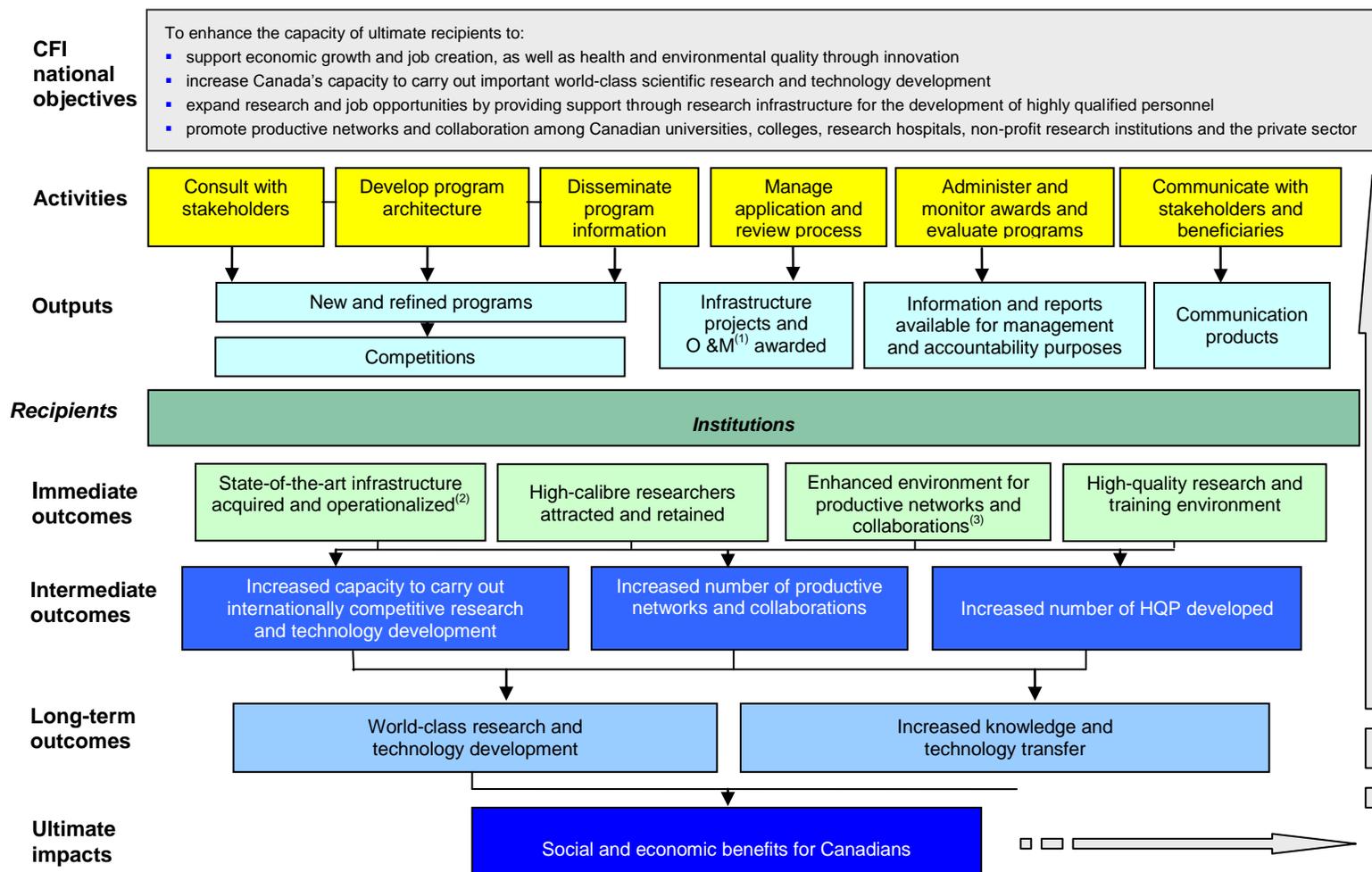


APPENDIX 2: THE CFI'S LOGIC MODEL

The CFI's current logic model is shown on the next page. This logic model depicts how the CFI contributes to the achievement of ultimate impacts, long-term outcomes, intermediate outcomes and immediate outcomes, through the activities it undertakes and the outputs it produces.

The development of this logic model preceded the 2010 Funding Agreement. As such it ties Activities, Outputs and Outcomes to the National Objectives. As shown in Appendix 1, the CFI has cross-walked these National Objectives to the Expected Results in the 2010 Funding Agreement.

The CFI's Logic Model
 (Source: CFI Performance, Evaluation, Risk and Audit Framework (2011))



(1) O & M includes support for Major Science Initiatives.

(2) Infrastructure acquired and operationalized includes partner funding secured and support for O & M.

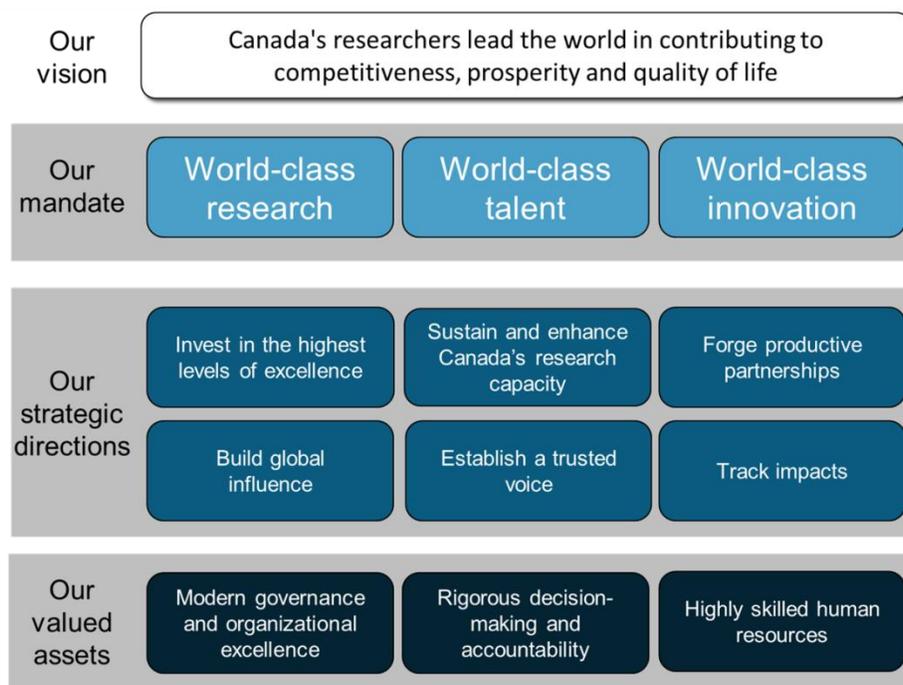
(3) Networks and collaborations include links between researchers, links between institutions and links with end users of the outputs of the R&D process.

APPENDIX 3: THE CFI'S STRATEGIC ROADMAP 2012-17

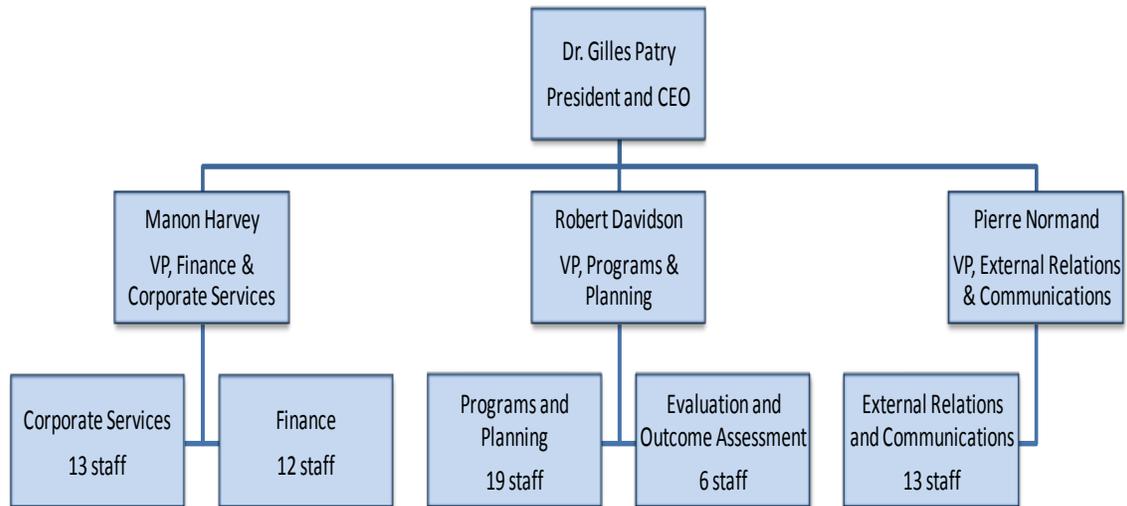
In 2011, the CFI updated its strategic plan. The plan – *CFI Strategic Roadmap 2012-17* – was finalized in 2012 and lays out the directions that CFI will adopt to meet the challenges of the economic environment and to help boost Canada's capacity for innovation.

An overview of the Roadmap is shown below.

The CFI's Strategic Roadmap 2012-17



APPENDIX 4: THE CFI'S ORGANIZATION CHART



APPENDIX 5: SELECTED EXTRACTS FROM THE CFI'S 2010 FUNDING AGREEMENT

From Section 1.1 – Definitions

Activities means "the providing by the Foundation of grants to **Ultimate Recipients** to support **Eligible Projects**".

Ultimate Recipient means "one of the following entities to which the Foundation may provide a grant to support an Eligible Project: a hospital university or post-secondary college, or educational institution that is situated in Canada and that carries on, or in the opinion of the Board is capable of carrying on, meaningful Research; or a non-profit organization or a trust, the activities of which are primarily carried on in Canada and carries on, or in the opinion of the Board is capable of carrying on, meaningful Research."

Eligible Project means "(a) a project carried on, or to be carried on, by an Ultimate Recipient for the modernization, acquisition, development, operation or maintenance of Research Infrastructure, by the Ultimate Recipient in Canada; or (b) the purchasing by an Ultimate Recipient of access to a world-leading research facility outside Canada, or to a major international collaborative research project, including the purchasing of such access by means of a Up-front Multi-year Funding toward a portion of capital costs, and purchase of a membership."

APPENDIX 6: EVALUATION ISSUES AND QUESTIONS

Core Issues (Treasury Board Directive)	Evaluation Questions
Relevance	
#1: Continued Need For Program Assessment of the extent to which the program continues to address a demonstrable need and is responsive to the needs of Canadians	1.1: Does the CFI's mandate continue to address a demonstrable need? Note: In formulating this question, it was agreed with the CFI and Industry Canada that the focus would be upon the CFI's mandate and how that mandate addresses a demonstrable need related to R&D infrastructure. The focus would not be upon the foundation model or upon the broader innovation system. 1.2: Is the CFI responsive to the needs of the R&D community?
#2: Alignment With Government Priorities	INCLUDED IN INDUSTRY CANADA EVALUATION. OUT OF SCOPE FOR THIS OPE OF CFI.
#3: Alignment With Federal Roles and Responsibilities	INCLUDED IN INDUSTRY CANADA EVALUATION. OUT OF SCOPE FOR THIS OPE OF CFI.
Performance (effectiveness, efficiency and economy)	
#4: Achievement Of Expected Outcomes Assessment of progress toward expected outcomes (immediate, intermediate and ultimate) with reference to performance targets, program reach and program design, including linkage and contribution of outputs to outcomes	4.1 What contributions has the CFI made to the achievement of its immediate outcomes? 4.2 What contributions has the CFI made to the achievement of its intermediate outcomes? 4.3 What contributions has the CFI made to the achievement of its long-term outcomes? 4.4 What contributions has the CFI made to the achievement of its ultimate impacts? 4.5 With respect to the achievement of expected outcomes, what challenges and or barriers were encountered by the CFI, and what has been done to address them? 4.6 Have the CFI's activities and outputs resulted in any unintended impacts, either positive or negative?
#5: Demonstration Of Efficiency and Economy Assessment of resource utilization in relation to the production of outputs and progress towards expected outcomes.	5.1 What and how are resources used by the CFI? 5.2 How are those resources related to the achievement of outputs? Include consideration of how relevance and contextual factors affect the outputs achieved. 5.3 How are those resources related to the achievement of outcomes? Include consideration of how relevance and contextual factors affect the outcomes achieved. 5.4 Has resource use been minimized given the results achieved and contextual factors? 5.5 Are there cost-effective alternatives to current program design and delivery, or resource consumption approaches? 5.6 With respect to efficiency and economy, what challenges and or barriers were encountered by the CFI, and what has been done to address them? 5.7 How could the design and / or delivery of the CFI or individual Funds be improved?

APPENDIX 7: LIMITATIONS AND MITIGATION STRATEGIES

Limitation	Impact/Potential Impact	Mitigation Strategy
<p>Analysis of Project Progress Report data Changes to the project reporting requirements were introduced for the 2011-12 reporting year. As a result, projects that completed award finalization prior to the end of 2010-11 continued to be required to submit reports for each of the five years following finalization. However, projects that completed award finalization after 2010-11 were required to submit reports starting when the infrastructure became operational, for four years when the CFI contribution was less than \$1 million and five years when over \$1 million.</p> <p>In 2010-11, modifications were made to some of the questions in the project reporting questionnaire.</p>	<p>Changes to the project reporting requirements and/or questions in the project reporting questionnaire meant that some of the data was not comparable over time.</p>	<p>Data impacted by changes in project reporting requirements and/or questions asked were analyzed and reported separately.</p>
<p>Key Informant Interviews Stakeholders invited to be key informants were selected across a range of stakeholder categories to reflect the stakeholder community, rather than to be a representative sample. In this context, key informant interviews provided insight into a process or problem, and, as such, are not conducive to counting up responses.</p>	<p>There may be an expectation by readers that information gathered in key informant interviews can be extrapolated across all stakeholders.</p>	<p>The range of responses was presented in addition to their frequency.</p>
<p>Survey of PLs/PUs The census (entire population) of PLs and PUs was selected for the online survey (i.e., all PLs/PUs associated with the two funds and award years listed above). The response rate was 25%. This exceeded the target response rate of 20%, which is typical of similar online surveys, and was the rate achieved in the survey conducted for the 2010 OPEA.</p> <p>Because the census of PLs and PUs was selected, it was not appropriate to apply a margin of error / confidence interval to the survey data. This is in accordance with the Government of Canada standards for the conduct of online surveys. Section 4.6 states</p>	<p>There still may be questions by readers as to the extent that the survey results can be considered to be representative of the entire population of PLs and PUs. They may also suggest that a margin of error / confidence interval should be applied to the survey data.</p>	<p>A comparison was made between the respondents who completed the survey with the total population. The two groups of data were compared on the following parameters for which data were available for the population: language, number of projects, fund type, year of award decision, amount of award and province of the respondent's institution. Based on these comparisons, we found that the two sets of data were very similar. There were a few minor variations; e.g., respondents tended to represent a slightly higher proportion of more recent projects; the LOF/JELF fund was slightly over-represented; and, larger awards were</p>

Limitation	Impact/Potential Impact	Mitigation Strategy
<p>that for census surveys, “do not state a margin of sampling error, as this does not apply to census surveys because no sample is drawn”: http://www.tpsgc-pwgsc.gc.ca/rop-por/enligne-online-eng.html#s4.6</p>		<p>slightly under-represented. But given the differences were small for each parameter, we determined that there was no need to statistically weight the data.</p>
<p>Survey of PLs/PUs Key survey questions from the survey for the 2010 OPEA were replicated in this survey. However, in some cases there were changes made in the questions, for example, in an attempt to better understand the employment history and choices of PLs and PUs.</p>	<p>Differences in the questions between the survey questionnaires used for the 2010 OPEA and the current survey have an impact upon the extent to which comparisons can be made between the findings for the two surveys.</p>	<p>Care was taken in this report as well as in the survey working paper to highlight cases where differences in the questions limit the ability to infer trends.</p>
<p>Financial data Financial data mapped to outputs or outcomes in the logic model was not available for the program.</p>	<p>There may be an expectation by readers that such data would be available and be used to assess the CFI's allocation and utilization of resources, regarding operational and allocative efficiency.</p>	<p>The report explains that the CFI's business cycles are not conducive to analyzing resources by output or outcome. Other lines of evidence – meta-analysis of the OMS studies, key informant interviews and the PL/PU survey were used to gather anecdotal evidence.</p>

APPENDIX 8: CROSS-WALK BETWEEN OUTCOMES IN THE CFI'S LOGIC MODEL AND EXPECTED RESULTS IN THE 2010 FUNDING AGREEMENT

Expected Results	Enhance the capacity of Ultimate Recipients to:			
	(a) Attract and retain the world's top research talent	((b) Enable researchers to undertake world-class research and technology development that lead to social, economic and environmental benefits for Canada	(c) Support private sector innovation and commercialization	(d) Train the next generation of researchers
Immediate Outcomes				
4.1.1 "State-of-the-art infrastructure acquired and operationalized"		X		
4.1.2 "High calibre researchers attracted and retained"	X.			
4.1.3 "Enhanced environment for productive networks and collaborations"		X	X	
4.1.4 "High quality research and training environment"		X.		X
Intermediate Outcomes				
4.2.1 "Increased capacity to carry out internationally competitive research and technology development"		X		
4.2.2 "Increased number of productive networks and collaborations"		X	X.	
4.2.3 "Increased number of HQP developed"				X
Long-Term Outcomes				
4.3.1 "World-class research and technology development"		X		
4.3.2 "Increased knowledge and technology transfer"			X	
Ultimate Impact				
4.4.1 "Social and economic benefits for Canadians"		X		