



PROGRAM EVALUATION & BEYOND

Evaluation of NSERC's Scholarships and Fellowships

Evaluation Report

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For the Natural Sciences and Engineering Research
Council of Canada

April 25, 2016

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Executive Summary

This report presents the evaluation of NSERC's Scholarships and Fellowships, for the period 2003-04 to 2013-14. Specific funding opportunities under review are Postgraduate Scholarships (PGS), Industrial Postgraduate Scholarships (IPS), Industrial Innovation Scholarships (IIS), the Collaborative Research and Training Experience (CREATE), and to a lesser extent the Postdoctoral Fellowships (PDF), Undergraduate Student Research Awards in Universities (USRA-U), and International Exchanges.

The funding opportunities support a significant number of students and postdoctoral fellows at various stages of their university studies, from the undergraduate level to post-doctoral studies. Actual expenditures under the sub-program amounted to \$73.3 million in 2013-2014.

The evaluation was based on the following seven lines of evidence:

- » a document and literature review
- » an administrative data review
- » a cost-efficiency analysis
- » surveys of recipients, trainees, and non-recipients
- » surveys of PGS, IPS and IIS Supervisors
- » case studies of CREATE grants
- » a review of CREATE reports

As described below, the findings from this evaluation indicate that the Scholarships and Fellowships sub-program is effective at supporting graduate students and post-doctoral fellows in the natural sciences and engineering (NSE). Each funding opportunity has its own niche consistent with its design, and together they constitute an effective toolbox for NSERC's intervention in support of NSE training.

Relevance

The funding opportunities were found to be relevant given government priorities and the needs of stakeholders. Federal government involvement in scholarships and fellowships is supported by the priority given to investing in people as part of a science, technology and innovation strategy, and is aligned with the objectives of NSERC. The funding opportunities are part of a larger system of financial support that is needed by graduate students and postdoctoral fellows. However, this evaluation finds that in the NSE, in general, all graduate students receive financial support. Finally, the professional training emphasized by some funding opportunities is highly valued.

Effectiveness

Although this evaluation finds evidence that the funding opportunities are contributing to longer-term outcomes, this contribution is not always as evident for more immediate outcomes, occurring during degree studies. This may be explained in part because of the complex funding environment in which NSE students find themselves. Because a typical NSERC recipient is in receipt of multiple other types of funding adding up to a much greater amount than their NSERC award or stipend, it is difficult to control for the effect of these other funding sources when assessing the contribution of the NSERC funding opportunity.

Across all highly qualified personnel (HQP) in the earlier survey cohort¹ (both recipients and non-recipients), more than 90% had completed their degree; the average Master's student took two years eight months to finish, and the average doctoral student took five years. It is possible that funding opportunities supported the completion of studies or the time to completion, but not in a way that is discernible via a comparison between recipients and non-recipients; this may be because all NSE graduate students are financially supported through their studies, be that by the NSERC funding opportunities or through other awards, prizes, or stipends.

The training environments provided under the various funding opportunities showed specific characteristics that are representative of their design: Canada Graduate Scholarships (CGS) recipients had more interactions within Canada while PGS awardees had more interactions outside Canada; IPS/IIS had more interactions with the private sector; IIPS/IIS and CREATE students enjoyed more exchange and internship opportunities.

On average, nine out of 10 recipients and non-recipients from the earlier cohort were working full-time at the time of the survey, and reported annual employment-related income between \$70,000 and \$80,000. The primary employer for Master's students was the private sector, while for doctoral students it was universities.

Although it was too early to assess long-term outcomes for CREATE, the PGS and IPS/IIS funding opportunities had observable impacts on employment outcomes. PGS recipients at both Master's and doctoral levels, compared to non-recipients, had higher incomes and reported their training was more useful to their careers. At the doctoral level, PGS recipients were more likely to be working full-time than non-recipients, and if employed in academia, were more likely to be research faculty as opposed to non-recipients who were more likely to be in a postdoctoral position. IPS/IIS recipients were more likely to be working in the private sector at both levels, and at the Master's level had higher income than non-recipients.

Participants from all funding opportunities contributed to research productivity. Although there were few observable differences across

¹ i.e., those who had been nominated or participated in competition cycles 2003 to 2008.

funding opportunities with regard to the types and amounts of academic outputs, the use of these outputs differed across funding opportunities: a greater number of citations of articles for PGS at the master level (M) and PGS at the doctoral level (D); more software and databases as well as more direct cost savings for IPS/IIS-M recipients; more professional practice outputs and more improved policies and programs for IPS/IIS-D recipients; more new practices for IPS/IIS recipients and CREATE trainees. These particularities were congruent with the design of the funding opportunities. PGS and IPS/IIS supervisors were satisfied with the awardee's research contributions to their research program or their impact on the supervisor's organization.

In order to address the question of whether direct or indirect funding of students provided better outcomes, a separate analysis was undertaken of the survey data, encompassing the full funding package of each student surveyed, assessing the extent to which types of Tri-Agency funding predicted better outcomes for these students. This analysis showed that direct Tri-Agency funding (scholarships or fellowships) had stronger positive associations with academic and employment outcomes than indirect Tri-Agency funding (stipends), and primarily at the doctoral rather than master's level.

One of the goals of CREATE is to influence the NSE academic system in a sustainable way; CREATE initiatives are expected to be self-sustaining by the end of the grant. The evaluation finds that this sustainability may not be assured. Many aspects of CREATE require funding that is unlikely to exist after the end of CREATE support.

Efficiency and Delivery

In terms of program delivery, few substantial issues were found; this is not surprising considering that most of the funding opportunities are long standing.

Funding opportunities were generally delivered in an efficient manner: about \$4.60 to \$5.50 in administrative costs were spent for every \$100 in grant funds, across all funding opportunities. For PGS, PDF, CGS and IIS, the cost-efficiency ratios have tended to increase over time (ranging from 80¢ to \$1.10 for every \$100 of grants awarded); however, they are still within acceptable ranges.

Although the majority of CREATE initiatives appear able to meet the program guideline requiring 80% of funds be directed to trainee stipends, CREATE recipients would prefer that this threshold be lowered. Also, some CREATE recipients indicated that limiting the payment of stipends to students from outside the NSE to 30% of payments was constraining in research domains at the interface of health, social sciences, and humanities.

Under-spending by CREATE initiatives was an issue. It was found that, on average, CREATE initiatives spent 35% less than the balance available to be spent in that year. Under-spending was greatest in Year 1 of the initiative's implementation (at 48%). By Year 3, annual expenditures met or exceeded annual instalments. If instalment amounts were reduced in Years 1 and 2, most CREATE initiatives would be better able to align expenditures with instalment amounts on a yearly basis.

While recipients were mostly satisfied with the management of the funding opportunities, the clarity (and fairness to a lower degree) of the selection process, the promptness of the notification, and the length of some awards generated lower satisfaction levels.

Recommendations

Based on the findings of the evaluation and noting that the results suggest that these programs are relevant and well managed, the following recommendations are offered to improve the operations and outcomes of these funding opportunities.

Recommendation 1: The quality and quantity of information communicated on the PGS and IPS/IIS selection processes should be improved.

Recommendation 2: CREATE program management should consider design adjustments to adapt to the initiatives' ability to spend in Year 1.

Recommendation 3: CREATE program management should consider revisiting the limits placed on certain CREATE spending categories.

Recommendation 4: Program management should continue to monitor administrative costs relative to grant expenditures.

ACRONYMS

CGS	Canada Graduate Scholarships
CIHR	Canadian Institutes of Health Research
COGS	Committee on Grants and Scholarships
CREATE	Collaborative Research and Training Experience
D	Doctoral level
FRQNT	Fonds de recherche du Québec - Nature et technologies
GPA	Grade point average
HQP	Highly qualified personnel
IIS	Industrial Innovation Scholarships
IPS	Industrial Postgraduate Scholarships
JSPS	Japan Society for the Promotion of Science
LOI	Letter of intent
M	Master's level
NAMIS	NSERC Award Management Information System
NSE	Natural sciences and engineering
NSERC	Natural Sciences and Engineering Research Council
PDF	Postdoctoral Fellowships
PGS	Postgraduate Scholarships
SSHRC	Social Sciences and Humanities Research Council
USRA-U	Undergraduate Student Research Awards in Universities

1 INTRODUCTION

The purpose of the Evaluation of the Natural Science and Engineering Research Council's (NSERC's) Scholarships and Fellowships, which covers fiscal years 2003-04 to 2013-14, is to provide NSERC senior management with information to support decision-making about the Scholarships and Fellowships sub-program. Specific funding opportunities under review are Postgraduate Scholarships (PGS) as well as the Industrial Postgraduate Scholarships (IPS), the Industrial Innovation Scholarships (IIS) funding opportunities, and the Collaborative Research and Training Experience (CREATE), and to a lesser extent the Postdoctoral Fellowships (PDF), Undergraduate Student Research Awards in Universities (USRA-U), and International Exchanges. The evaluation focuses on CREATE, PGS, and IPS/IIS, but also briefly assesses some evaluation issues related to relevance for USRA-U, PDF, and International Exchanges. The reason for this focus is that USRA-U and PDF have both been evaluated recently while CREATE, PGS, and IPS/IIS have not, and that International Exchanges represents a very small portion of the program's expenditures. The evaluation also helps ensure that NSERC is meeting the requirements of section 42.1 (1) of the Financial Administration Act and the Treasury Board Secretariat's Policy on Evaluation.

The evaluation focuses on the relevance of the funding opportunities (consistency with government priorities, need for the funding opportunities, and role of the federal government), their effectiveness at producing the expected impacts, and the efficiency and economy with which they are delivered.

Chapter 2 presents the evaluation approach. Chapter 3 provides information on the funding opportunities themselves. Chapter 4 deals with the issues relative to relevance while chapter 5 discusses results associated with effectiveness, and chapter 6 contains information on efficiency and economy. Chapter 7 synthesises the observations of the evaluation.

2 EVALUATION APPROACH

The evaluation of NSERC's scholarships and fellowships was based on the seven lines of evidence.

Case studies of CREATE grants

The case studies of CREATE initiatives and the cross-case analysis were intended to provide a qualitative understanding of CREATE's relevance and performance, including challenges and mitigating factors related to context, funding opportunity design and delivery.

Five cases were selected to represent the range of variability in the grants, while allowing adequate time for outputs and early outcomes for trainees to have occurred. Each case study comprised a document review and individual qualitative interviews with representatives from each of the following groups: the CREATE grantee, a Program Committee member other than the applicant (may also have been a co-applicant), collaborators with different roles in the initiative, representatives of the lead university, and trainees.

Each case was the subject of a case report. The analysis then synthesized case study findings in a cross-case report.

Review of CREATE reports

A file review examined progress- and mid-term reports associated with 74 CREATE grants awarded between 2009 and 2012. The review included the most recent progress- or mid-term report submitted by each grantee.

Document and literature review

The document and literature review served to help address program relevance and to provide background and context for the interpretation of findings from the student surveys pertaining to effectiveness. The evaluation team reviewed documents produced by NSERC, the Government of Canada, and other sources. Literature/documents from

external sources were identified through searches in databases and online search engines.

Administrative data review

The NSERC Award Management Information System (NAMIS) data pertaining to initial applications was mined to provide descriptive information mainly related to the relevance evaluation questions.

Cost-efficiency analysis

Financial data were reviewed to assess the administrative costs in comparison with those of similar funding opportunities and to measure the operational efficiency of PGS, IPS/IIS, and CREATE. This analysis used a traditional, resource-based costing method and divided expenditures into direct and shared costs which are allocated to the most detailed level possible. It featured full cost allocation (including indirect and direct non-attributable costs).

Surveys of recipients, trainees, and non-recipients

The evaluation collected survey data and used data collected as part of the evaluation of the Canada Graduate Scholarship (CGS) program led by the Canadian Institutes of Health Research (CIHR). The surveys of students were implemented from July to October 2014. Using similar survey questions for all groups of students enabled comparisons across the different types of funding support received. The years under review for these surveys are competition years 2003-2012, divided into two cohorts: 2003 to 2008, and 2009 to 2012. Non-recipients were surveyed as well as recipients. Two types of analyses were conducted on the survey data: 1) comparison by type of NSERC funding received (as well as involving students who applied for but did not receive NSERC scholarships and did not participate in CREATE training); and 2) assessment of the full funding package received by each student. The first comparison, which examines differences across recipients of different types of NSERC funding, presents the primary source of evidence used by this evaluation. The second assessment, which is presented in section 5.6 below, examines the difference between direct funding (e.g., scholarships) and indirect funding (e.g., stipends received through research grants) in their association with various experiences and outcomes.

Response rates varied from 39% for CREATE trainees (251 respondents), 29-30% for PGS (2,144 respondents) and IIS recipients

(114 respondents) to 22-23% for IPS (270 respondents) and CGS (1,425 respondents) recipients, to 12% for non-recipients (503 respondents).

Surveys of PGS, IPS and IIS Supervisors

The PGS supervisor sample was obtained through a review of application files. All researchers having supervised a PGS recipient in competition year 2011 and for whom NSERC has contact information was contacted to complete the survey. Out of 552 successful PGS applications from competition year 2011, 567 unique supervisors were identified² and contact information was found for 94%. Of the 533 sent an invitation to the PGS survey, 215 completed the survey.

For IPS and IIS, the supervisors' information was extracted from NAMIS. The sample covered all industry supervisors associated with students who obtained an award in fiscal years 2003-2004 to 2012-2013. The IPS sample included 653 supervisors and the IIS sample amounted to 206 supervisors. For IPS/IIS, of the 875 sent an invitation, including a few extra cases, 168 completed the survey.

Evaluation design

The evaluation design was both descriptive and comparative. Indicators of reach and outcomes were presented for each funding opportunity and, where possible, comparisons were provided among funding opportunities and between recipients and non-recipients. Because non-recipients were individuals who passed the initial review by their institution before their application was sent to NSERC, they were worthy candidates and as such they constitute an acceptable comparison group to gauge the results obtained by recipients and estimate the contribution of the funding opportunities.

Some of the funding opportunity outcomes are cast as improvements, (e.g., increased completion rates, improved quality of the highly qualified personnel). The evaluation provides useful information albeit not definitive information on such changes. However, many expected outcomes are expressed as simple states (e.g., recipients are supported, trainees develop professional skills). This evaluation is well equipped to provide evidence of the effectiveness of the funding opportunities with regard to the latter. In particular, the evaluation focussed on CREATE, a new initiative that had never been evaluated, and it offers rich information in its regard.

² Some applications listed more than one supervisor.

Challenges, mitigation and methodological notes

As in any cross-case study with a limited number of cases, the CREATE case study analysis has the limitation of uncertain generalizability. Also, the CREATE case studies saw a low response to interview invitations, especially among trainees probably due to the timing of the data collection outside the academic year. Nonetheless and by design, the cross-case study provides information on a range of CREATE outcomes and contributes to the interpretation of the observations from the other data sources.

As a source of evaluative information, it is possible that self-reported data in CREATE progress- and mid-term reports may overstate progress or impact in some cases. This risk was mitigated by using these reports along with other sources of information.

Data on CREATE grants do not cover an entire cycle of funding, as no CREATE grants had reached the end of its term as of the period under review. This means, firstly that trends observed in CREATE grants can not necessarily be expected to continue throughout the full term of the grants. Secondly, the issue of the sustainability of CREATE grants can only be addressed through an ex ante assessment at this time.

Relatively low response rates were noted for all surveys, especially for non-recipients. To mitigate this situation, survey responses were weighted to account for non-response bias. The number of responses received in each group was judged to be sufficiently large in absolute terms for confidence to be placed in the analysis.

The PGS supervisor data provide a snapshot from a single competition year. The results may not be generalizable across all competition years.

Globally, the evaluation offers evidence of relevance and performance from several sources of information and from a variety of angles. Taken together the available sources of evaluation findings constitute a credible web of evidence.

3 FUNDING OPPORTUNITIES

The Scholarships and Fellowships sub-program supports a significant number of students at various stages of their university studies.³ “At the undergraduate level, support for 16-week research internships in universities aims to nurture and develop students’ aptitudes towards research in the natural sciences and engineering and encourage them to undertake graduate studies and pursue a research career in these fields. At the postgraduate level, students earn a Master's or Doctoral degree at a domestic and/or foreign institution, after having spent time in an academic and/or industrial setting. The Council also supports the development of innovative training programs that encourage collaborative and integrative approaches, address significant scientific challenges associated to Canada’s research priorities, include the acquisition of professional skills, and facilitate the transition of new researchers from trainees to productive employees in the Canadian workforce. Postdoctoral Fellowships provide support to promising Doctoral graduates to further their research training in Canada or abroad.” Actual expenditures under the sub-program amounted to \$73.3 million in 2013-2014.⁴

Appendix A of this report provides a description and brief overview of the funding opportunities. This evaluation focusses on three funding opportunities (CREATE, PGS and IPS/IIS); three other opportunities that have been the subject of an evaluation recently were assessed only for their relevance (USRA-U, PDF, and International Exchanges).

The funding opportunities are delivered by the Research Grants and Scholarships Directorate of NSERC, which is headed by the Vice-President, Research Grants and Scholarships. The directorate has four divisions. PGS and IPS reside in the Scholarships and Fellowships Division and the CREATE in the Innovative Collaborations, Science Promotion and Program Operations Division.

³ This information is extracted from page 26 of the *2013-2014 Natural Sciences and Engineering Research Council Departmental Performance Report* <http://www.nserc-crsng.gc.ca/NSERC-CRSNG/Reports-Rapports/DPR-RMR/2013-2014/docs/DPR-RMR_eng.pdf>.

⁴ Page 26 of the 2013-2014 NSERC Departmental Performance Report.

The Committee on Grants and Scholarships (COGS) is an advisory sub-committee of Council. It is responsible for making recommendations on the allocation of funds to the various scholarship and fellowship funding opportunities. Such recommendations are made in accordance with specific decisions, guidelines, and funding provided by Council. COGS is also responsible for making recommendations for grant funding opportunities, within a separate allocation. It provides advice on and monitors the scholarships and fellowship funding opportunities and advises Council on policy issues and possible mechanisms in support of students and postdoctoral fellows.

4 RELEVANCE

Summary: *The funding opportunities are relevant because (1) the Government of Canada is committed to supporting science and technology personnel; (2) graduate students and postdoctoral fellows need financial support and the funding opportunities are part of a larger system of support; (3) the professional training emphasized by some funding opportunities is highly valued; and (4) federal government involvement is supported by the priority given to investing in people as part of a science and technology strategy.*

4.1 Do NSERC's scholarship and fellowship funding opportunities continue to be consistent with NSERC's and government-wide priorities?

Finding: *The Government of Canada is committed to supporting science and technology personnel; these funding opportunities are logically linked to the objectives of the Council.*

Industry Canada has placed the attraction of researchers high on its list of priorities: "Our Government will continue to provide record support to Canadian universities, colleges and polytechnics so they can develop, attract and retain tomorrow's research leaders and experts."⁵ More generally, the Government of Canada has also committed to "developing the next generation of S&T workers."⁶

As for NSERC, the scholarship and fellowship funding opportunities contribute to its strategic outcome: "Canada is a world leader in advancing, connecting and applying new knowledge in natural sciences and engineering."⁷ It does so via program 1.1.2 regarding CREATE, PGS, and USRA-U ("The expected results for this sub-program are: Bachelors, Masters, Doctoral students gain research experience in natural sciences and engineering that provides them with a competitive

⁵ Industry Canada (2014). Seizing Canada's Moment: Moving Forward in Science, Technology and Innovation in 2014.

⁶ Industry Canada (2009). Mobilizing Science and Technology to Canada's Advantage: Progress Report 2009.

⁷ NSERC 2014-2015 Report on Priorities and Plans, http://www.nserc-crsng.gc.ca/NSERC-CRSNG/Reports-Rapports/RPP-PPR/2014-2015/index_eng.asp#s1.3.1

advantage in their careers") and program 1.3.4 regarding IPS ("The expected results for this sub-program are: Students and fellows gain research experience in an industrial setting").

4.2 To what extent is there a need to support graduate students and postdoctoral fellows during their studies and research?

Findings: *The need to support graduate students and postdoctoral fellows is generally supported by the evidence available: there is some evidence that future demand for university graduates may surpass supply (particularly outside academia); there is a felt need for support during graduate studies even though the average Canadian NSE student debt load is not very high; there is a consensus about the need to add professional components to graduate studies; and the funding opportunities support industry access to needed graduate students. Moreover, the funding opportunities are part of a system of financial support to NSE students which includes provincial or university awards, research assistantships, teaching assistantships, or stipends; this system is currently able to support all NSE graduate students.*

There are four angles to the need to support graduate students and postdoctoral fellows: the labour market need for university graduates, the needs for financial support of these individuals during their studies and research, the need for professional training, and the needs of industry partners associated with the recipients.

4.2.1 Labour market need

The funding opportunities would more likely be relevant if future demand for people with graduate-level education was expected to exceed supply. While the evidence is nuanced, it tends to point in this direction.

Pointers to the existence of a disequilibrium between supply and demand include:

- » Anticipated growth in general labour demand in Canada will require commensurate growth in university graduates to prevent labour shortages in knowledge intensive occupations, particularly given the aging population.⁸

⁸ Association of Universities and Colleges of Canada (AUCC) (2010). Value of a degree in Canada's labour market; Association of Universities and Colleges of Canada (AUCC) (2011). Canada's universities: Mapping the way forward; Association of Universities and Colleges of Canada (AUCC) (2011). Trends in Higher Education: Volume 1- Enrolment; Tétrault, M (with Legault, M-A.) (2013). L'attribution des bourses d'études des conseils subventionnaires. Fédération étudiante universitaire du Québec.

- » Canada lags behind other developed countries in the production of graduate degrees.⁹
- » The development of highly qualified personnel (HQP) at the postdoctoral level is a key ingredient in stimulating research and development in Canada¹⁰ and post-doctoral fellowships were less common in NSE disciplines than in other disciplines a decade ago.¹¹

On the other hand, many graduate students and postdoctoral fellows need to change their career aspirations in academia, given the limited number of new faculty openings.¹² Furthermore, the number of graduate students in Canada has grown faster over the past 30 years than the growth in undergraduate students over the same time period.¹³

4.2.2 Need for financial support

The funding opportunities would more likely be relevant if graduate students and postdoctoral fellows suffered financial hardship during their studies or as a consequence of them. The evidence suggests that there is a substantial felt need that stems from low revenues during studies but that the accrued study debt is not a barrier to studies. The funding opportunities are part of the system of financial support to NSE students that also includes scholarships and prizes from other sources, research assistantships, teaching assistantships, loans, and other types of funding.

There is clear evidence that the financial value of the NSERC award or stipend is important to the recipients. Financial pressures during graduate studies are a large concern for one-half of Master's students and two-thirds of doctoral students. This is particularly the case for IPS/IIS recipients.¹⁴ No less than eight recipients out of 10, in all recipient groups, indicated that the award they received has a positive impact on their financial situation during their studies as well as currently.

⁹ Desjardins, L., & King, D. (2011). Expectations and labour market outcomes of doctoral graduates from Canadian universities. Ottawa, ON: Statistics Canada; Association of Universities and Colleges of Canada (AUCC) (2011). Trends in Higher Education: Volume 1- Enrolment; Annan R & Canadian Association of Graduate Studies (2012). Research internships and graduate education: How applied learning provides valuable professional skills and development for Canada's most highly trained students. MITACS; Science, Technology and Innovation Council (2011). State of the nation 2010 – Canada's science, technology and innovation system: Imagination to innovation – building Canadian paths to prosperity.

¹⁰ EKOS Research Associates Inc. (2013) Evaluation of NSERC's Postdoctoral Fellowships.

¹¹ King, D., Eisl-Culkin, J., & Desjardins, L. (2008). Doctorate Education in Canada: Findings from the Survey of Earned Doctorates, 2005/2006. Ottawa, ON: Culture, Tourism, and the Centre for Education Statistics. "The number of graduates pursuing further study or training with a postdoctoral fellowship remained the same for the past three years at around 75%. Graduates from humanities (about 86%) and social sciences (about 84%) were the most likely to take a postdoctoral fellowship while graduates in physical sciences and engineering (about 67%) were the least likely."

¹² Mitchell, J.S., Walker, V.E., Annan, R.B., Corkery, T.C., Goel, N., Harvey, L., Kent, D.G., Peters, J., Vilches, S.L. (2013). The 2013 Canadian Postdoc Survey: Painting a Picture of Canadian Postdoctoral Scholars. Ottawa, ON: Canadian Association of Postdoctoral Scholars and Mitacs.

¹³ Rose, Marilyn (2012). Graduate Student Professional Development: A Survey with Recommendations. Prepared for The Canadian Association for Graduate Studies in conjunction with The Social Sciences and Humanities Research Council of Canada.

¹⁴ Source: surveys of recipients conducted for this evaluation.

Furthermore, this economic need continued beyond doctoral studies: Surveyed seven years after receiving a fellowship, 91% of PDF recipients indicated that that NSERC funding was moderately to very important to remaining in an academic research environment.¹⁵

The prospect of receiving an award played a role in the decision to enroll in graduate studies for about four students out of 10 – more so among IPS/IIS recipients. About one-quarter of Master's award recipients and somewhat fewer doctoral award recipients would not have enrolled without the award. In comparison, 11% of non-recipients of all levels reported not enrolling in the degree for which they sought a scholarship or another degree at the same level.

According to the literature, many graduate students face economic pressures, including debt incurred over their different levels of study.¹⁶ However, this evaluation finds that the levels of debt incurred, even among those not in receipt of a NSERC award or stipend, are not insurmountable. Based on their responses to survey questions, non-recipients have roughly twice as much debt (about \$4,000 for Master's students and about \$8,000 for doctoral candidates) as most awardees — with the exception of IPS/IIS-D recipients who have a debt similar to non-recipients.

In some cases, students must spend time in paid employment to help fund their studies.¹⁷ This employment may detract from the time available for research and studies. However, according to the surveys, only about 5% of students worked in a non-academic job during their degree program by necessity. This is true of award recipients and non-recipients.

Survey data confirm that graduate students in NSE disciplines are generally supported financially through their studies. NSERC awards and stipends at the graduate level tend to represent a small proportion of the full funding package received by a typical student. A PGS recipient, for example, receives about twice the value of the PGS award in other types of funding, particularly from scholarships and awards from other sources. In the undergraduate world, in contrast, the USRA-U award represents almost two-thirds of students' personal annual income on average.¹⁸

¹⁵ NSERC (2012) Scholarship and Fellowship Career Survey.

¹⁶ King, D., Eisl-Culkin, J., & Desjardins, L. (2008). Doctorate Education in Canada: Findings from the Survey of Earned Doctorates, 2005/2006. Ottawa, ON: Culture, Tourism, and the Centre for Education Statistics.

¹⁷ M. Tétrault, op cit.

¹⁸ NSERC (2012) Evaluation of NSERC's Undergraduate Student Research Awards.

4.2.3 Need for professional training

Some of the funding opportunities are geared toward supporting professional training relevant to industry and other non-academic sectors. Evidence indicates a consensus that more professional (rather than academic) training is needed.

Some academic literature supports the need for professional skills development for graduate students, as a complement to research and technical skills development. Work experience and evidence of commercial understanding rank highly as selection criteria among employers of graduates in engineering and science disciplines.¹⁹ This may explain why three-quarters of PDF recipients consider that postdoctoral training was critical to their careers.²⁰

There are a number of examples in the literature of Canadian and international models for providing combined research and professional skills training.²¹ In some cases, employers have been involved in course design.²² Universities in several countries are now seeking to graduate researchers employable beyond research, with industry-relevant capabilities.²³ These types of initiatives have been driven by the observation that proportionately fewer doctoral graduates are finding employment within academia, indicating a need to be prepared for industry employment.²⁴

As part of the survey conducted for this evaluation, CREATE trainees, queried on what experiences an ideal training program would include to prepare students for the workforce, placed research activities highest on the list (about 90% indicated that this was between moderately and extremely important). Four activities came in a second group of importance (with ratings of about 75%): teaching activities, co-op at a

¹⁹ Association of Universities and Colleges of Canada (AUCC) (2010). Learning from living laboratories: Canada's universities contribute to the digital economy; Rose, Marilyn (2012). Graduate Student Professional Development: A Survey with Recommendations. Prepared for The Canadian Association for Graduate Studies in conjunction with The Social Sciences and Humanities Research Council of Canada; Mason G, Williams G, Cranmer S (2009). Employability skills initiatives in higher education: What effects do they have on graduate labour market outcomes? *Education Economics*, 17(1), 1-30.

²⁰ NSERC (2012) Scholarship and Fellowship Career Survey.

²¹ McPherson BD (2004). Toward a transformation in graduate education and fellowship funding in Canada: A guide for a discussion and a proposed agenda for the social sciences and humanities. Ottawa, ON: SSHRC Standing Committee on Fellowships and Career Development (SCFCD); Annan R & Canadian Association of Graduate Studies (2012). Research internships and graduate education: How applied learning provides valuable professional skills and development for Canada's most highly trained students. MITACS; Jacob, BA, Lefgren, L (2012). The impact of NIH postdoctoral training grants on scientific productivity. *Research Policy*, 41(2), pp.864-874.

²² G. Mason et al, op cit.

²³ Barnacle R, Dall'Alba G (2010). Research degrees as professional education? *Studies in Higher Education*, 36(4), 459-470; Servage L (2009). Alternative and professional doctoral programs: What is driving the demand? *Studies in Higher Education*, 34(7), 765-779; Mowbray S., Halse C. (2010). The purpose of the PhD: Theorising the skills acquired by students. *Higher Education Research & Development*, 29(6), 653-664.

²⁴ L. Servage, op cit.

non-academic organization, internship at a non-academic organization, and professional skills development workshops.

Based on the perceived need for better multi-path trainee preparation, institutions involved in the CREATE cases offered complementary training in many areas of professional development. The CREATE initiatives studied have provided trainees with valuable and useful exposure to alternative career paths and helped develop their skills for a broader range of career options.

The data do not suggest, however, that CREATE is the unique purveyor of this response. CREATE provides an additional form of support for graduate student and postdoctoral fellow training. In order to respond to the need for greater exposure to professional opportunities and skills, many universities expanded or are considering expanding undergraduate co-op models to graduate training.

4.2.4 Industry need

In the surveys conducted for the present evaluation, IPS/IIS industrial supervisors articulated another need for these funding opportunities: 67% indicated that IPS/IIS had been very or extremely effective in addressing the needs of their organization (mostly private sector, some not-for-profit organizations). Some 68% of IPS/IIS industrial supervisors indicated that, without funding to the student, they would have delayed or cancelled their project. Almost nine in ten (86%) declared that they would host other IPS/IIS awardees.

4.3 Is there a necessary role for the federal government to support students during their graduate studies and postdoctoral research?

Findings: *Federal government involvement in scholarships and fellowships is supported by the priority given to investing in people as part of a science and technology strategy.*

The Science, Technology and Innovation Council articulates a clear role for the federal involvement in developing Canadian talent: “Developing world-class talent is the foundation for Canada’s success now and in the future. Nurturing and growing the knowledge and skills of people through all stages of their lives allows them to contribute to society and the economy, and it underpins the country’s progress and competitiveness in

all areas. Investment in ongoing, high-quality education, training, and mentoring of our talent must be a priority."²⁵

NSERC sees its own role as making "investments in people, discovery and innovation to increase Canada's scientific and technological capabilities for the benefit of all Canadians. NSERC invests in people by supporting postsecondary students and postdoctoral fellows in their advanced studies. We promote discovery by funding research conducted by postsecondary professors and foster innovation by encouraging Canadian companies to participate and invest in postsecondary research and training."²⁶

While these references don't establish a necessary role, they support a useful role for the federal government. One dissenting voice was heard as part of the CREATE case studies: a question was raised about the appropriate federal role in structuring graduate training programs, in ways that could be considered connected to, or in the constitutional domain of, provincial education authorities. Note, however, that CREATE is not meant to influence curriculum and the actual training is delivered by universities.

²⁵ Science, Technology and Innovation Council (2011). State of the nation 2012.

²⁶ http://www.nserc-crsng.gc.ca/NSERC-CRSNG/vision-vision_eng.asp

5 EFFECTIVENESS

This section deals with the effectiveness of the funding opportunities. It shows that each funding opportunity contributes to supporting studies in the NSE using a particular angle and, together, the funding opportunities constitute an effective toolbox for NSERC's intervention in support of NSE training.

5.1 To what extent are high calibre, highly qualified personnel participating in CREATE, IPS/IIS and PGS?

Findings: There is some evidence that high-calibre HQP are being selected to participate in the PGS, CREATE, and IPS/IIS funding opportunities, based on supervisor ratings of students and undergraduate GPAs. Ratings of the prestige of each funding opportunity are consistent across stakeholder groups, with PGS rated higher than IPS/IIS and CREATE.

5.1.1 Success rates

Considering that the selection criteria are excellence-related, a low rate of successful applications might be an indicator that awardees are among the most qualified. In the case of PGS/CGS, the success rate is artificially inflated by the pre-filtering performed by universities to maximise the use of their award quotas.²⁷

According to an administrative file review, in competition years 2009 to 2013, the application success rate was 51% for doctoral PGS (and CGS-D); it declined from the low 60's in 2009-2010 and to the mid 40's in 2011-2013. At the Master's level, PGS (and CGS) application success rates averaged 63% between 2009 and 2013; it decreased from 2009 (73%) to 2011 (52%) and then increased (63% in 2013). The success rates for IPS/IIS applications were nearly 100% throughout the period – but the volume of application is much lower for these funding

²⁷ See Chapter 0 for details. Applications that were not relayed by universities to NSERC (i.e., they were filtered out by universities) were not used as a comparison because of concerns over the data quality.

opportunities. Note again that applications deemed unsuccessful by universities are not included in the calculations which reduces the validity of this indicator.

5.1.2 Supervisor rankings

Supervisors are generally satisfied with the quality of their trainees. One-half of academic supervisors of PGS awardees indicated in a survey that the student was "much above average" and an additional one-third that they were "somewhat above average". Regarding IPS/IIS awardees, one-third of supervisors ranked them as "much above average" and an additional one-third "somewhat above average".

The CREATE grantees indicated that the quality of trainees participating in the initiatives was high. CREATE trainees were identified most often through advertisements on the web sites or through informal and formal networks according to information gathered in the case studies. They were mostly screened using resumes, grade point averages and interviews.

5.1.3 Prestige

PGS supervisors and recipients of CGS, PGS, and IPS/IIS awards as well as CREATE trainees were asked to rate the prestige of various types of funding from NSERC to HQP. Across all respondent groups, the Vanier CGS was consistently rated the most prestigious, followed by CGS-Doctoral, PGS, and CGS-Masters. CREATE was rated lower than all NSERC scholarship awards, but higher than a stipend from an NSERC research grant.

5.1.4 Undergraduate grades

PGS and CGS recipients appear to have had higher grades in their undergraduate degrees than IPS/IIS recipients and CREATE trainees.²⁸ 97% of Master's level PGS and CGS recipients received an A grade (A- to A+); whereas about 90% received such a grade at the doctoral level (with CGS grades higher than PGS). Undergraduate grades were somewhat lower for IPS/IIS and CREATE, particularly the former where only 70% at both levels had an A grade. Non-recipients were not asked this question, and although national statistics on average grades are not available, it is highly likely that these statistics are well above that of the national population (although since they are self-reported, their accuracy is uncertain).

²⁸ According to self-reported undergraduate GPAs from the survey.

5.2 To what extent has the type of support received had an impact on students' and fellows' training environment?

Findings: *Nine out of ten applicants completed their Master's or doctoral degree but funding opportunities did not contribute to shorter studies. The training environments provided under the various funding opportunities show specific characteristics that are representative of their design: CGS recipients had more interactions within Canada while PGS awardees had more interactions outside Canada; IPS/IIS had more interactions with the private sector; IIPS/IIS and CREATE students enjoyed more exchange and internship opportunities.*

This section is concerned with how the different funding opportunities provided different training environments to participants. We review program completion rates, the duration of studies, opportunities for interactions, and the foci of training.

5.2.1 Completion of program

Focusing on applicants from 2003 to 2008 (cohort 1), the vast majority (in excess of 90%) had completed their degree, be that at the Master's or the doctoral level. At the Master's level, PGS awardees were slightly more likely to have completed their degree (94%) than CGS awardees (87%). At the doctoral level, PGS and CGS students were somewhat more likely to have completed (95% and 97%) than IPS/IIS students (87%). Program completion rates were the same across academic disciplines.

5.2.2 Duration of studies

The evidence suggests that awards do not contribute to a shorter duration of studies.²⁹ All groups at both levels took the same amount of time to complete their degree, including non-recipients, with the exception of IPS/IIS-M recipients. IPS/IIS-M recipients took 10% longer than PGS and CGS recipients to complete their Master's degree (34 months) and they were more likely to be behind schedule than PGS recipients (62% vs. 36%); this is an expected result of spending time in industry. As the next exhibit shows, considering all supported and unsupported graduates, the average time to graduation has decreased between cohort 1 and cohort 2 both at the Master's level (although the median has stayed the same) and at the doctoral level.

²⁹ Duration of studies was calculated based on self-reported start and end dates for their degree studies.

EXHIBIT 5.1 • Study Duration in Months (all groups)

	Master's level		Doctoral level	
	Cohort 1, 2003-2008	Cohort 2, 2009-2012	Cohort 1, 2003-2008	Cohort 2, 2009-2012
Mean	32.3	29.0	60.3	56.0
Median	28.0	28.0	59.0	55.0
n	479	736	994	948

Note: differences between cohort 1 and cohort 2, within levels of study, are statistically significant.

Students from all disciplines completed their degree within the same number of months except for engineering students who complete their degree 5.3 months faster than health sciences.

5.2.3 Interactions

The frequency of meeting with supervisors was the same across programs. PGS-M and PGS-D students were less likely to interact with researchers in Canada than CGS recipients, but more likely to interact with researchers and HQP from outside Canada; this might well be related to the fact that PGS awardees are allowed to study outside Canada whereas CGS students are not.

IPS/IIS recipients interacted more frequently with companies and had more involvement with the private sector, which is congruent with the design of the programs which emphasize industrial connections. IIPS/IIS and CREATE students enjoyed more exchange and internship opportunities which, again, is consistent with the program designs.

5.2.4 Training focus

Students described the level of emphasis given to each of 28 topics as part of their study program. A factor analysis based of these answers identified five types of training initiative areas of focus. Funding opportunities were associated with different combinations of program focus.

The next table describes the nature of the program focus and depicts which program focuses more on some areas. This table suggests that funding opportunities are associated with certain types of program focus: more technical research skills and technical professional skills for CGS (as well as teaching skills at the doctoral level; more professional creativity and communication skills (Master's) and technical professional

skills for CREATE; more professional creativity and communication skills for all funding opportunities (compared to non-recipients).

EXHIBIT 5.2 • Training Focus Associated with Funding Opportunities

Emphasis	Level of emphasis	More in...	Less in...
Technical research skill emphasis (research idea, research protocol, data collection, etc.)	Highest	CGS, non-recipients	PGS, CREATE, IPS/IIS-D
Professional creativity and communication skills (networking, communications, critical thinking, etc.)		CREATE-M, PGS-M, non-recipients-M, IPS/IIS-M	CGS-M
Research creativity and communication skills (collaboration, international, knowledge transfer, etc.)		No differences	
Teaching skills		CGS-D	IPS/IIS-D, CREATE-D
Technical professional skills (business, entrepreneurship, finances, etc.)	Lowest	CREATE, CGS	PGS, IPS/IIS, non-recipients

Satisfaction with opportunities available to develop skills during graduate studies was high (above 90%) in all student groups with regard to research skills. Satisfaction was lower regarding teaching skills (about 70%, doctoral level only), and personal/professional skills (about 80% at the doctoral level). At the Master's level, satisfaction with opportunities to develop personal/professional skills was variable – lower for CGS and non-recipients (around 75%) and higher for CREATE trainees (97%).

Although little difference was observed across recipient groups, an analysis of direct vs. indirect funding (see section 5.6 below) showed that greater indirect funding at the Master's level was associated with lower satisfaction with acquisition of research skills.

Satisfaction with supervisors and with the available infrastructure reached or exceeded 80% at both levels and among recipients and non-recipients as measured by survey data. The only exception is that PGS-M recipients were more satisfied with the equipment available to them than non-recipients.

5.2.5 CREATE specifics

Various sources of evidence indicate that CREATE trainees are offered a unique, value-added learning environment where they are more likely to

be paid via a stipend, where they are exposed to topics that others are less likely to address (e.g. ethics, interdisciplinary, strategic planning) through a greater variety of training opportunities.

In their survey responses, CREATE trainees (both at the Master's and the doctoral levels) indicated spending significantly more hours toward paid academic work to fulfill the requirements of the degree program, and research/teaching activities outside of the requirements of the degree. This is congruent with the CREATE model (stipend payments, not scholarships).

CREATE trainees report more emphasis in their training than some other groups vis-à-vis the following:

- » Master's level: knowledge of research integrity/ethical conduct, multidisciplinary/interdisciplinary research, international research collaborations, strategic planning/advice, and digital activities.
- » Doctoral level: development of research protocol/methods, knowledge translation/mobilization, multidisciplinary/interdisciplinary research, strategic planning/advice, and digital activities.

CREATE reports reviewed indicated that a variety of training opportunities were offered to trainees. Most prevalent were workshops, research activities and conferences, followed by courses, internships, and guest lectures. A variety of organizations contributed to these opportunities — in decreasing order of frequency: other Canadian universities, Canadian companies, Canadian government organizations, non-Canadian universities, other Canadian organizations, and non-Canadian companies.

An unexpected finding from the CREATE cross-case analysis was the major differences in the CREATE initiatives' approaches to and operationalization of the training environment. The different models have different adaptive strengths for the domain and nature of the research community they are serving. CREATE initiatives that aimed to develop a cohesive cohort of trainees appeared to be especially successful in generating attractiveness and prestige among students and fellows, which was contributing to an increase in the number and quality of applicants and hence trainees.

The CREATE grants studied as cases have had multiple impacts on training environments, including:

- » consolidation and concentration of new suites of graduate courses;
- » internships in other academic research laboratories, in industry, government, or other settings;

- » diverse collaborations that help trainees gain access to a greater breadth of knowledge and skills than they would have otherwise;
- » exposure of trainees to, and increasing valuing of, career paths outside academia; and
- » integration of substantial and varied professional skills training.

In line with the CREATE approach, participating institutions are increasingly incorporating professional skills development as part of graduate training as documented in the case studies.

Nearly all CREATE grants indicated in their reports that they provide trainees with value added experiences in the 18 categories listed in the reporting template which include such things as multi-disciplinary research collaboration, research competence, and societal responsibilities. Regarding activities targeting specific skills/experiences, activities targeting communication and interpersonal skills as well as critical and creative thinking were most common.

5.3 To what extent has the type of support received had an impact on students' and fellows' experiences, skills, professional networks, employability and educational/career goals?

Findings: *Nine out of ten Cohort 1 respondents from all groups worked full time. While the private sector is the major employer for Master's students and universities for doctoral students, IPS/IIS recipients were more likely than other student groups to work in the private sector at both levels. On average, recipients and non-recipients reported annual employment-related income between \$70,000 and \$80,000 (more for PGS, IPS-M, and CGS-D and less for CGS-M and non-recipients). For PGS recipients, significant differences in employment outcomes were observed when compared against non-recipients, particularly at the doctoral level. For the other award groups, however, there were limited differences in their professional experiences.*

This section is concerned with the impact of funding opportunities on the employment history of awardees and participants.

All in all, recipients and non-recipients presented a successful employment history. Nine out of ten Cohort 1 respondents worked full time; this proportion was the same for all student groups.

The private sector was the major employer for Master's level awardees and non-recipients according to survey data. Among them, IPS/IIS-M recipients were more likely to work in the private sector than PGS-M recipients and less likely to work in a university setting. A similar pattern

was found at the doctoral level but with more individuals employed in universities.

Awardees and non-recipients held significant positions. By and large, one-half of awardees and non-recipients indicated that they have significant influence over others in their organization. About four in ten stated that they have influence over the strategic direction of their organization – more among IPS/IIS recipients than among PGS recipients.

On average, recipients and non-recipients reported annual employment-related income between \$70,000 and \$80,000. PGS-M and IPS/IIS-M recipients declared higher income than CGS-M recipients and non-recipients. PGS-D and CGS-D recipients declared a higher level of income than non-recipients. Cohort 1 employment income was higher for PGS-D recipients in mathematics and computer sciences (\$87,236) and engineering (\$94,261) than for PGS-D recipients in life sciences (\$62,811) and physical sciences (\$72,397).

For survey respondents at the doctoral level, employment income ranged from \$67,000 in the not-for-profit sector to \$88,000 in the private sector. Within universities, employment income ranged from \$49,000 for postdoctoral fellows to \$89,000 for research faculty.

Seven to nine awardees out of ten (depending on funding opportunity) indicated that their current job was at least moderately related to their degree program. IPS/IIS-M recipients were more likely to state so than non-recipients, as were PGS-D awardees. Similar results were obtained on the usefulness of the training in preparing them for a career. As discussed in section 5.6 below, greater direct funding (i.e., scholarships) was associated with a greater inclination to find one's training useful for one's career, at the doctoral level.

5.3.1 PGS specifics

PGS recipients had better employment outcomes than non-recipients, particularly at the doctoral level. PGS awardees were highly likely to finish their degree and PGS-M were more likely than average to continue on to the doctoral level.

The overwhelming majority of PGS award recipients (96.5%) go on to finish the degree for which they are being funded.³⁰ Over 62% of PGS award recipients at the Master's level plan to go on to obtain a doctoral degree, a figure well above the national average of 32% of natural

³⁰ Natural Sciences and Engineering Research Council (2012). Scholarship and Fellowship Career Survey.

sciences and engineering master's degree holders who go on to do a PhD. Over 64% of respondents at the PhD level would like to pursue a postdoctoral fellowship.

PGS recipients at both Master's and doctoral levels reported earning a higher income than non-recipients. PGS recipients at the doctoral level are more likely to be working compared to non-recipients, and when employed in academia, are more likely to be research faculty, as opposed to non-recipients who are more likely to be postdoctoral fellows.

A large majority of the PGS recipients believe that graduate training was critical to their careers, and that the award improved their prospects of getting a permanent position in a relevant area. PGS recipients at the doctoral level find their employment to be more closely related to their studies than do non-recipients.

5.3.2 IPS/IIS specifics

The preferences of industry coalesce with the training experience offered by IPS/IIS. Indeed, IPS/IIS industrial supervisors indicated in a survey that the most important factors in making hiring decisions for entry-level candidates in research intensive positions in their organization were demonstrated research skills (69% very to extremely important) and the level of formal education (68%) whereas prior industry research experience (37%) and business-related skills (28%) were less significant. Meanwhile, two-thirds of them classified as at least very important the industrial research experience a student gains through the IPS/IIS for obtaining permanent employment in a research and development position in industry.

5.3.3 CREATE specifics

Indications are that the CREATE experience is also a conduit to employment.

There was consensus across case study stakeholders and trainees that CREATE initiatives had broadened trainees' research and career perspectives. Important from trainees' point of view, was their development of collegial and professional networks, including contacts with industry or other sector representatives. Provision of CREATE funding supported to graduate students facilitates their capacity to focus on research and hence to complete their degree in a timely manner.

In terms of employability, it was generally too early to tell from the CREATE case studies whether CREATE graduates will be more employable and secure better positions than comparable non-CREATE

trainees. From the CREATE file review, it can be gathered that, where the information is available, after graduation or completion of their post-doc, 55% were still in academic training, 5% were working for a CREATE collaborator, 21% were working for a non-collaborator, and 15% worked for a university.

5.4 To what extent has the type of student and fellow support had an impact on research productivity, university researchers, collaborating organizations and communities?

Findings: *Participants from all funding opportunities contributed to research productivity. There were few differences between recipients and non-recipients with regard to the types and amounts of academic outputs. However, regarding the use of these academic outputs, each recipient category appears to demonstrate somewhat of a specific pattern: a greater number of citations of articles for PGS-M and PGS-D; more software and databases as well as more direct cost savings for IPS/IIS-M recipients; more professional practice outputs and more improved policies and programs for IPS/IIS-D recipients; more new practices for IPS/IIS recipients and CREATE trainees. These particularities are congruent with the design of the funding opportunities. PGS and IPS/IIS supervisors were satisfied with the awardee's research contributions to their research program and their impact on the supervisor's organization.*

5.4.1 HQP academic outputs

The academic outputs of awardees and non-recipients was fairly similar among groups. An analysis of direct vs. indirect funding showed that, at the doctoral level, greater direct funding was associated with greater numbers of peer-reviewed publications, as presented in section 5.6 below. CREATE-M trainees reported more outputs in several categories compared to all other groups at the Master's level. CGS-D awardees reported more published papers than other groups and CGS-M more than IPS-M.

Citation of publications was the most frequent result from research among those tested. Tools, techniques, instruments, and procedures came second. PGS-M and PGS-D reported more cited articles than other recipient groups. IPS/IIS-M recipients reported more software and databases as well as more direct cost savings than CGS-M recipients. IPS/IIS-D recipients reported much more professional practice outputs than other groups (including CGS-D) and more improved policies and programs than CGS-D. IPS/IIS recipients and CREATE trainees reported more new practices than other groups. Awardees and non-recipients

indicated similar numbers of oral presentations and poster presentations made at international conferences – with the exception of CGS-D indicating more of them than IPS/IIS-D.

5.4.2 HQP contributions to supervisors' research

PGS and IPS/IIS awardees contributed to the research of their supervisors. Based on survey data, some 80% of PGS supervisors were "very satisfied" with the awardee's research contributions to their research program; almost all supervisors were at least "satisfied". Two-thirds indicated that the awardee had a large positive impact on their research productivity. One-half of IPS/IIS industrial supervisors reported a large or very large positive impact of the awardee on their organization.³¹

CREATE specifics

CREATE trainees contributed to a significant number of academic outputs. According to CREATE reports, on average, each CREATE initiative has contributed to producing 66 conference presentations/posters, 28 refereed journal articles (accepted or published), 6 refereed journal articles (submitted) and 1 patent during the reporting period covered by their most recent progress/mid-term report provided by the initiatives. CREATE initiatives had an average of 18 awards going to CREATE trainees during their most recent reporting period. Without comparable data for other grant/scholarship/fellowship funding opportunities, it is difficult to value this output.

5.5 To what extent has the CREATE program improved standards and practices in research training at participating institutions?

Findings: *The sustainability of CREATE practices may not be assured. The three most commonly reported activities most likely sustainable after the end of the grant were academic courses and programs, student activities, and collaborations.*

CREATE reports suggested that the sustainability of CREATE practices may not be assured. Institutional commitments to facilitate and further the plans and goals of the CREATE initiative beyond the term of the grant are partial. The three most commonly enduring activities were academic courses and programs, student activities, and collaborations.

³¹ The IPS/IIS questionnaire used a seven-point scale whereas the PGS questionnaire used a four-point scale.

The institutions and laboratories involved in the case study CREATEs are already considered to be highly reputable, but university representatives indicated that the CREATE grants reinforced their prestige and hence their attractiveness. In all five cases, the research areas of the CREATE had been recognized by at least one of the participating institutions as a strategic research priority for their institution.

Full sustainability of the CREATEs examined in the case studies appears unrealistic. On the other hand, some CREATEs will likely evolve into new entities that will preserve the most unique and sought after aspect of their training initiatives if they remain within the strategic research priorities of participating institutions and if there are no disincentives for faculty to participate.

5.6 Analysis of direct versus indirect funding

Finding: *Direct Tri-Agency funding (scholarships or fellowships) had stronger positive associations with academic and employment outcomes than indirect Tri-Agency funding (stipends), and primarily at the doctoral rather than Master's level.*

In addition to analyzing survey responses by award type, an analysis was done of the total funding package of each student to examine the extent to which direct or indirect funding from the Tri-Agencies predicted future academic and employment outcomes.³² There is evidence from the literature that the type of financing (e.g., scholarships, research assistantships, or loans) can have an effect on persistence, degree completion, and quantity of research outputs among graduate students.³³

At the Master's level, no positive associations were found between the amount of Tri-Agency funding received, and academic and employment outcomes. Conversely, students with larger amounts of indirect funding from the Tri-Agencies had *lower* ratings of satisfaction with their development of research skills. This indicates there may be room for improvement in the development opportunities provided to Master's students receiving stipends from NSERC research grants.

³² Only students who had completed their studies at the time of the survey were included in this analysis. Gender, year of birth, and year of graduation were included as covariates in the analyses.

³³ Industry Canada (2007). Mobilizing Science and Technology to Canada's Advantage; Strayhorn, T.L. (2010). Money Matters: The Influence of Financial Aid on Graduate Student Persistence. *Journal of Student Financial Aid*, 40 (1), pp.4-25; Mendoza, P., Villarreal III, P., & Gunderson, A. (2014). Within-Year Retention among Ph.D Students: The Effect of Debt, Assistantships, and Fellowships. *Research and Higher Education*. 55, pp. 650-685; Ehrenberg RG, Mavros PG (1992). Do doctoral students' financial support patterns affect their times-to-degree and completion probabilities. Working Paper No. 4070, NBER Working Papers Series. Cambridge, MA: National Bureau of Economic Research; Larivière, V. (with Viau, L.) (2011). La relation entre les bourses des doctorants et le rendement en recherche, l'impact scientifique et l'obtention des diplômes. Montréal, QC : Conseil national des cycles supérieurs, Fédération étudiante universitaire du Québec.

At the doctoral level, there were several positive associations between outcomes/experiences and direct Tri-Agency funding, including the number of published/accepted peer-reviewed articles written/co-written by respondents. This association was stronger for Tri-Agency funding than for other funding (which was also significantly associated with the number of papers). A significant positive association was also found between direct Tri-Agency funding and student development of personal/professional skills. However, the effect was smaller than the effects of direct funding from an external source, and other types of funding. Finally, students who received larger amounts of Tri-Agency funding directly rated the usefulness of their training higher than students with less direct Tri-Agency funding. There were no significant associations between indirect Tri-Agency funding and these same outcomes and experiences.

Overall, it appears that direct Tri-Agency funding has stronger positive associations with experiences and outcomes than indirect Tri-Agency funding, and primarily at the doctoral rather than Master's level.

This finding appears to be corroborated by the views of PGS supervisors. In response to survey questions,³⁴ PGS supervisors indicated that scholarships tend to provide better quality experiences to HQP than stipends regarding research skills and professional skills; they consider on the whole that scholarships and stipends provide similar quality experiences to students with regard to teaching skills.

EXHIBIT 5.3 • Relative value of scholarships and stipends at providing quality training experiences in each training area according to PGS supervisors

Which provides most value? (% of PGS supervisors)	Scholarships provide more value	Scholarships and stipends provide equal value	Stipends provide more value
Research skills	64%	21%	15%
Teaching skills	26%	43%	31%
Professional skills	49%	36%	15%

³⁴ "Please indicate whether you think that scholarships or stipends provide a higher quality training experience for developing the three broad skill areas listed below: research skills; teaching skills; professional skills."

6 EFFICIENCY AND ECONOMY

6.1 CREATE Income Support

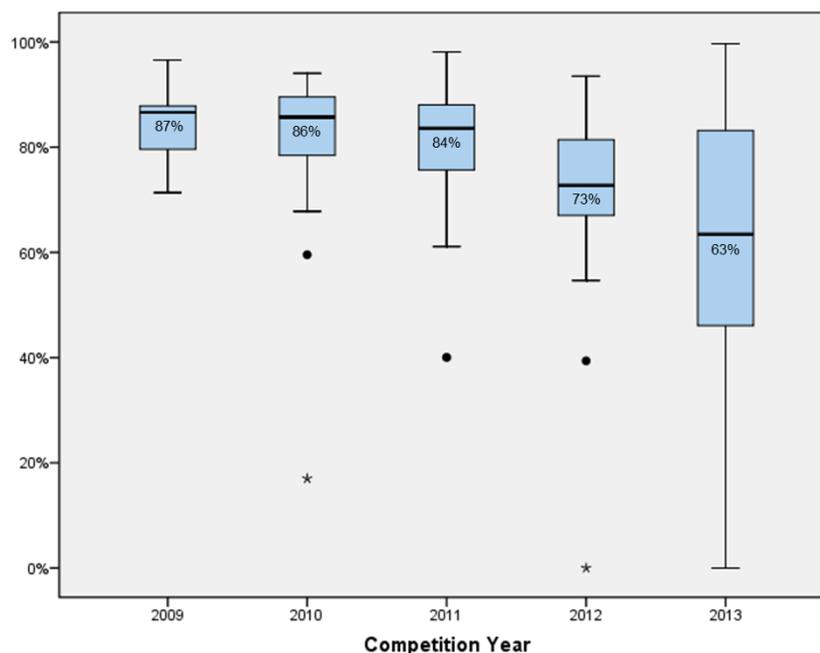
Findings: CREATE provides substantial income support to trainees in the form of stipends. The majority of CREATE initiative appear to be able to meet the program guideline that requires that 80% of the funds be used for trainee stipends.

Based on a file review, between April 2009 and September 2013, at least 3,937 unique trainees have participated in CREATE initiatives according to the CREATE progress/midterm reports from 75 CREATE grants.³⁵ Two-thirds (69%) received stipends averaging a little under \$13,000 yearly. The other third were trainees in CREATE activities but not in receipt of a stipend. Among those for whom the information is available, one-quarter of CREATE trainees were at the undergraduate level (24%), one-third at the Master's level (30%) or doctorate level (34%), and one-tenth at the post-doctoral level (10%).

In effect, based on statement of accounts for grants from competition years 2009 to 2013, 81% of the \$58 million expended by CREATE initiatives went to stipend payments to trainees (52% to Canadians or permanent residents and 29% to trainees of foreign origin, totalling the 81% noted above; 5% to students at the undergraduate level, 33% to students at the Master's level, 27% to students at the doctoral level, and 16% to postdoctoral fellows). This is in line with program guidelines which state that at least 80% of the total CREATE funding must be used for trainees' stipends over the course of the grant. Data from the Statements of Accounts indicate that this percentage increases through the course of the CREATE grant and the median value exceeds 80% by year 3. However, by year 5, 30% of initiatives are still below this threshold. We can't yet conclude how many meet the target by end of grant, as none of the CREATE initiatives are completed yet.

³⁵ These CREATE grants were at different stages of development, having started their activities on or in between 2009 and 2012.

EXHIBIT 6.1 • Percentage of CREATE funds used for stipend payments by competition year according to Statements of Accounts



Note: Exhibit 6.1 displays the actual percentage that stipends represent of all expenses across projects by competition year, cumulatively up to 2013 (e.g., competition year 2009 shows cumulative results for five years of grant funding). The boxplot shows the median value (the middle horizontal bar), the lower and upper quartiles (the lower and higher horizontal bars), and minimum and maximum values, for all CREATE initiatives in each competition year. Dots and stars represent outliers.

6.2 Are the most effective and efficient means being used to deliver CREATE, IPS/IIS and PGS?

Findings: Funding opportunities are generally delivered in an efficient manner. For PGS, IPS, IIS, and CREATE, the NSERC administrative expenditures represent 4% to 5% of total costs while grant expenditures account for the remaining 95%. Over five years, administrative costs have had a tendency to increase as a proportion of the grant funds. While recipients were mostly satisfied with the management of the funding opportunities, the clarity (and fairness to a lower degree) of the selection process, the promptness of the notification, and the length of some awards generated lower satisfaction levels.

6.2.1 Administrative costs

A cost-efficiency analysis was conducted of grants and NSERC administrative expenditures from 2009-2014. Overall, it was determined that the PGS, IPS/IIS, and CREATE funding opportunities were delivered in an efficient manner. For all funding opportunities over the five year

period, administrative costs averaged \$4.60 to \$5.50 for every \$100 awarded (not including value/cost of volunteer time).

As Exhibit 6.2 shows, over the five-year period, the cost of administering the funding opportunities relative to grant expenditures has improved for CREATE and been fairly stable for IPS. For PGS, PDF, CGS and IIS, the cost-efficiency ratios have tended to increase over time (ranging from 80¢ to \$1.10 for every \$100 of grants awarded); however, they are still within acceptable ranges. For these funding opportunities, with the exception of IIS, both administrative and grant expenditures have declined over this period, but administrative costs have not declined at as great a rate as grant expenditures (e.g., admin costs decreased 30 per cent versus 40 percent for grant expenditures). It is noteworthy that the two funding opportunities (PGS and PDF) with the greatest decreases in administrative and grant expenditures are also the two with the greatest increases in operating ratios. While the observed increases may reflect a reduction in economies of scale or a lag in the reduction of administrative costs as grant expenditures decline, they warrant continued monitoring.

EXHIBIT 6.2 • Cost-Efficiency Ratios, 2009-2010 to 2013-2014

Fiscal Year	Total Grant \$	Total Admin. \$	Operating Ratio (\$Admin: \$100 Grants)	Estimated volunteer work ^a	Total Grant \$	Total Admin. \$	Operating Ratio (\$Admin: \$100 Grants)	Estimated volunteer work ^a
PGS					CREATE			
2009-2010	46,399,825	2,216,964	4.8	1,312,422	2,966,876	164,378	5.5	Not avail.
2010-2011	35,892,435	1,988,988	5.5	1,817,004	8,902,164	451,692	5.1	
2011-2012	30,723,382	1,839,921	6.0	1,103,454	14,489,345	681,741	4.7	
2012-2013	28,556,013	1,590,809	5.6	907,228	19,553,164	863,881	4.4	
2013-2014	24,765,812	1,466,363	5.9	1,106,003	24,099,519	1,037,035	4.3	
Total	166,337,467	9,103,045	5.5	6,246,111	70,011,068	3,198,727	4.6	
PDF					IPS			
2009-2010	16,376,512	782,824	4.8	Not avail.	4,021,834	178,710	4.4	Not avail.
2010-2011	17,001,714	846,050	5.0		4,067,444	196,000	4.8	
2011-2012	13,974,451	754,747	5.4		4,418,101	208,031	4.7	
2012-2013	10,619,737	579,501	5.5		4,170,000	193,171	4.6	
2013-2014	9,437,414	540,806	5.7		4,021,088	190,047	4.7	
Total	67,409,828	3,503,928	5.2		20,698,467	965,959	4.7	
CGS					IIS			
2009-2010	56,433,126	2,507,609	4.4	1,450,036	1,117,528	49,657	4.4	Not avail.
2010-2011	56,579,999	2,734,064	4.8	1,009,164	1,217,928	59,923	4.9	
2011-2012	49,580,000	2,526,125	5.1	932,712	1,252,612	64,293	5.1	
2012-2013	42,576,471	2,185,853	5.1	733,937	1,268,361	64,038	5.1	
2013-2014	42,563,232	2,200,084	5.2	690,614	1,366,824	70,509	5.2	
Total	247,732,828	12,153,735	4.9	4,816,463	6,223,253	308,420	5.0	

^a The award selection process rely on volunteer time in the form of peer review and committee members' time. NSERC and SSHRC

commissioned an analysis of the value of this time. Cost of volunteer time is estimated based on cost of volunteer time and travel time in fiscal year 2012/2013 for PGS and CGS (according to KPMG 2014), divided by the number of awards in that year. Volunteer time for other years is calculated based on number of awards and the imputed cost per award mentioned above. The rate of \$60/hour has been used as an estimation of the cost of volunteers' time. KPMG (2014). Estimated Monetary Value of Merit Review. Ottawa: Social Sciences and Humanities Research Council of Canada.

6.2.2 Recipient satisfaction

Not surprisingly, non-recipients were significantly less satisfied than recipients with all aspects of the management of the funding opportunities, as measured in surveys. While recipients were mostly satisfied with the management of the funding opportunities, some areas generated lower levels of satisfaction:

- » The clarity of the selection process, for all groups
- » The promptness of the notification of the outcome of the application, for all but IPS/IIS-D recipients.
- » The length of the award for CGS-M recipients and, to a lesser degree, for PGS-D and IPS/IIS-D recipients
- » The fairness of the selection process for PGS-D recipients

Asked in a survey about opportunities for improvements, PGS supervisors indicated the following (none of these suggestions gathered large support):

- » Increasing the number of PGS awards
- » Increasing duration of support at Master's and doctoral levels
- » Increasing the value of the awards or, conversely, lowering scholarships to fund more students
- » Improving candidate selection (e.g., lower the number of publications needed because some programs require a few years of research for one single paper, requiring teaching experience)
- » Supporting students who have a scientific curiosity/motivation instead of students who do graduate studies because they have good grades

6.2.3 CREATE specifics

The CREATE cases studied routinely availed themselves of resources in their institutions when these were seen as appropriate for their trainees, including workshops and online resources for professional and academic skills development. These offerings are expected to increase.

The issue of the capacity to spend the funds was noted in an analysis of CREATE budgets and expenditures. Awards granted to CREATE initiatives are provided in annual instalments over the course of the six-year grant periods. In most cases, these instalments equal \$150,000 in the first year and \$300,000 each year thereafter for the remainder of the

grant. Initiatives are expected to spend the instalment in the year in which the money is disbursed, to the extent possible.

Data from the Statements of Account document 75 CREATE initiatives from competition years 2009 to 2013. It was found that, on average, CREATE initiatives spent 35% less than the balance available to be spent in that year. Under-spending was greatest in Year 1 of the initiative's implementation (at 48%); according to CREATE case studies, this was due to slower than anticipated recruitment, itself attributed to several factors, including timing of the award announcement in the first year. By Year 3, annual expenditures met or exceeded annual instalments. If instalment amounts were reduced in Years 1 and 2, most CREATE initiatives would be better able to align expenditures with instalment amounts on a yearly basis.

6.3 Can the efficiency of the delivery be improved (i.e., can outputs and outcomes be achieved in a more affordable manner)?

Findings: *The evaluation did not identify significant opportunities to improve the efficiency of delivery. Researchers pleaded for increased flexibility in the use of CREATE funds.*

6.3.1 CREATE specifics

CREATE reports and CREATE case studies contain the following researcher suggestions for improved efficiency:

- » allow more flexibility in use of funds, in particular the limitations in rolling funds over from year to year;
- » allow the coverage of the expenses of program committee members to support industrial collaboration;
- » relax the 80% rule of stipend support cases where the research itself involves travel for field work in remote sites;
- » relax the 70% rule of funding to NSE trainees in a research domain that is at the interface of health, social sciences, and humanities;
- » make the CREATE grants renewable;
- » increase the administrative budget;
- » more rapid feedback on reports;
- » showcase successful CREATEs;
- » alert unsuccessful PGS applicants to CREATE programs; and,
- » give more start-up/recruitment time

Some of these suggestions may facilitate the management of the CREATE grant but may not improve the efficiency of the delivery.

Two sources of dissatisfaction with delivery were identified through case studies: the reporting requirements and the timeliness of feedback from NSERC on reports. Overall, stakeholders agreed that the balance between investments and benefits in CREATE was very positive, because of the opportunities it affords to trainees.

7 SUMMARY AND CONCLUSIONS

7.1 Summary results across programs

Overall, this evaluation provides evidence that the Scholarships and Fellowships sub-program is effective at supporting graduate students and post-doctoral fellows in the NSE. Each funding opportunity has its own niche consistent with its design, and together they constitute an effective toolbox for NSERC's intervention in support of NSE training.

Although evidence has been found of the contribution of funding opportunities to longer-term outcomes, such as employment, this contribution is not always as evident for more immediate outcomes. This may be due to the system of financial support available to NSE students, which is sufficiently large and complex that Tri-Agency funding plays a smaller role than in other areas, such as in the social sciences and humanities. Almost all NSE students avail of multiple types and sources of funding, and their NSERC award or stipend, if they receive one, represents only a small portion of their full funding package. Due to the difficulty in controlling for the effect of these other funding sources, assessing the contribution of the NSERC funding opportunity becomes a challenge.

The funding opportunities were found to be relevant given government priorities and the needs of stakeholders. Federal government involvement in scholarships and fellowships is supported by the priority given to investing in people as part of a science, technology and innovation strategy, and is aligned with the objectives of NSERC. The funding opportunities are part of a larger system of financial support that is needed by graduate students and postdoctoral fellows.

There is some evidence that high-calibre HQP are being selected to participate in the PGS, CREATE, and IPS/IIS funding opportunities, based on supervisor ratings of students and self-reported undergraduate GPAs. Ratings of the prestige of each funding opportunity are consistent across stakeholder groups, with PGS rated higher than IPS/IIS and CREATE stipends.

Across all HQP in the earlier survey cohort³⁶ (both recipients and non-recipients), more than 90% had completed their degree; the average Master's student took two years eight months to finish, and the average doctoral student took five years. It is possible that funding opportunities supported the completion of studies or the time to completion, but not in a way that is discernible via a comparison between recipients and non-recipients; this may be because all NSE graduate students are financially supported through their studies, be that by the NSERC funding opportunities or through other awards, prizes, or stipends.

The training environments provided under the various funding opportunities showed specific characteristics that are representative of their design: CGS recipients had more interactions within Canada while PGS awardees had more interactions outside Canada; IPS/IIS had more interactions with the private sector; IIPS/IIS and CREATE students enjoyed more exchange and internship opportunities.

On average, nine out of 10 recipients and non-recipients from the earlier cohort were working full-time at the time of the survey, and reported annual employment-related income between \$70,000 and \$80,000. Average income varied by sector of employment, with large variation in academia at \$49,000 for postdoctoral fellows and \$89,000 for research faculty. The primary employer for Master's students was the private sector, while for doctoral students it was universities.

The impact of funding opportunities on employment outcomes was observable for PGS and IPS/IIS recipients. It was not possible to assess long-term impacts such as employment for CREATE, as it began in 2009. However, PGS recipients at both Master's and doctoral levels, compared to non-recipients, had higher incomes and reported their training was more useful to their careers. At the doctoral level, PGS recipients were more likely to be working full-time than non-recipients, and if employed in academia, were more likely to be research faculty as opposed to non-recipients who were more likely to be in a postdoctoral position. IPS/IIS recipients were more likely to be working in the private sector at both levels, and at the Master's level had higher income than non-recipients.

Participants from all funding opportunities contributed to research productivity. Although there were few observable differences across funding opportunities with regard to the types and amounts of academic outputs, the use of these outputs differed across funding opportunities: a greater number of citations of articles for PGS-M and PGS-D; more software and databases as well as more direct cost savings for IPS/IIS-M

³⁶ i.e., those who had been nominated or participated in competition cycles 2003 to 2008.

recipients; more professional practice outputs and more improved policies and programs for IPS/IIS-D recipients; more new practices for IPS/IIS recipients and CREATE trainees. These particularities were congruent with the design of the funding opportunities. PGS and IPS/IIS supervisors were satisfied with the awardee's research contributions to their research program or their impact on the supervisor's organization.

A separate analysis was undertaken of the survey data, encompassing the full funding package of each student surveyed, and assessing the extent to which types of Tri-Agency funding predicted better outcomes for these students. This analysis showed that direct Tri-Agency funding (scholarships or fellowships) had stronger positive associations with academic and employment outcomes than indirect Tri-Agency funding (stipends), and primarily at the doctoral rather than Master's level.

One of the goals of CREATE is to influence the NSE academic system in a sustainable way; CREATE initiatives are expected to be self-sustaining beyond the period of the grant. The evaluation finds that this sustainability may not be assured. While academic courses and programs, student activities, and collaborations may be sustainable after the end of the grants, other aspects of CREATE require funding that is unlikely to exist without CREATE support.

In terms of program delivery, few substantial issues were found; this is not surprising considering that most of the funding opportunities are long standing.

Funding opportunities were generally delivered in an efficient manner: about \$4.60 to \$5.50 in administrative costs were spent for every \$100 in grant funds, across all funding opportunities. For PGS, PDF, CGS and IIS, the cost-efficiency ratios have tended to increase over time (ranging from 80¢ to \$1.10 for every \$100 of grants awarded); however, they are still within acceptable ranges.

The majority of CREATE initiatives appear able to meet the program guideline requiring 80% of funds to be used for stipends. However, CREATE recipients would prefer that this threshold be lowered. Also, some CREATE recipients indicated that limiting the payment of stipends to students from outside the NSE to 30% of payments was constraining in research domains at the interface of health, social sciences, and humanities.

Underspending by CREATE initiatives was an issue. It was found that, on average, CREATE initiatives spent 35% less than the balance available to be spent in that year. Under-spending was greatest in Year 1 of the initiative's implementation (at 48%). By Year 3, annual expenditures met or exceeded annual instalments. If instalment amounts

were reduced in Years 1 and 2, most CREATE initiatives would be better able to align expenditures with instalment amounts on a yearly basis.

While recipients were mostly satisfied with the management of the funding opportunities, the clarity (and fairness to a lower degree) of the selection process, the promptness of the notification, and the length of some awards generated lower satisfaction levels.

7.2 Recommendations

Based on the findings of the evaluation and noting that the results suggest that these programs are relevant and well managed, the following recommendations are offered to improve the operations and outcomes of these funding opportunities.

Recommendation 1: The quality and quantity of information communicated on the PGS and IPS/IIS selection processes should be improved.

Although most respondents indicated satisfaction with all areas of the program management for all programs, clarity of the selection process was one area with the lowest levels of satisfaction for all programs. Programs could do more to communicate how selection is made.

Recommendation 2: CREATE program management should consider design adjustments to adapt to the initiatives' ability to spend in Year 1.

Many CREATE initiatives are unable to spend their entire Year 1 allocation because of delays in decisions and in announcements of grants. In some cases, this leads to reduction in payments made by NSERC in later years of the grant. The Year 1 allocation could be calibrated to the ability of the initiative to spend the funds or barriers to early initiation of the Year 1 work could be alleviated; program management may offer other possible remedies. Corrective reductions in future payments should be communicated earlier and more clearly.

Recommendation 3: CREATE program management should consider revisiting the limits placed on certain CREATE spending categories.

CREATE guidelines indicate that no more than 20% of the grant can be used to pay for expenses associated with administration, travel, dissemination and networking, and no more than 30% of stipends can be distributed to trainees who are not enrolled in the NSE. Because of the nature of their partnerships and activities, some initiatives may be less productive because of these constraints. These rules should be

reconsidered in light of the experience accumulated since the inception of the program.

Recommendation 4: Program management should continue to monitor administrative costs relative to grant expenditures.

PDF, PGS, CGS, and IIS have seen their administrative costs relative to grant expenditures increase between 2009-2010 and 2013-2014. While this may be due to reductions in economies of scale or a lag in the reduction of administrative costs as grant expenditures declined, it warrants monitoring. Program management should continue to monitor the operating ratio and should it persist explore the factors behind the trends.

ANNEX A: FUNDING OPPORTUNITIES

This appendix provides a description and brief overview of the governance structure of the funding opportunities in focus for this evaluation (CREATE, PGS and IPS/IIS) as well as those of other funding opportunities addressed secondarily in this report (USRA-U, PDF, and International Exchanges).

A1 CREATE

The CREATE funding opportunity was established in 2009 to support the training of teams of highly qualified students and postdoctoral fellows from Canada and abroad through the development of innovative training programs that encourage collaborative and integrative approaches and the development of professional skills. These skills and experiences are intended to complement trainees' qualifications and technical skills by adding value to the university training environment by better preparing trainees for their future career.

To build on Canada's research strengths and priorities, at least 60% of the CREATE funding is directed towards NSERC's priority areas³⁷: environmental science and technologies; natural resources and energy; information and communications technologies and manufacturing.³⁸

The two overarching objectives of the CREATE funding opportunity focus on the funding opportunity's intended contribution to research and training in Canada:

- » Encourage collaborative and integrative approaches, and address significant scientific challenges associated with Canada's research priorities; and
- » Facilitate the transition of new researchers from trainees to productive employees in the Canadian workforce.

³⁷ Industry Canada (2007). Mobilizing Science and Technology to Canada's Advantage. Ottawa, Ontario.

³⁸ When CREATE was first conceived, the fourth target area was health and related life science. This priority area was replaced by manufacturing in 2012 to further improve the alignment with NSERC's mandate.

In addition, the training initiatives funded by CREATE develop their own objectives intended to encourage some or all of the following:

- » Student mobility, nationally or internationally, between individual universities and between universities and other sectors;
- » Interdisciplinary research within the natural sciences and engineering (NSE), or at the interface between the NSE and health, or the social sciences and humanities, however, the main focus of the training must still lie within the NSE;
- » Increased collaboration between industry and academia; and
- » In the Industrial Stream, an additional objective is to support improved job-readiness within the industrial sector by exposing participants to the specific challenges of this sector and training people with the skills identified by industry.

Funding of up to \$150,000 in the first year and up to \$300,000 annually in subsequent years is provided by NSERC for a maximum period of six years. At least 80% of the total CREATE funding must be used for trainees' stipends over the course of the grant. The remaining 20% can be used to pay for expenses associated with administration, travel, dissemination and networking. Up to 30% of stipends can be distributed to trainees who are not enrolled in the NSE.

The funding opportunity primarily targets graduate students (Master's and doctoral students) in the NSE, partly because most of the funding for CREATE was re-allocated from the PGS funding opportunity which targets graduate students.³⁹ In addition to graduate students, undergraduate students can be supported and integrated into the training initiative as potential future graduate students. Postdoctoral fellows may also be supported if their participation contributes to the training of the graduate and undergraduate students. A CREATE Trainee is defined as a student or postdoctoral fellow who participates in the CREATE initiative, whether they are paid by CREATE funds or not. Trainees can be Canadians, landed immigrants, or international students.⁴⁰ International exchange trainees not enrolled at a Canadian university may be supported for a maximum of 125 days. Students and fellows can receive CREATE Stipends and scholarships or fellowships from NSERC or other sources concurrently.

The industrial stream

³⁹ There has been emphasis on graduate students since the program inception, but the wording concerning this focus was clarified in the program description as part of the 2010 competition.

⁴⁰ CREATE allows for international travel expenses, so there could be opportunities for foreign students to visit Canadian labs as part of the training program.

An Industrial Stream was established as part of the 2012 competition to further strengthen CREATE's focus on collaborations with industry. Up to 50% of the CREATE grants are now allocated to training initiatives awarded in this stream. All trainees under this stream should hold at least one industrial internship and the industrial internship(s) must constitute at least 20% of their training (e.g., 2-4 months at the MSc level and 8-10 months at the PhD level over the duration of their involvement).

Mechanism for enabling international student exchanges

NSERC established agreements with research funding organizations in other countries to develop a formal mechanism for supporting international student exchanges through CREATE. An agreement was established with The German Research Foundation (2011), followed by another agreement with the Research Foundation for the State of São Paulo (2013).

Application process and competition results

Applicants and co-applicants must hold an NSERC eligible position at an eligible Canadian university. Co-applicants and applicants must be from the NSE fields, but co-applicants may be at the interdisciplinary frontier between NSE and the areas covered under the umbrella of SSHRC and CIHR.

NSERC establishes a yearly application quota for each university and only those researchers selected at their university can submit Letters of Intent (LOIs). The CREATE Selection Committee evaluates letters of intent followed by applications from researchers against the selection criteria and recommends meritorious letters of intent for submission of a full application and applications for funding. Letters of Intent are due May 1st, applicants are notified by June 30 whether or not they are invited to apply and applications are due September 22nd. Awards are announced in March of the following year. Table A1 provides an overview of the competition results from 2009 to 2013. In 2012-2013, 42% of the awards were associated with the Industrial Stream.

Table A1: CREATE Competition Statistics 2009-2013

Competition year*	Total LOI Quota	# of LOIs received	# of applications received	Total awards	Total funds approved (\$)	LOI success rate	Application success rate
2009	240	157	134	20	\$ 31,964,031	13%	15%
2010	240	162	65	20	\$ 32,321,967	12%	31%
2011	242	123	50	18	\$ 29,692,750	15%	36%
2012	242	105	52	17	\$ 28,025,746	16%	33%
2013	242	103	50	15	\$ 24,527,650	15%	30%
Total	1,206	650	351	90	\$ 146,532,144	14%	26%

Source: The Scholarships and Fellowships Directorate

*The competition year is the year the funding was awarded.

Roles and responsibilities in delivering the training initiatives

Each funded CREATE initiative has a Program Committee (PC) which is responsible for overseeing the progress of the program and its future directions. It provides input and guidance in the conduct of program reviews, any related major changes in the program, and in the setting of performance indicators specific to their grant and performance reporting.

Each CREATE initiative has collaborators. A collaborator is defined as an individual or an organization that has contributed to the CREATE initiative, either through training of students and fellows or through research projects undertaken. Collaborators can be from all sectors (e.g., companies, public or non-governmental organizations, educational institutions).

Logic model

When the CREATE funding opportunity was being developed in 2009, it was decided that it should have its own performance measurement strategy rather than being part of the already existing NSERC umbrella Scholarship and Fellowship performance measurement strategy because CREATE was significantly different from NSERC's other scholarship and fellowship funding opportunities.

The logic model for the CREATE funding opportunity is shown in Annex B. The model outlines how the funding opportunity's activities will achieve the intended outcomes over the immediate, intermediate, and long term and deliver on the expected results.

A2 Postgraduate Scholarships

The PGS funding opportunity was established in 1978 to provide financial support to high-caliber students working towards a Master's or doctoral degree in the natural sciences or engineering. While the name of the funding opportunity has changed over the years, the objectives have remained the same. This support allows these students to fully concentrate on their studies and seek out the best research mentors in their chosen fields. The objective of the funding opportunity is *to assist in the training of highly qualified scientists and engineers to ensure a reliable supply of highly qualified personnel to meet the needs of Canada's knowledge economy.*

The PGS awards used to be available in two categories: PGS Master's and PGS Doctoral. The PGS-M funding opportunity ended in competition year 2014 as a result of the PGS/CGS harmonization process and budget reallocations. PGS-M scholarships were given for a maximum duration of 12 months with a total value of \$17,300 for one year.⁴¹ PGS-D offers support for 24 months or 36 months with a value of \$21,000 per annum. PGS-D awards may be taken up at any eligible Canadian university. They may also be taken up at any eligible foreign university, provided the scholarship recipient has received a previous degree in the NSE from a Canadian university.

Application process and competition results

Applicants to PGS-D (and PGS-M up until competition year 2013) either apply directly to NSERC or through a Canadian university depending on the applicant's status at the application deadline date and/or the registration status in the year of application. The application must be submitted through a Canadian university if the applicant is currently registered at the university or was registered at the university during the year of application. If the applicant is currently registered at a foreign university or completed all of the requirements for a degree program prior to January 1 of the year of application, the application can be submitted directly to NSERC.

The NSERC scholarship liaison officer at each Canadian university coordinates the review of PGS applications submitted through the university. The university review committee ranks each application according to their own criteria and process and then submits the applications that they recommend for a scholarship to NSERC. Each university is assigned an overall quota of scholarship applications based on its students' success in recent PGS/CGS competitions.

⁴¹ In 2009, awards at the Master's level were reduced to one year in order to align the PGS with that of CGS.

Applications that are sent directly to NSERC are forwarded on to the selection committees together with the applications submitted from the universities. The criteria used for assessing applications include academic excellence, research ability or potential, and communication, interpersonal and leadership abilities. NSERC scholarships and fellowships selection committees review and score the applications they receive and a ranked list based on these scores is used to determine the award recipients.

The application process serves both the PGS and the CGS. The CGS is offered to the top-ranked applicants and the next tier of meritorious applicants will be offered an NSERC PGS.

Table A2: PGS Awards and Expenditures by Competition Year

Competition year	Total Number of awards	Total value of new awards	Total expenditure (for new and ongoing awards by fiscal year)
2009	701	\$12,082,959	\$34,821,658
2010	939	\$16,479,985	\$35,500,238
2011	606	\$9,865,744	\$30,723,382
2012	628	\$9,902,938	\$28,556,013
2013	622	\$10,574,280	\$24,766,412
Total	7,162	\$119,848,383	\$276,327,711

Source: The Research Grants and Scholarships Directorate

*The competition year is defined as the year in which the funds were awarded. Total expenditures are reported by fiscal year.

A-list contains all those eligible applications recommended by postsecondary institutions, or if submitted directly to NSERC, by the pre-selection committees of NSERC. B-list applications are those not recommended by postsecondary institutions.

Logic model

The PGS funding opportunity is covered by NSERC's umbrella Scholarships and Fellowships Logic Model developed as part of the performance measurement strategy in 2004 (Annex B).

A3 IPS

The Industrial Postgraduate Scholarships funding opportunity was introduced in 1994 to provide financial support for highly qualified science and engineering graduates. The support allows them to gain research experience in industry while undertaking advanced studies in Canada. The objective of the funding opportunity is *to encourage scholars to consider research careers in industry where they will be able to contribute to strengthening Canadian innovation.*

Canadian citizens, permanent residents of Canada and foreign student can apply to the funding opportunity. Industrial postgraduate scholarships are available in two categories: IPS 1 and IPS 2. IPS 1 scholarship support is for a minimum of 1 year (in exceptional circumstances only) up to a maximum of 2 years and must be held during the first three years of graduate study. IPS 2 scholarship support is for either 2 or 3 years and must be held during the first four years of doctoral-level studies. Applicants are eligible for this type of scholarship only if they are, or will be, a doctoral candidate. Scholarship recipients must spend a minimum of 20 percent of their time (at least 50 days per year) at the organization on activities related to their thesis project. During these periods, they are not an employee of the sponsoring organization and cannot directly receive payment for work done.

NSERC will pay a stipend of \$15,000 per year to the applicant's university. In addition, a sponsoring organization is required to pay at least \$6,000 (or more) per year to the university in scholarship funds to support the recipient. IPS award holders may be eligible for some postgraduate supplements. Part-time students are accepted.

Students registered at Quebec universities must apply through the NSERC-FRQNT Industrial Innovation Scholarships (IIS) funding opportunity which is funded in collaboration with the Quebec provincial government. This funding opportunity is very similar to the IPS funding opportunity, but the annual size of the scholarship that students receive is slightly higher (\$21,000 at the Master's level and \$27,000 at the PhD level).

Any company or not-for-profit organization is eligible to host an IPS holder as long as they register with NSERC. Prior to 2012, organizations were asked to submit an application for eligibility which NSERC assessed to ensure that the organization could support the student, both scientifically and financially. To reduce reporting requirements on participating organizations and to encourage participation, NSERC no longer performs these assessments unless an organization participates through IIS.

Logic model

The IPS funding opportunity is covered by the same NSERC's umbrella Scholarships and Fellowships Logic Model as PGS (Annex B).

Application process and competition results

The university's Graduate Studies Office coordinates all of NSERC's industrial postgraduate scholarship applications and sends the

nomination documents to NSERC. The university ensures that eligibility criteria and standards of excellence are those of NSERC. The university reviews nominations and decides which applicants will receive scholarships. The award is made for a specific research proposal involving a student, a faculty supervisor and a sponsoring organization. A university faculty member and a researcher from the sponsoring organization jointly supervise the project. The scholarship is administered by the university and the university is responsible for making regular payments to the scholarship holder.

Table A3: IPS and IIS Awards and Expenditures by Fiscal Year

Fiscal year	Total number of awards	Total value of new awards	Total expenditure (for new and ongoing awards)
2009-10	223	\$5,706,218	\$ 5,139,362
2010-11	234	\$6,073,150	\$ 5,288,372
2011-12	240	\$6,568,339	\$ 5,670,713
2012-13	223	\$5,731,617	\$ 5,438,361
2013-14	240	\$6,001,645	\$ 5,387,911
Total	1,798	\$48,603,940	\$ 44,481,058

Source: The Research Grants and Scholarships Directorate

A4 Undergraduate Student Research Awards in Universities

Undergraduate Student Research Awards in Universities (USRA-U) are meant to stimulate interest in research in the NSE.⁴² They are also meant to encourage graduate studies and the pursuit of a research career in these fields.

To be eligible to apply for an award, the applicant must be a Canadian citizen or permanent resident of Canada; be registered in a bachelor's degree program at an eligible university; and have obtained, over the previous years of study, a cumulative average of at least second class. Additional conditions apply.

USRA-U awards have a value of \$4,500 for 16 consecutive weeks on a full-time basis. Universities are required to supplement the amount of the award by at least 25 percent of its value using other sources, such as university funds, NSERC grants, or any other research funds. Universities may also provide fringe benefits.

⁴² http://www.nserc-crsng.gc.ca/Students-Etudiants/UG-PC/USRA-BRPC_eng.asp

A5 Postdoctoral Fellowships

The Postdoctoral Fellowships Program provides support to a core of the most promising researchers at a pivotal time in their careers, according to the program description.⁴³ The fellowships are intended to secure a supply of highly qualified Canadians with leading-edge scientific and research skills for Canadian industry, government, and universities. NSERC encourages qualified Aboriginal researchers who are interested in the program to apply.

To be considered eligible for support, applicants must be Canadian citizens or permanent residents of Canada; and, hold or expect to hold a doctorate in one of the fields of research that NSERC supports. Additional conditions apply.

PDFs can be held at Canadian universities, provincial research institutions in Canada, other appropriate research laboratories in Canada; and universities and research centres abroad.

The PDF award is for \$45,000 per year for two years.

A6 International Exchanges

The International Exchanges funding opportunity includes the Summer Programs in Japan or Taiwan, as well as the Japan Society for the Promotion of Science (JSPS) Researcher Exchange Program.

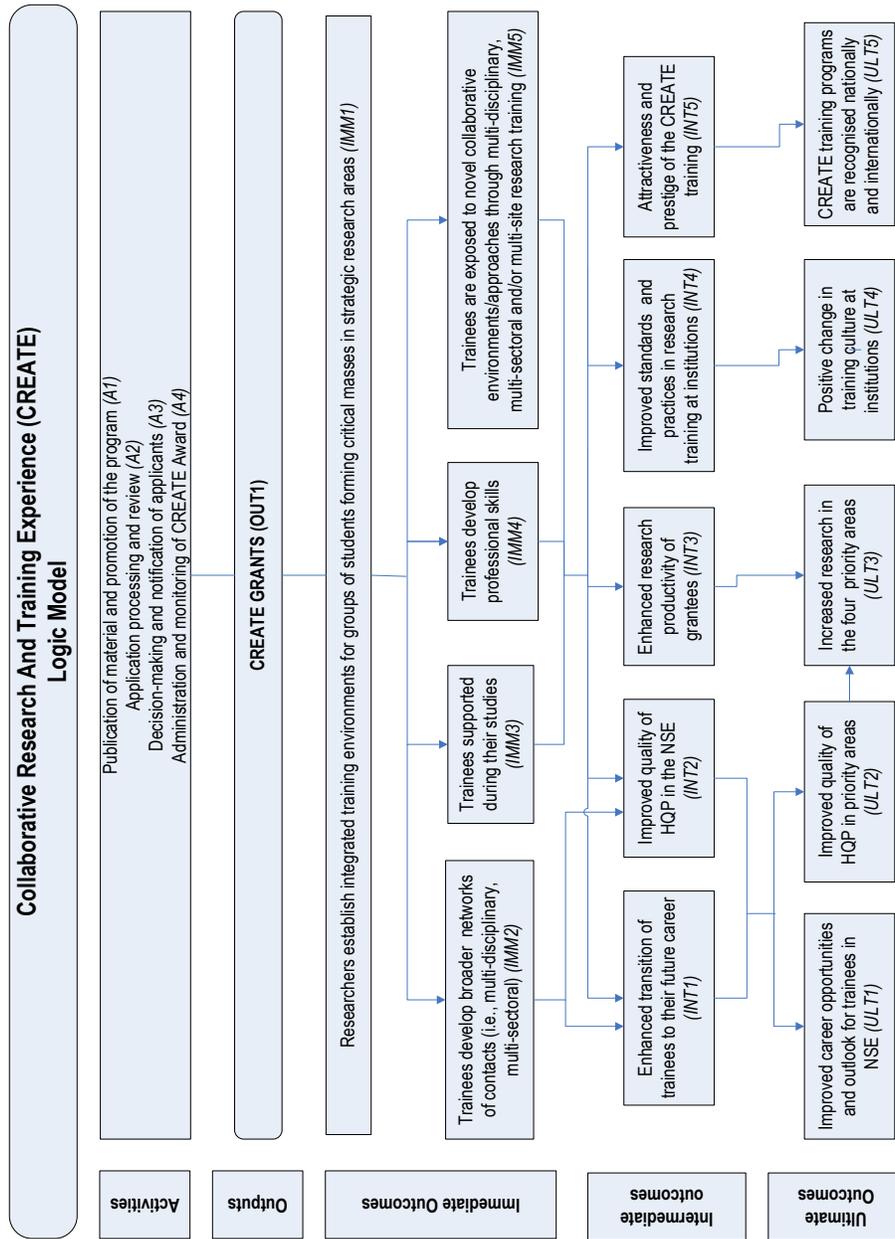
The Summer Programs in Japan or Taiwan provide graduate students in science and engineering with two months of hands-on research experience and an introduction to a different culture, language, and university research system. Awardees must be Canadian citizens or permanent residents with a Canada Graduate Scholarship. Awardees receive a minimum of \$2,500 from NSERC as well as coverage of living expenses and, in Japan, air fare and a maintenance allowance of approximately \$5,500.

The JSPS Researcher Exchange Program provides funding to Japanese researchers visiting an eligible Canadian institution to complete research that is clearly intended to advance knowledge in one of the natural sciences or in engineering. NSERC provides a maintenance allowance of \$4000 per month while JSPS covers international airfare. The awards can be either short-term (14-30 days) or long-term (3-10 months).

⁴³ http://www.nserc-crsng.gc.ca/Students-Etudiants/PD-NP/PDF-BP_eng.asp

The International Exchanges funding opportunity is covered by the same NSERC umbrella Scholarships and Fellowships Logic Model as PGS and other aforementioned awards.

ANNEX B: LOGIC MODELS



Umbrella Logic Model – All NSERC Scholarships and Fellowships Programs

Activities and Outputs

Development of scholarships and fellowships programs
 Publication of material and promotion of programs
 Application processing and review
 Decision-making and notification of applicants
 Administration and monitoring of awards

Immediate Outcomes

Academic Outcomes

1. Individuals apply for awards in reaction to promotion of programs
2. Recipients are supported during their studies and/or get research experience
3. Professors have more financial flexibility – can spend grant money on additional students or other research costs
4. Mentoring by recipients and to recipients
5. Undergraduate and Masters' and doctoral students are motivated to pursue further studies or training
6. University researchers are assisted by recipients
7. NSERC programs are promoted through word-of-mouth

Industrial Outcomes

1. Individuals/nominating companies apply for awards in reaction to promotion of programs
2. Recipients get R&D experience and/or get job training
3. Mentoring by recipients and to recipients
4. Industrial researchers are assisted by recipients
5. NSERC programs are promoted through word-of-mouth
6. Formation of new / strengthening of on-going collaborations between various sectors, especially university, industry and non-profit

Intermediate Outcomes

Academic Outcomes

1. Knowledge is produced/exchanged through research
2. Increased completion rates among recipients
3. Decreased time to degree completion among recipients
4. Increased employability of recipients (recipients gain professional skills and experience)
5. Recipients of multiple NSERC scholarships and fellowships continue on their academic path
6. Encourages student interest in research

Industrial Outcomes

1. Knowledge is produced/exchanged through research
2. Increased employability of recipients (recipients gain professional skills and experience)
3. Enhanced research capacity of industry
4. Recipients are motivated to seek jobs in industry
5. Encourages on-going collaborations between various sectors
6. Recipients of multiple NSERC scholarships and fellowships continue on their academic path
7. Promotes the capacity of Canadian universities to the industrial sector
8. New technologies/products/processes developed

Final Outcomes

HQP fuel technological innovation through university-industry collaboration and increased industrial R & D capabilities
 Canadian ranking in R&D performance improves
 Stronger Canadian economy
 Increased employment opportunities
 Development of more knowledgeable society