Summative Evaluation of the Networks of Centres of Excellence – Centres of Excellence for Commercialization and Research Program

FINAL REPORT

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Evaluation Division
Natural Sciences and Engineering Research Council

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List of Acronyms

AAPS	Advanced Applied Physics Solutions, Inc.
BIC	Bioindustrial Innovation Centre
BL-NCE	Business-Led Networks of Centres of Excellence
C2Mi	MiQro Innovation Collaborative Centre
C3E	Centre of Excellence in Energy Efficiency
CCA	Council of Canadian Academies
CCR	Centre for the Commercialization of Research
CCRM	Centre for Commercialization of Regenerative Medicine
CDMN	Canadian Digital Media Network
CDRD	Centre for Drug Research and Development
CECR	Centre of Excellence for Commercialization and Research
CEPMed	Centre of Excellence in Personalized Medicine
CFI	Canadian Foundation for Innovation
CIHR	Canadian Institutes of Health and Research
CImTeC	Centre for Imaging Technology Commercialization
CPDC	Centre for Probe Development and Commercialization
CSII	Centre for Surgical Invention and Innovation
FA	Full Application
FTE	Full-Time Equivalent
GCC	GreenCentre Canada
HQP	Highly Qualified Personnel
ICA	International Commercialization Alliance
ICT	Information and Communications Technology
IP	Intellectual Property
IRICoR	Institute for Research in Immunology and Cancer
LOI	Letters of Intent
LOOKNorth	Leading Operational Observations and Knowledge for the North
MI	MaRS Innovation
MIC2	MiQro Innovation Collaborative Centre
NCE	Networks of Centres of Excellence
NSERC	Natural Sciences and Engineering Research Council
ONCCEE	Oceans Network Canada Centre for Enterprise and Engagement
PC-TRIADD	The Prostate Centre's Translational Research Initiative for Accelerated Discovery and Development
PREVENT	Pan-Provincial Vaccine Enterprise
PROOF	Centre of Excellence for the Prevention of Organ Failure
PSAB	Private Sector Advisory Board
R&D	Research and Development
RMAF-RBAF	Results-based Management Accountability Framework – Risk-based Audit Framework

S&T	Science and Technology
SME	Small and Medium-Sized Enterprises
SPM	Senior Program Managers
SSHRC	Social Sciences and Humanities Research Council
STIC	Science, Technology and Innovation Council
TTO	Technology Transfer Offices
UILO	University Industry Liaison Office

EXECUTIVE SUMMARY

In order to inform the program renewal process and meet the requirements of the Treasury Board *Policy on Evaluation*, a summative evaluation of the Centres of Excellence for Commercialization and Research (CECR) Program was commissioned covering the period from program inception (2007-08) to 2011-12.

Profile of the CECR Program

Administered by the Networks of Centres for Excellence (NCE) Secretariat, the CECR Program is a federal mechanism to support research and/or commercialization centres that bring together people, services, and research infrastructure to position Canada at the forefront of breakthrough innovations in priority areas. The goal of the CECR Program is to create internationally recognized centres of commercialization and research that establish public-private research and commercialization partnerships that deliver economic, social and environmental benefits to Canadians in the four priority areas of the S&T Strategy: environmental science and technologies; natural resources and energy; health and related life sciences and technologies; and information and communications technologies.

The CECR Program's application review process is based on selection criteria and a peer review process designed to align with present and future challenges of the Canadian innovation system, and with Canada's needs and government priorities. Applications submitted to the CECR Program in response to national competitions are assessed against three selection criteria: benefits to Canada; track record and potential of applicants; and strength of the business plan. The review process involves two stages: a letter of intent stage and a full application stage. The CECR Program has held three competitions since its inception. There have been 22 Centres funded to date for a total of $286.9 million in grant funding.

Methodology

The evaluation of the CECR Program is based on multiple lines of evidence, including qualitative and quantitative data sources:

- A ***document and literature review*** was undertaken to support a thorough understanding of the CECR Program, the broader context in which the program operates and to address evaluation questions related to relevance, performance and efficiency.
- ***Key informant interviews*** were conducted with 46 individuals with knowledge of the CECR Program.
- ***Case studies*** of the 17 Centres funded by the CECR Program in 2008 and 2009 were undertaken to provide in-depth data collection and analysis at the Centre level. The case studies collected qualitative and quantitative data on the operation, performance and achievement to date of expected research and commercialization benefits as a result of the CECR Program grant.
- An ***online survey*** was conducted of Centre participants from the 17 Centres funded in the 2008 and 2009 competitions. The purpose of the survey was to obtain quantitative data on Centre partners'/ clients' interactions with, as well as perception and opinions of the Centres and the CECR Program.

Limitations

Overall, the evaluation methodology is strong in providing the basis for reaching conclusions for all issues and questions using multiple lines of evidence. There are limitations with the evaluation methodology; however, the limitations were carefully taken into account when conducting the analyses, and are acknowledged in the interpretation of the findings. The limitations and mitigation measures taken are described below.

- ***Reliance on information/opinion gathered from sources internal to the program.*** Much of the evidence that was gathered for this evaluation is drawn from internal sources. This potential bias was mitigated to some extent by including external interview respondents, as well as documentary sources/external literature as sources of evidence.

- ***Inconsistencies in the annual performance data.*** The case studies of the 17 Centres and program-level measures of research and commercialization outcomes relied on performance information prepared annually by the Centres for the NCE Secretariat. The reporting template has been revised each year during the period under study, resulting in some inconsistencies in performance data year to year. The use of performance data was limited to time periods where consistent data are available.

- ***Analytical challenges.*** While the Centres are now fully established and implementing their corporate or strategic plan, it is still premature for some Centres to demonstrate outcomes of their work that may only materialize in the longer-term. To mitigate this limitation, the evaluation used a case study methodology that focused on short-term immediate/intermediate outcomes, and tracked progress toward longer term intermediate and ultimate outcomes. Where possible, common measures identified in the evaluation matrix were used to allow for aggregation of impacts at the program-level for some indicators.

- ***Difficulties identifying and surveying CECR participants.*** Achieving a high level of survey participation of CECR participants proved challenging. While mitigation strategies were employed to increase the response rate, the final response rate to the survey was 39 percent. There was a high degree of variability in the response rate across the Centres. Survey findings should be considered suggestive of program-level outcomes, rather than definitive, and sub-group analyses were limited.

- ***Limited inclusion of the perspective of highly qualified personnel (HQP).*** The case studies included at least one key informant interview with a graduate or trainee from Centres where training opportunities were provided (13 out of 17 Centres). Therefore, the evidence to address this intended immediate outcome is limited.

- ***Lack of data on comparable programs.*** Establishing benchmarks for the CECR Program was challenged by a lack of comparability of program objectives and the ability to generate metrics similar to the available CECR Program performance data. This gap was addressed by examining international program experience in a more qualitative fashion, focusing on best practices.

Key Findings

Relevance

There is a continued need to address a commercialization gap in Canada that impedes the successful movement of discoveries to the commercial market. The operation of research and commercialization Centres is consistent with recommendations in the literature on building a strong innovation system and is supported by key

informants and Centre participants. More advantages than disadvantages of the centre of excellence approach were identified.

The CECR Program is distinguished from other federal and provincial initiatives by a focus on operational funding in the form of large scale grants to centres that collaborate with government, business and academia. The program's commercialization focus addresses a gap in the public research and development (R&D) funding array that has, to date, focused more heavily on research. Where provinces have focused efforts on commercialization, in many instances, funded Centres are accessing these complementary programs with the CECR Program to address common objectives.

The federal government plays an important and appropriate role in supporting innovation and addressing research and commercialization to foster economic growth. Provinces also fund many of the Centres to address common objectives, though structured, formal inter-jurisdictional collaboration continues to be an underdeveloped aspect of the CECR Program.

The CECR Program is aligned with federal government priorities, supporting the advantages and principles articulated in the federal S&T Strategy. An early overrepresentation in Centres addressing the health priority area is being addressed. While the CECR Program clearly supports NSERC and CIHR priorities, the evaluation evidence indicates a more mixed picture of the alignment of the program with the priorities of SSHRC for service and business innovation. The S&T priority areas themselves and the profile of Centre projects and Centre participants suggest a focus on technology and product innovation over service and process innovation. Still, the services offered by the Centres include a broad range of commercialization and business-related advice/expertise, which suggests that the Centres' staffing complement and commercialization model is multi-disciplinary (though research field of staff could not be quantified in the evaluation).

Performance

The CECR Program has been successful in making progress toward achieving many immediate and intermediate outcomes, including enhancing research and commercialization capacity, and strengthening domestic collaboration and attracting investment from partners (leveraging $1.50 for every $1 of the CECR grant expended). Centre participants have accessed a broad range of support/assistance including financial (cash) support and commercialization expertise from the Centres and interactions with the Centres are having organizational benefits for these participants in terms of knowledge base and R&D capacity. The program has had more modest success in providing training opportunities for HQP (an intended outcome more evident among Centres in the health priority area and research and commercialization Centres). Progress toward research outcomes (research leading to public benefits) is preliminary in nature due to the longer timeframe required for research benefits to be realized. It is unlikely that any of the Centres will achieve self-sufficiency within the funding period.

With respect to commercialization outcomes, there is good evidence that the CECR Program has accelerated the commercialization of new technologies (including filing and issuing of patents and negotiating licenses, company creation) and participants indicate the Centres are having a significant impact both on their projects and their relevant sector more broadly. Generating further social, economic, health and environmental benefits for Canadians of a more ambitious nature is anticipated only in the much longer term. The CECR program does not have any significant unintended negative outcomes.

Efficiency and Economy

Key informants and Centre participants view many elements of the CECR Program's design as sound and appropriate to achieve the program's goal of advancing the commercialization of research. A strong majority of Centre participants are satisfied with their experience, support the work of the Centres and agree that their involvement has been worthwhile. Administrative efficiency of the program is consistent with the costs of delivering other NCE Secretariat programs. A key program strength is the level of industry involvement in the program. While Centres have encountered a number of implementation issues, at the program level, the self-sufficiency expectation at the end of the five-year grant is viewed as a significant challenge in the program design for commercialization Centres.

The quality of the leadership of the Centres and strength of governance were highlighted as key ingredients of Centre success, viewed as important for relationship-building with partners, companies and individual investigators within the sector. A customer focus/commercial relevance and focused organizational objectives and strategy were also noted as critical success factors.

There are some challenges in capturing the commercialization outcomes of the Centres due, in part, to the diversity of their business models and inherent challenges in measuring the impacts of commercialization intermediaries. While the performance measures for the program have improved, some challenges remain including inconsistencies in how Centres are reporting aspects of their operations and sufficient NCE Secretariat resources to vet and clarify these inconsistencies. The enhanced use of qualitative narratives to capture the impacts of the Centres would be welcomed by Centres and consistent with other trends in reporting for commercialization intermediaries. The risks identified for the CECR program continue to be relevant (with the exception of peer review). Risks related to intellectual property management and conflict of interest are managed at the Centre level. Risks related to meeting the program's matching funding requirement remain relevant, particularly with the economic downturn and current cautious investment climate.

The CECR Program has many strengths, including its focus on commercialization. Aspects of the program meriting improvement include current guidelines that limit applications for an extension or renewal of funds to research Centres, and the expectation of self-sufficiency of Centres within the funding period. Other improvements concern aspects of program design such as the application and selection process, supports available to Centres, program guidelines and communications.

Recommendations

Based on the findings of the evaluation of the CECR Program, the following recommendations are provided.

1. The NCE Secretariat should consider providing an opportunity for Centres in both research and commercialization, and commercialization streams to request an extension of their current five-year grant or apply for renewed funding to allow them to advance implementation of their business model and begin to realize a return on investment. The funding extension/renewal decision should consider factors such as Centres' achievement of objectives outlined in their funding agreement, demonstrated value to the sector (e.g., demand for services, partner contributions) and international interest garnered by the Centre. Given the high degree of variability in the time to market for new technologies, the evaluation of the extension/renewal request should take sector into consideration.

2. The NCE Secretariat should continue to reinforce the program's focus on commercialization. Commercialization, particularly of early stage technologies to bridge the commercialization gap, is a distinguishing feature of the program, contributing to its niche in the array of federal research and development programs. Moving forward, it will be important for the program to remain flexible to promote and support a variety of innovation models and approaches, including service, process and social innovations, to achieve its commercialization outcomes.
    a. The NCE Secretariat should review the stated intended outcomes of the CECR Program to ensure that they are more closely aligned with the evolving focus of the program on commercialization and are articulated to avoid redundancies among the outcome statements. This recommendation pertains specifically to the intended research outcomes of the program and the intended outcome for providing training opportunities to HQP.
    b. Given that there are few examples of research and commercialization intermediaries that are self-sufficient, the NCE Secretariat should expand on its expectations and definition of self-sufficiency of the Centres. The rationale for self-sufficiency and successful Canadian and/or international examples that could provide a model for long-term viability of the Centers should be identified.

3. Recognizing that improvements to the performance reporting template have been made over the CECR program cycle and universally accepted indicators to measure the progress of a discovery toward commercialization are limited, the NCE Secretariat should continue to seek improvements to Centres' performance reporting. Three areas are identified:
    a. Definitions of key concepts – the NCE Secretariat should work towards providing more detailed definitions of key performance indicators to strive for greater consistency in the way in which Centres populate the reporting template. Ongoing communications and guidance to the Centres on completing the templates is essential to ensure program performance measures are accurate and timely. The creation of a web-based reporting system may be helpful and the feasibility of obtaining regular partner/client feedback on the impact of their interactions with the Centres (such as through an online assessment form or third party assessment) could be explored.
    b. Review of performance measurement needs – the NCE Secretariat should review its current annual report template to ensure that all measures are required and being used for assessment of the Centres' performance and that measures that may be useful to understand the Centres' contributions to the CECR Program outcomes and value to the sector are not overlooked (e.g., recruitment of business talent). Due to the heterogeneity of the Centres, it is recommended that, in addition to measures related to commerce (company creation, jobs), qualitative measures of performance – including broader measures such as impacts on the health care costs – be included for Centres to tell their performance story. Centres could be asked to describe possible economic or societal impacts of the innovations they help to commercialize.
    c. Management practice – ensure that adequate time and effort are available for NCE Secretariat senior program managers to review and vet the performance information provided by the Centres. The feedback memoranda are useful, but could be more tailored to document Centre strengths, as well as weaknesses. This would be an important tool to enhance continuity in the event of turnover of NCE Secretariat staff.

1. INTRODUCTION

The Networks of Centres of Excellence (NCE) Secretariat commissioned EKOS to conduct a summative evaluation of the Centres of Excellence for Commercialization and Research (CECR) Program to inform the program renewal process (the terms and conditions of the program apply for a five-year period ending in June 2012) and meet the requirements of the *Financial Administration Act* and Treasury Board *Policy on Evaluation*. The purpose of this Final Report is to present the findings from the evaluation.

1.1 PROFILE OF THE CECR PROGRAM

Established by the Government of Canada in 2007, the CECR Program is managed by the NCE Secretariat, which is a joint initiative of the Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Research Council of Canada (NSERC), and the Social Sciences and Humanities Research Council of Canada (SSHRC), in partnership with Industry Canada and Health Canada. The CECR Program is a federal mechanism to support research and/or commercialization centres that bring together people, services, and research infrastructure to position Canada at the forefront of breakthrough innovations in priority areas. The goal of the CECR Program is to create internationally recognized centres of commercialization and research that establish public-private research and commercialization partnerships that deliver economic, social and environmental benefits to Canadians in the four priority areas of the S&T Strategy. The benefit to Canadians is defined by the program as incremental Canadian economic activity and improved quality of life in Canada. The maximum benefits are to be derived from the creation of high quality jobs in Canada, which according to program documentation, should be an important goal of any commercialization activity.[1] As established in the 2007 federal science and technology (S&T) Strategy - *Mobilizing Science and Technology to Canada's Advantage*, the four priority areas in which the CECR Program operates are: environmental science and technologies; natural resources and energy; health and related life sciences and technologies; and information and communications technologies.

The NCE Secretariat administers the program's national competitive processes through which a Steering Committee recommends centres for funding based on reviews by Expert Panels and a Private Sector Advisory Board (PSAB). The 22 Centres funded to date are listed below.

[1] National Centres of Excellence, CECR Program Guide, March 2011.

Table 1.1: CECR Centres Funded in 2008, 2009 and 2010

Name of Centre	Centre Type*	Primary S&T Priority Area	Location	Value of Grant
2008 Competition				
1. Advanced Applied Physics Solutions Inc. (AAPS)	Research & Commercialization	Health	Vancouver, BC	$14.95M
2. Bioindustrial Innovation Centre (BIC)	Commercialization	Natural Resources and Energy	Sarnia, ON	$14.95M
3. Centre for the Commercialization of Research (CCR)	Research & Commercialization	All	Ottawa, ON	$14.95M
4. Centre for Drug Research and Development (CDRD)	Research & Commercialization	Health	Vancouver, BC	$14.95M
5. Centre of Excellence in Personalized Medicine (CEPMed)	Research & Commercialization	Health	Montreal, QC	$13.80M
6. Centre for Probe Development and Commercialization (CPDC)	Research & Commercialization	Health	Hamilton, ON	$14.95M
7. Institute for Research in Immunology and Cancer – (IRICoR)	Research & Commercialization	Health	Montreal, QC	$14.95M
8. MaRS Innovation (MI)	Commercialization	Health	Toronto, ON	$14.95M
9. Prostate Centre's Translational Research Initiative for Accelerated Discovery and Development (PC-TRIADD)	Research & Commercialization	Health	Vancouver, BC	$14.95M
10. Pan-Provincial Vaccine Enterprise (PREVENT)	Research & Commercialization	Health	Saskatoon, SK	$14.95M
11. Centre of Excellence for the Prevention of Organ Failure (PROOF)	Research & Commercialization	Health	Vancouver, BC	$14.95M
2009 Competition				
12. Tecterra	Research & Commercialization	Natural Resources and Energy	Calgary, AB	$11.68M
13. Canadian Digital Media Network (CDMN)	Research & Commercialization	Information and Communications Technologies	Waterloo, ON	$10.72M
14. Centre of Excellence in Energy Efficiency (C3E)	Research & Commercialization	Natural Resources and Energy	Shawinigan, QC	$9.62M
15. Centre for Surgical Invention and Innovation (CSII)	Research & Commercialization	Health	Hamilton, ON	$14.8M
16. GreenCentre Canada (GCC)	Commercialization	Environmental Science and Technologies	Kingston, ON	$9.10M
17. Oceans Network Canada Centre for Enterprise and Engagement (ONCCEE)	Research & Commercialization	Environmental Science and Technologies	Victoria, BC	$6.58M
2010 Competition				
18. Centre for Commercialization of Regenerative Medicine – CCRM	Commercialization	Health	Toronto, ON	$15 million
19. Centre for Imaging Technology Commercialization – CImTeC	Commercialization	Health	London, ON	$13.3 million
20. Leading Operational Observations and	Commercialization	Natural Resources	St. John's,	$7.1 million

Name of Centre	Centre Type*	Primary S&T Priority Area	Location	Value of Grant
Knowledge for the North – LOOKNorth		and Energy	NFLD	
21. MiQro Innovation Collaborative Centre – MIC2	Commercialization	Information and Communications Technologies	Bromont, QC	$14.1 million
22. Wavefront	Commercialization	Information and Communications Technologies	Vancouver, BC	$11.6 million

*Based on type of Centre indicated in full application

1.2 Objectives and Scope of the Evaluation

The summative evaluation of the CECR Program addresses the core evaluation issues outlined in Treasury Board's *Policy on Evaluation*, which include program relevance and performance (effectiveness, efficiency and economy). Because the CECR Program was subject to a formative evaluation, the current evaluation builds on the previous study and examines the extent to which recommendations from the formative evaluation have been implemented. Ultimately, the evaluation will inform the program renewal process and meets coverage requirements of Treasury Board's evaluation policy. The summative evaluation covers the time period from program inception (2007-08) to the present. Note that while the CECRs funded in 2010 are included in the evaluation (e.g., in the file review), the case study research which explores outcomes focuses on the 17 CECRs funded in 2008 and 2009, given the greater time for these Centres to demonstrate progress toward outcomes. The evaluation matrix, including issues, questions and indicators is included in Appendix A.

An Interagency Evaluation Steering Committee has provided oversight for the evaluation, with day-to-day management of the evaluation provided by the NSERC evaluation officer and an advisory committee (with representatives from NSERC, CIHR and SSHRC, the NCE Secretariat and an observer from Industry Canada). The clients for the evaluation are the NCE Steering Committee and the NCE Management Committee.

1.3 Methodology

The evaluation is based on multiple lines of evidence, including qualitative (documentation, key informant interviews and case studies) and quantitative sources of evidence (performances measures, financial data, survey of Centre participants). The evaluation approach and methodology are briefly described below.

- A ***document and literature review*** was undertaken to support a thorough understanding of the CECR Program, the broader context in which the program operates and to address evaluation questions related to relevance, performance and efficiency, including a review of relevant literature related to innovation and commercialization challenges in Canada, and other programs supporting innovation/ commercialization.
- ***Key informant interviews*** were conducted with 46 individuals with knowledge of the CECR Program.

- ***Case studies*** of the 17 Centres funded by the CECR Program in 2008 and 2009 were undertaken to provide in-depth data collection and analysis at the Centre level. The case studies collected qualitative and quantitative data on the operation, performance and achievement to date of expected research and commercialization benefits as a result of the CECR Program grant. Case study interviews with key informants from the Centres typically included: Centre management and staff; Centre Board of Directors; Representatives of Centre partner organizations; and, where feasible and appropriate, a graduate student or postdoctoral fellow (n=1).

- An ***online survey*** was conducted of Centre participants from the 17 Centres funded in the 2008 and 2009 competitions. The purpose of the survey was to obtain quantitative data on Centre partners'/ clients' interactions with, as well as perception and opinions of the Centres and the CECR Program. Due to the considerable variability in the Centres' business model, there were differences in the nature of participants' role and interactions with the Centres. "Participants" refers to Centre members, funding contributors or operational partners (providing funding, assistance or services to the Centre), as well as users or recipients of Centre funding, assistance or services. The sampling frame for the survey was constructed based on lists provided by the Centres as part of their annual reporting as well as during the planning stage of the case studies with Centres.

1.4 LIMITATIONS

Overall, the evaluation methodology is strong in providing the basis for reaching conclusions for all issues and questions using multiple lines of evidence. There are limitations with the evaluation methodology; however, the limitations were carefully taken into account when conducting the analyses, and are acknowledged in the interpretation of the findings. The limitations and mitigation measures taken are described below.

- ***Reliance on information/opinion gathered from sources internal to the program.*** Much of the evidence that was gathered for this evaluation is drawn from internal sources – program documentation and administrative data, as well as interviews or surveys with program managers and Centre participants who have a clear stake in the program. This potential bias was mitigated to some extent by including external interview respondents, including unfunded applicants as well as documentary sources/external literature.

- ***Inconsistencies in the annual performance data.*** The case studies of the 17 Centres and program-level measures of research and commercialization outcomes relied extensively on performance information prepared annually by the Centres for the NCE Secretariat. While there is broad agreement that performance reporting for the CECR Program has improved over successive years with adjustments to the reporting template, the consequence is that year-over-year data has not been collected consistently over the first three years of the program. For example, the revisions to the annual reporting templates in 2010-2011 resulted in the removal of some indicators and the addition of new indicators which has resulted in only two years of data for "old" indicators (e.g., profile of HQP) and only one year of data for "new" indicators (e.g., commercialization outcomes for organizations served by the Centres). As well, there are inconsistencies in the way that Centres are reporting on performance measures related to research and commercialization outcomes and the extent to which the achievement of outcomes of the Centres can be attributed to the CECR Program grant (a function of the funding model

that requires matching funding, and particularly challenging for those Centres where the CECR grant represents a comparatively smaller portion of overall Centre funding) (these issues are outlined in more detail in Section 3.3(e)). The use of performance data were limited to time periods where consistent data are available and caveats are noted for individual outcome indicators where appropriate.

- ***Analytical challenges.*** The summative evaluation occurred three and two years into the five-year grant for Centres funded in 2008 and 2009 respectively. While, at this time, the Centres are now fully established and implementing their corporate or strategic plan, it is still premature for some Centres to demonstrate outcomes of their work that may only materialize in the longer-term (particularly, the intended ultimate outcomes of the CECR Program). To mitigate this limitation, the evaluation focused on short-term immediate/intermediate outcomes, with tracking of progress toward longer term intermediate and ultimate outcomes. As well, the innovation/commercialization process is complex, and the inherent measurement difficulties are compounded by the fact that Centres represent a diverse set of models, in a variety of sectors, with varying degrees of maturity. Aggregating the experience across the Centres to the CECR Program level presented challenges in presenting a program-level performance story. The case study method was used to better understand the various models and approaches used by the Centres in more depth. The performance data and survey instrument utilized common measures identified in the evaluation matrix to allow for aggregation of impacts at the program-level for some indicators.

- ***Difficulties identifying and surveying CECR participants.*** There was no extant list of the pool of CECR participants. While Centres provide lists of partners/contributors/Committee members/staff/HQP/researchers/personnel to the NCE Secretariat as part of their annual report, the lists were not consistently compiled (according to a common definition) and required updating for survey purposes. As well, due to the different business models utilized by the Centres, some Centres have very few external participants (PREVENT, CSii) and are therefore not represented in the survey. On the other hand, some Centres reach a broader clientele (GCC, CPDC) and are, therefore, overrepresented in the survey compared to other Centres. Achieving a high level of survey participation of CECR participants proved challenging. While mitigation strategies were employed to increase the response rate (email and telephone reminders, tracing of bounceback emails), the final response rate to the survey was 39 percent. There was a high degree of variability in the response rate across the Centres (from a low of five per cent to a high of 70 per cent). Thus, the analysis of survey findings was limited to basic frequencies and some sub-group analyses where question sample sizes would permit. Survey findings should be considered suggestive of program-level outcomes, rather than definitive.

- ***Limited inclusion of the perspective of highly qualified personnel (HQP).*** The attraction and training of graduate students and postdoctoral fellows is an identified immediate outcome related to research for the CECR Program. The case studies included at least one key informant interview with a graduate or trainee from Centres where training opportunities were provided, however, these interviews were conducted in 13 out of 17 Centres that provide training opportunities for HQP. Therefore, the evidence to address this intended immediate outcome is limited.

- ***Lack of data on comparable programs.*** The evaluation included a review of external literature and data on the experience of other programs with objectives similar to the CECR Program (e.g., TTOs/UILOs, research and commercialization alliances). Establishing benchmarks for the CECR Program was challenged by a lack of comparability of program objectives and the ability to generate

metrics similar to the available CECR Program performance data. This gap was addressed by examining international program experience in a more qualitative fashion, focusing on best practices.

2. FINDINGS

2.1 RELEVANCE

a) Continued Need

Evaluation Question 1. To what extent is there a continued need for funding to support the operation of research and commercialization Centres?

Key Finding: There is a continued need to address a commercialization gap in Canada that impedes the successful movement of discoveries to the commercial market. The operation of research and commercialization Centres is consistent with recommendations in the literature on building a strong innovation system and is supported by key informants and Centre participants. More advantages than disadvantages of the centre of excellence approach were identified.

Continued Need

The documentary evidence and key informant views support the need to continue to address research and commercialization challenges in Canada. A number of studies and reports have been released in recent years that together signal concern about the state of innovation in Canada.[2] These analyses agree that innovation is key to productivity, and innovation-based growth is an important ingredient of Canada's prosperity and continued competitiveness in a global economy. In reviews of Canadian and international indicators of productivity and innovation,[3] a common emerging conclusion is high praise for Canada's investments in basic science, infrastructure (universities, institutes, and hospitals) and support for higher education. However, while strong in invention, Canada lags in innovation. Sometimes termed a 'commercialization gap' or 'valley of death', the research indicates that Canadian discoveries too often do not move successfully through the stages of development and demonstration to obtain follow-on investment to reach the commercial market to derive economic and quality of life benefits. Analyses of the commercialization gap in Canada points to gaps in support during the stages of the innovation process, in particular during the later development and demonstration phases (e.g., improve IP, proof of principle) and the early commercialization and market development phases (e.g., market assessment, commercial prototype development). Using indicators related to knowledge production, transformation and market share of selected knowledge based-sectors, the Conference Board of Canada gave Canada a 'D' grade and a ranking of 14th of 17 countries considered with respect to its capacity to innovate.[4]

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2 Independent Panel on Federal Support to Research and Development, Innovation Canada: A Call to Action, Review of Federal Support to Research and Development – Expert Panel Report, 2011; Institute for Competitiveness and Prosperity, Canada's innovation imperative, Report on Canada, 2011; CATAAlliance, Canada as a Competitive Innovation Nation: What Needs to be Done (White paper), 2012; Mowat Centre for Policy Innovation, School of Public Policy and Governance, University of Toronto, Canada's Innovation Underperformance: Whose Policy Problem is it?, 2011; Science, Technology and Innovation Council, Imagination to Innovation: Building Canadian Paths to Prosperity, States of the Nation 2010, Canada's Science, Technology and Innovation System, 2010; The Council of Canadian Academies, Innovation and Business Strategy: Why Canada Falls Short, The Expert Panel on Business Innovation, June 2009.

3 Indicators include, for example, business R&D spending, productivity growth, businesses collaborating with universities for R&D, angel/venture capital investment.

4 Conference Board of Canada, Innovation Report Card, February 2010, http://www.conferenceboard.ca/hcp/details/innovation.aspx.

The reasons for the commercialization gap that are identified in recent studies are many – absence of entrepreneurial culture/infrastructure to commercialize university-based research, lack of venture capital exacerbated by the 2008 economic downturn, public policy that supports both invention and hard sciences over innovation and business management education, and lack of firm-level investments in innovation related technologies.

While outlining a number of broad recommendations to improve federal support to research and development, the recent Review of Federal Support to Research and Development (2011) (the Jenkins Report) highlights the importance of "collaboration among businesses, governments and the higher education sector [that] can contribute importantly to the conception and successful introduction of new products and processes… Intermediaries play a role in the innovation "ecosystem" by supporting effective synergies, connections, and flows of knowledge and ideas". Similarly, according to the Conference Board of Canada, countries that outperform Canada on innovation are successful because of their ability to coordinate industry, government, and research institutes.[5]

Key informants across all respondent groupings, often also citing recent studies of innovation in Canada, agree that the CECR Program is addressing persistent research and commercialization challenges in Canada. Considering the specific challenges the program addresses, key informants variously pointed to:

- Canada's poor record in translating public research investments into economic benefit;
- Lags in key indicators compared to international peers in translating public research investments into commercial products, services and solutions;
- Lack of industry or institutional funding sources in Canada that are prepared to invest in early stage technologies and higher risk ventures;
- The geographic distribution of Canada and small population within many regions, resulting in fragmentation of research and commercialization potential; and
- Dearth of a commercialization culture in Canada and lack of business skills and acumen among publicly funded researchers.

The opinions of Centre participants are consistent with these views – 90 per cent of surveyed Centre participants believe to a significant extent (responded 4 or 5 on a 5-point scale) that there is a need for the federal government to continue to fund centres to foster research and commercialization in priority areas. The reasons for their rating are varied and echo those of key informants: to bridge a commercialization gap; to encourage investment in R&D; to foster partnerships between researchers and industry; and to help Canada become an international industry leader.

A common indicator of continued program need is the extent of demand for and incrementality (would not have happened in the absence) of the program funding. With respect to demand, administrative data indicate that interest in the CECR Program over its three competition cycles has been strong, although the number of letters of intent (LOIs) received by the program has declined with each successive competition. In 2008, 110 LOIs were received, which decreased to 34 and 30 LOIs in 2009 and 2010, respectively. The decline in applications owes in

[5] Canada's Pathways Toward Global Innovation Success: Report of the Leaders' Panel on Innovation-Based Commerce, the Conference Board of Canada.

part to greater targeting of the program criteria in the latter competitions. Across each competition cycle, the application success rate is 10 to 17 per cent for LOIs and 40 to 50 per cent for full applications (FAs).

With respect to incrementality of the CECR Program grant, the reports of the funded Centres, as well as the outcomes of unfunded applicants to the CECR Program are relevant. Of the 17 Centres included in the case studies, nine of the Centres indicated that the Centre would not have been established in the absence of the CECR Program funding. Centres that are reliant on the CECR Program grant as their predominant source of funding were more apt to note the incrementality of the grant. The remaining eight Centres indicated that it is likely some form of the Centre, or the activities undertaken by the Centre, would have moved forward without the CECR grant. This is the case for several Centres that are recipients of significant provincial or other sources of funding, and the CECR grant represents a lesser component of their overall funding envelope. These Centres indicate that the CECR grant allowed a significant expansion of their Centre (e.g., number of projects supported) and increased the speed with which they were able to advance their activities. The CECR grant also enabled a broader geographic reach or expanded opportunities to engage in networking opportunities and development of commercialization expertise.

With respect to the experience of unfunded applicants and the outcome of their proposed centre, of seven unfunded applicants who were interviewed, four indicated that their proposal has not received other funding or that they were continuing to pursue funding from other sources. Three of the seven applicants had received funding from other sources (province of Ontario, though two of these at substantially lower levels in comparison to the requested CECR grant). Unfunded applicants reported that they continued to engage in activities related to their application in some refined or more narrowly defined form.

Advantages of the Centre Approach

Key informant respondents at the program level and within the Centres broadly approved of the centre of excellence approach adopted by the CECR Program to address research and commercialization challenges in priority areas. These respondents noted that the creation of research and commercialization "hubs" reflects a cluster approach to innovation which has been utilized elsewhere with success (e.g., in the US – Silicon Valley, Boston Innovation District). Key informants named a number of specific advantages of the Centre approach. Notably, Centres:

- Provide opportunities and mechanisms for collaboration. The Centre model brings together universities and research institutions and links them to private sector partners in an 'honest broker' role (by creating partnerships and alliances across various parties and identifying commercialization options in an independent and neutral fashion). These new cross-sectoral collaborations have the capacity to increase the alignment between publicly funded research and industry and market needs.
- Create critical intellectual mass/leadership in areas of Canadian strength by bringing together the best expertise nationally and internationally. The Centre approach also provides an opportunity for cross-fertilization between and across the Centres in adjacent areas of expertise (e.g., to refer or co-fund projects).
- Create synergy and visibility within targeted sectors which enables them to bring national/ international partners together and to attract funding from a variety of sources.
- Cultivate sectoral or regional hubs of research and commercialization intelligence/resources.

- Stimulate critical mass or commercialization capacity in terms of infrastructure, expertise and industry networks within specific sectors. Centres creating accessible "one-stop shops" are providing a package of unique services tailored to sector needs.

Surveyed Centre participants also indicate support for the effectiveness of the Centre approach: eight in ten participants indicated that the Centre with which they are affiliated is addressing research and commercialization needs and challenges in its sector to a great extent (responded 4 or 5 on a 5-point scale). Respondents indicated that needs and challenges in their sector are being addressed by the Centre's commercialization advice/expertise (50 per cent), provision of financing and capital (27 per cent), facilities/equipment (18 per cent) and coaching/mentoring (17 per cent).

Although less prevalent, a few key informant interviewees identified disadvantages to the centre of excellence model, such as the potential for the selection of funded Centres to overlook key opportunities for future economic development or to focus on regional issues/resources rather than adopting a truly national perspective. The operation of Centres can also be hampered by risks associated with complex intellectual property (IP) management, and, depending on expertise/outreach may appeal to a narrow segment of the sector it serves (e.g., participation barriers for small and medium-sized enterprises (SMEs)).

b) Program Niche

Evaluation Question 1.1: What niche, if any, does the program occupy in relation to similar programs at the federal and other levels of government?

Key Finding: The CECR Program is distinguished from other federal and provincial initiatives by a focus on operational funding in the form of large scale grants to centres that collaborate with government, business and academia. The program's commercialization focus addresses a gap in the public research and development funding array that has, to date, focused more heavily on research. Where provinces have focused efforts on commercialization, in many instances, funded Centres are accessing these complementary programs with the CECR Program to address common objectives.

A number of recent studies of innovation capacity in Canada have mapped federal and provincial programming to support research and development activities within universities and the private sector. Often critical, the Jenkins Report (2011) found, for example, a "bewildering array of innovation support programs (at both the federal and provincial levels)", and a review by the Mowat Centre (2011) characterized programming as an array of "direct supports to clusters, sectors, industries and firms …found in hundreds of overlapping and confusing federal and provincial programs delivered by multiple departments with contradictory and overlapping objectives". Indeed, most program and Centre-level key informants and Centre participants indicated being aware of other Centres, and other initiatives in Canada, at either the federal or provincial level, that have similar or complementary objectives to the CECR Program. Not surprisingly, many of the programs mentioned by key informants focus on the health sector (given this residual sector bias in the funded Centres) and also include provincial programs where the Centres are commonly located – e.g., Ontario and Quebec. The programs demonstrate a variety of foci with respect to funding target (e.g., individual investigators, SMEs) and activity (e.g., networks, research, commercialization – early and late stage). An analysis of the program landscape indicates that the CECR Program is unique in providing operational funding for Centres (a form of funding that is rarely available from other programs) and provides a high degree of

flexibility that allows Centres to interact with a variety of client types (e.g., individual academic investigators, small businesses, research alliances).

Key informants at the program-level and from the Centres most commonly characterized the CECR Program as complementary to other research and commercialization programs or funding opportunities. The CECR Program is seen as completing the suite of fundamental and R&D research programs offered by the funding agencies. The pre-commercialization and commercialization focus of the program is identified as one of its distinguishing features, addressing a perceived gap in the research and development funding array. The CECR Program was also considered unique in the federal suite of programs because grant funds can be used to support the *operating* costs of research and commercialization centres whereas other federal programs tend to support only the direct costs of research, researchers and networks, and public research infrastructure. In addition, the program features a high degree of flexibility to work with a variety of partners under different arrangements and to offer multi-dimensional approaches to addressing research and commercialization challenges tailored to the needs of a specific sector (labs, physical structure, dedicated staff expertise, industry partners and networks, capital/seed funding). Other important features of the CECR Program noted by program- and Centre-level key informants included:

- Targeted focus on specific sectors in areas of natural strength or advantage.
- National scope that enables the program to capitalize on areas of existing research strength from across Canada. While many of the Centres are now regionally clustered, there may be future opportunities to extend outreach to a wider constituency.
- Significantly larger funding amounts, creating the scale and capacity required to address challenges within a sector.
- High level of private sector engagement and industry involvement.

Overall, there were few concerns about the potential for overlap and duplication between the CECR Program and other alternative sources of funding for research and commercialization at the federal or provincial level. Where there are programs at the provincial level that have objectives similar to the CECR Program (e.g., Ontario Centres of Excellence, Alberta Innovates), these programs are often providing funding to Centres that is complementary to the CECR Program grant to address common objectives.

A thread in the comments of program- and Centre-level key informants is a need for the program to maintain its focus on commercialization capacity as opposed to research capacity. Some key informants (e.g., provincial representatives), indicated that the CECR Program is seen to be too academically-driven and lacking a clear commercialization imperative and sufficient "market pull" orientation. Supports for commercialization are generally perceived to be lacking in comparison to researching funding, creating a need to support entrepreneurs, start-ups and SMEs that may not otherwise have access to the management expertise, capital, development support, and industry partners needed to successfully bring their innovations through the pre-commercialization phase.

c) Necessary Role for Federal Government

Evaluation Question 2. Is there a necessary role for the federal government in providing the program?

Key Finding: The federal government plays an important and appropriate role in supporting innovation and addressing research and commercialization to foster economic growth. Provinces also fund many of the Centres to address common objectives, though structured, formal inter-jurisdictional collaboration continues to be an underdeveloped aspect of the CECR Program.

Documentary evidence and views of key informants agree on the continued importance of and need for federal level intervention in addressing research and commercialization challenges. In a review of federal support to research and development, the Jenkins Report (2011) noted that countries around the world are seeking ways to support innovation. Reflecting a consensus in the literature, the report states that "the federal and provincial governments play an important role in fostering an economic climate that encourages business innovation". In the Conference Board of Canada's report card on innovation, countries with higher overall scores related to innovation tended to have policies that drive innovation supply and demand that are supported at the highest level. The Conference Broad urged coherent public policy that promotes innovation in the national interest.[6]

Key informants are virtually unanimous in their view that there is a legitimate role for the federal government in addressing research and commercialization challenges in Canada. Many key informants, as noted above, point to the need for federal involvement to address lags in Canada's return on public investment in research and the country's poor track record in the innovation area. According to these key informants, a federal commitment is required to address gaps in the commercialization of Canadian discoveries in order to stimulate innovation-based growth.

Some key informants also noted additional benefits associated with the federal government's involvement in research and commercialization centres. First, from a public benefit perspective, the federal government makes an important contribution in identifying strategic priorities for the whole of Canada, and fosters collaboration at the national and international levels. The private sector and other government jurisdictions are not in a position to assume this role. Federal involvement in the CECR Program also parallels international practice as there are many examples within developed countries of commercialization being supported in a similar manner (see Section 3.3(c)). According to several key informants, the involvement of the federal level also has the potential to provide an equalizing effect that supports commercialization and fosters national growth across regions.

The nature of the involvement of the provinces has evolved over successive CECR Program funding competitions. There was reportedly little engagement of the provinces during the initial design of the CECR Program due to a highly compressed design period and rapid roll out of the program. In the first and second application rounds, provinces were invited to review LOIs or FAs from Centres within their jurisdiction to assess alignment with provincial priorities and provide feedback or letters of support. This process was not fully successful and in the third funding round, the process for provincial and territorial engagement was revised, in consultation with provinces and territories. The process of meetings between the NCE Secretariat and provincial officials to identify provincial

[6] Conference Board of Canada, Innovation Report Card, February 2010, http://www.conferenceboard.ca/hcp/details/innovation.aspx.

priorities was replaced with a process whereby the NCE Secretariat provided each province and territory with a copy of all LOIs submitted from their province or territory and required applicants to include, in their full application, letters confirming support from all sources, including those secured from provincial and territorial governments. Many of the Centres have done this successfully (ten of the 17 Centres included in the case studies have received provincial funding), with good synergy between federal and provincial government funding and priorities (e.g., Tecterra, CCR, C3E). As well, several of the Centres have been funded on a foundation of extensive provincial investment prior to receiving the CECR Program grant (e.g., GCC, CCR, MaRS Innovation).

In general, program- and Centre-level key informants support provincial involvement in the Centres to create synergies with provincial priorities and benefits for the provinces, as well as to Canada overall. While provincial support is not a formal criterion in evaluating CECR Program applications, provincial support and matching funds that may be contributed by provinces are viewed in a positive light – e.g., to enhance cross-fertilization of ideas, increase industrial relevance, support for self-sufficiency, validation of regional research and commercialization strength, pooling of resources/leveraging of infrastructure/networks. A small number of key informants, however, note significant differences in the capacity of provinces to fund innovation. The CECR Program selection criteria – e.g., "excellence, focus and coherence of the research and commercialization program" and the opportunity to benefit Canada by drawing on existing national and international research and/or commercialization strength may also lead to regional variability in approved applications (favouring provinces with established capacity and strength in priority areas).

While provincial involvement and support for the Centres is viewed as important and positive by the majority of key informants (and, in fact, provincial investments in several entities such as the precursor to the GreenCentre Canada pre-dates the CECR Program), collaboration between the federal and provincial jurisdictions (a recommendation of the 2009 formative evaluation) is not yet formally in place. Provincial representatives are of the view that more collaboration is desirable and program staff respondents agree that the NCE Secretariat could do more in this area. Recommended approaches included greater information-sharing and "good conversations" about involvement of the province in the CECR Program, and greater recognition of the provincial role in funding and contributing to the impacts of the Centres. In the formative evaluation, provincial representatives also noted the importance of being consulted in a more structured fashion earlier in the Centre application and selection process.

d) Alignment with the Federal Priorities

Evaluation Question 3. To what extent is the program aligned with federal government priorities?

Key Finding: The CECR Program is aligned with federal government priorities, supporting the advantages and principles articulated in the federal S&T Strategy. An early overrepresentation in Centres addressing the health priority area is being addressed. While the CECR Program clearly supports NSERC and CIHR priorities, the evaluation evidence indicates a more mixed picture of the alignment of the program with the priorities of SSHRC for service and business innovation. The S&T priority areas themselves and the profile of Centre projects and Centre participants suggest a focus on technology and product innovation over service and process innovation. Still, the services offered by the Centres include commercialization and business-related advice/expertise, which suggests that the Centres' staffing complement and commercialization model is multi-disciplinary (though research field of staff could not be quantified in the evaluation).

Alignment with Federal Priorities

The documentary evidence and views of program key informants indicate a satisfactory alignment between the CECR Program and federal government priorities. Within the *Whole-of-government framework*[7], the CECR Program activity supports the Government of Canada Outcome: Economic Affairs; Innovative and Knowledge-based Economy. The CECR Program was one of three new programs within the NCE Secretariat created in the 2007 Budget to address the federal S&T Strategy – Mobilizing Science and Technology to Canada's Advantage. The program supports the Entrepreneurial Advantage as articulated in the Strategy by contributing to the translation of research into commercial applications. In addition, program key informants noted that the program also addresses the Knowledge Advantage by advancing the development of new technologies and, to a lesser extent, the People Advantage. The collaborative and multi-sectoral approach adopted by the Centres is consistent with the S&T Strategy core principle of encouraging partnerships.

CECR Program funding decisions are also mapped to the four priority areas of the S&T Strategy: health and related life sciences and technologies, environmental science and technologies, natural resources and energy, and information and communications technologies. Program key informants are of the view that the priority areas provide a means to focus the CECR Program and fit with areas of research strength in Canada. A small number of respondents added that the priority areas offer a way to focus finite program resources and to foster complementarities among the Centres. Most key informants believe that the S&T priority areas continue to be relevant and are sufficiently broad to ensure that sectors of potential strength within Canada that could potentially benefit from the CECR program are not excluded from funding. An exception to this was noted in the coverage of the CECR Program of Canada's people strength and, specifically, the need for the definition of the commercialization within the program to include not only goods and products, but also services and business process.[8] Several interviewees highlighted the need for the CECR Program to place greater focus on selecting Centres that capitalize on Canada's national advantages, and research and business strengths.

The file review analysis examined the number of LOIs, FAs, and funded Centres by the S&T Strategy's priority areas for the 2008, 2009, and 2010 competitions. CECR Program activity addresses all of the priority areas, with a strong emphasis on health at the primary level, and a focus on the health and ICT priorities at the secondary level. For funded Centres, 52 per cent of the 22 funded Centres address the health and health-related life sciences and technologies as their primary focus. Natural resources and energy is a primary focus of 20 per cent of funded Centres, followed by 16 per cent in information and communication technologies and 12 per cent in environmental science and technologies.

For the 174 LOIs submitted to the CECR Program: one-third (31 per cent) identified health and related life sciences and technologies as a primary area; just under one-third (27 per cent) identified information and communications technologies; roughly one in five (19 per cent) identified natural resources and energy; and 14 per cent identified environmental science and technologies. For the 50 FAs, four in ten (40 per cent) identified health and related life sciences and technologies as a primary area; one-third (32 per cent) identified information and communications technologies; nearly one in five (18 per cent) identified natural resources and energy; and 16 per cent identified environmental science and technologies.

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7 http://www.tbs-sct.gc.ca/ppg-cpr/frame-cadre-eng.aspx. Accessed February 13, 2012.

8 The instructions for the CECR Program's 2010-2011 Annual Report template defines commercialization as follows: Transforming knowledge and technology into new goods, processes or services to satisfy market demands.

Program key informants attributed the initial overrepresentation of Centres in the health area as due, in part, to the maturity of the health research sector and greater experience with grant writing compared to other sectors. Competitions in 2009 and 2010 addressed the overrepresentation of applications relating to health through increased promotion of the program and adjusting competition criteria in order to target underrepresented sectors (a recommendation of the 2009 formative evaluation of the CECR Program). As a result, the 2009 and 2010 funded Centres have good coverage of the Science, Technology and Innovation Council's (STIC) sub-priority areas.[9] The Centres funded in the 2009 and 2010 competitions have a near equal coverage of the S&T priorities and the STIC sub-priorities with just over one-quarter (27 per cent) of funded Centres representing each of health and related life science technologies, natural resources and energy, and information and communication technologies, and 18 per cent have an environmental science and technology primary priority area. The STIC 13 sub-priority areas were introduced after the 2008 competition and were therefore not included in early competitions.

Alignment with Agency Priorities

The evaluation assessed the extent to which the CECR Program is aligned with the respective agency research and commercialization strategic outcomes and program activities. The objective of the CECR Program is to establish collaborative-based centres to advance research and facilitate commercialization of innovative technologies, products and services within the federal S&T Strategy priority areas. However, as mentioned previously, the focus of the CECR Program on the S&T priority areas does not appear to adequately integrate SSHRC's focus on the role of knowledge mobilization in innovation.[10] For example, the profile of collaborative projects between Centres and organizations they serve indicates that projects focusing on commercializing a process or service occur less frequently than projects focused on commercializing a technology or product. Similarly, Centre participants were less likely to indicate that their organization conducts or supports research and/or commercialization in the social sciences and humanities (13 per cent) than the health sciences (60 per cent), and natural sciences and engineering (58 per cent). On the other hand, the nature of the types of supports and assistance provided by Centres (e.g., advice/ expertise on commercialization, business development/consulting/advice, coaching/mentoring/training, and market studies/intelligence/assessment) and the staff positions within some Centres (e.g., regulatory affairs, policy, marketing) suggest that these Centres are implementing a multi-disciplinary approach to commercialization that utilizes knowledge and expertise from the social sciences and that the Centres are having an impact on the products, services, process and practices of the organizations they serve.

The documentary evidence indicates how the CECR Program is aligned with the priorities of each of the funding agencies with respect to the mobilization and commercialization of research:

- The program is consistent with NSERC's strategic outcome of innovation through funding research in strategic areas, funding university-industry-government partnerships and supporting commercialization.

[9] The STIC sub-priority areas were announced in 2008 (after the 2008 competition) and the 2010 competition required that proposed Centres address one or more of the 13 sub-priorities.

[10] The gap was addressed in the NCE Secretariat Business-led Networks of Centres of Excellent Program with the addition of a fifth priority area – Management, business or finance.

- The program aligns with CIHR's strategic focus on accelerating the dissemination and commercialization of health research. This alignment is fostered by the strong uptake of the program by Centres in the health priority area.
- The program aligns with SSHRC's strategic outcome of knowledge mobilization through research networking that supports and facilitates the use of social sciences and humanities knowledge within and beyond academia.

2.2 PERFORMANCE

a) Achievement of Intended Immediate and Intermediate Outcomes

Evaluation Question 4. To what extent has the program achieved expected research and commercialization outcomes?

Key Finding: The CECR Program has been successful in making progress toward achieving many immediate and intermediate outcomes, including enhancing research and commercialization capacity, and strengthening domestic collaboration and attracting investment from partners (leveraging $1.50 for every $1 of the CECR grant expended). Centre participants have accessed a broad range of support/assistance including financial (cash) support and commercialization expertise from the Centres and interactions with the Centres are having organizational benefits for these participants in terms of knowledge base and R&D capacity. The program has had more modest success in providing training opportunities for HQP (an intended outcome more evident among Centres in the health priority area and research and commercialization Centres). Progress toward research outcomes (research leading to public benefits) is preliminary in nature due to the longer timeframe required for research benefits to be realized. It is unlikely that any of the Centres will achieve self-sufficiency within the funding period.

Enhance Research and Commercialization Capacity and Strengthen Domestic Collaborations

Since the CECR program's inception, $229.6M has been deployed to address research and commercialization challenges in sectors served by the 22 funded Centres (including expenditures of CECR Program funding ($91.6M) and expenditures of leveraged partner funds ($138M). As a result of these expenditures, Centres have enhanced research and commercialization capacity through:

- Operation of physical infrastructure (specialized equipment or facilities, lab services) which is utilized by Centres or on a contract or fee-for-service basis by investigators from academia and industry to conduct applied research and development work (e.g., testing, validation) to add value to discoveries. Physical infrastructure has also been enhanced in the form of incubator-style space arrangements that bring partners together within a hub. Fourteen of the 17 Centres that were included in the case studies have made enhancements to their physical capacity for commercialization purposes.
- Providing commercialization expertise (internally or through the Centre's network) to academic investigators and industry. Centres offer an array of services such as evaluation of new technologies/disclosures, IP management, regulatory affairs, and business management. Fourteen of the 17 Centres included in the case studies provided this kind of expertise to external clients.

- Capital investment in new companies or providing seed funding to selected projects was offered by nine of the 17 Centres included in the case studies.

With respect to strengthening domestic collaborations, the performance data submitted by the Centres indicate numerous interactions with industry and other knowledge translation activities (431 knowledge translation activities were recorded by Centres over the first three years of the CECR Program). In the case studies, there were many examples of domestic collaborations fostered by workshops, conferences, and networking events hosted by the Centres. In addition, Centres have entered into formal, collaborative MOUs or partnership agreements and joint ventures with other Centres, research and commercialization entities, universities and with private industry.

Table 2.1: Knowledge Translation Activities: FY 2008-09 to FY 2010-11

	2008-09	2009-10	2010-11	Total
Interactions with industry	304	635	N/A	939
Other knowledge translation activities	85	85	261	431

Source: NCE Secretariat Administrative Data, 2012.

The program administrative data further indicate that the reach of the Centres has increased since the CECR program's launch in 2008-09. Over the last three years, the number of partners has increased from 71 partners in 2008-09 to 297 in 2010-11. This increase reflects both an increase in the number of partners established by each Centre[11], as well as an increase in the number of Centres funded during this period.

In 2010-11, ONCCEE launched a national Ocean Technology Industry Network to deliver services to sector companies across Canada, and initiated an alliance of regional associations across Canada to establish the Ocean Technology Alliance of Canada to facilitate networking and collaboration nationwide. The Centre has provided consulting expertise to a number of Canadian companies to improve products such as ASL, Instrument Concepts, Pro-Oceanus, Weir-Jones, Ocean Works, Romor Atlantic, Satlantic, Nanometrics, and Nortek Scientific.

Table 2.2: Centre Partners: FY 2008-09 to FY 2010-11

Organization	2008-09	2009-10	2010-11
University	23	39	39
Host organization	7	12	13
Company/Industry	16	68	164
Federal (non-CECR)	0	9	12
Provincial	10	13	20
Municipal	0	2	4
Other	15	35	45
Total	**71**	**184**	**297**

Source: NCE Secretariat Administrative Data, 2012.

[11] For example, between 2008-09 and 2009-10, the first 11 Centres that were funded reported an increase of about 100 partners (a significant portion of this from PROOF which added 59 partners in 2009-10).

Attract Research and Business Talent

For all Centres, talent recruitment has occurred for key management positions, as well as for members of Centre Board of Directors, committees and panels. The number of Centre staff ranges significantly from relatively small numbers (5 to 10 staff) to well over 50. Organizational size depends to a large extent on Centre capacity for leveraging cash contributions from partners, as well as Centre revenues derived from contract or fee-for-service activities.

Centre annual reports quantify research personnel hired by the Centre, but not business talent.[12] From 2008-2009 to 2010-2011, funded Centres reported 433 FTE research personnel working on Centre activities paid through the CECR grant. In addition, 670 FTE research personnel are associated with the Centres, paid through other sources. Most (365 FTEs) of the CECR-funded research personnel are working in Centres in the health S&T priority area, with another 584 FTEs supported through other funding in these Centres. Similarly, the majority of research personnel (392 FTEs through CECR funding and 640 FTEs through other funding) are working in research and commercialization Centres, and the remainder (41 FTEs through CECR funding and 30 FTEs through other funding) are employed in commercialization Centres.

Table 2.3: Research Personnel FTEs funded by the CECR Grant and Other Funds

	Researcher		Research Associate		Other*		Total	
	CECR Funds	Other Funds	CECR Funds	Other Funds	CECR Funds	Other Funds	CECR Funds	Other Funds
2008-2009	25	65	38	6	24.3	141.2	87.3	212.2
2009-2010	32.3	60.3	31.3	29.3	72.1	204.9	135.7	294.5
2010-2011	34.5	25.6	38.7	62.2	136.3	75.8	209.5	163.6
Total	**91.8**	**150.9**	**108.0**	**97.5**	**232.7**	**421.9**	**432.5**	**670.3**

*Other includes: Technical staff (reported in 2008-2009 and 2009-2010, include total), Clinician (total), Health Professional (total), Post-health professional degree fellow (total) and Salaried Professional, non-research (total) (reported in 2010-2011).

While not expected to yield results in the short-term, a number of Centres have undertaken activities with CECR and non-CECR funds that include mentorship of youth in science and business-related disciplines. These include, for example, sectoral education and awareness activities (CSII, ONCCEE) and collaboration with educational institutions in program development (C3E, CDMN).

Attract Investments

The extent to which Centres have attracted or increased investment was measured on the basis of the following three indicators:

- Extent and nature of partner contributions to the Centre;
- Investments in the Centre through use of the Centre's research and commercialization capacity (contract research agreements, fee-for-service); and

[12] Staff and Board of Director/committee lists indicate name, organization and title, but not the research field or area of expertise.

- Follow-on investment accessed by organizations served by the Centre.

Expenditure of Partner Contributions

In the first three years of operation, Centres have expended $138M in leveraged partner contributions (a leveraging ratio that has increased each year and is now 1.5 compared to CECR Program grant expenditures over the first three years). On average, 73 per cent of partner expenditures were in the form of cash. Industry and the provincial governments were the most significant contributors (33 and 26 per cent of partner contributions, respectively).[13]

Table 2.4: Expenditures of Partner Contributions: FY 2008-09 to FY 2010-11

	Cash	%	In-Kind	%	Total
2008-09	$17,954,628	67%	$8,702,899	33%	$26,657,527
2009-10	$28,686,861	74%	$10,110,420	26%	$38,797,281
2010-11	$53,771,303	74%	$18,861,676	26%	$72,632,980
Total	**$100,412,792**	**73%**	**$37,674,995**	**27%**	**$138,087,788**

Source: NCE Secretariat Administrative Data.

Table 2.5: Expenditure of Partner Contributions: FY 2008-09 to FY 2010-11 by Source

	Cash	%	In-Kind	%	Total	%
University	$8,871,630	42%	$12,075,341	58%	$20,946,971	15%
Industry	$31,858,243	71%	$13,147,459	29%	$45,005,702	33%
Federal (non-CECR)	$9,389,068	93%	$726,710	7%	$10,115,778	7%
Provincial	$33,391,825	94%	$2,248,533	6%	$35,640,358	26%
Other (e.g., municipal, health authority, non-profit)	$16,902,026	64%	$9,476,952	36%	$26,378,978	19%
Total Partner Contribution Expenditures	**$100,412,792**	**73%**	**$37,674,995**	**27%**	**$138,087,788**	**100%**
Total CECR Program Grant Expenditures	**$91.6M**				**$91.6M**	

Source: NCE Secretariat Administrative Data.

Centre Revenues

In addition to partner contributions, seven Centres also identify Centre-generated revenue in their most recent annual report. Revenue generation occurs through activities such as event registrations, tenants and production, distribution and sale of goods. Centres may also record interest income from their grant as generated revenue. In 2010-11, these Centres generated $2.17M in revenue. Almost half of this revenue was generated by the radiopharmacy operated by the CPDC.

[13] Guidelines on the eligibility and value of in-kind contributions for Centres to complete the information can be found at: http://www.nserc-crsng.gc.ca/NSERC-CRSNG/Policies-Politiques/orgpartners-orgpartenaires_eng.asp.

Follow-on Investment

In their annual report (since 2010-11), Centres record the amount of funds (Canadian and foreign) leveraged by organizations served by the Centre. According to the 2010-11 CECR Program performance data, organizations served by the Centres accessed over $104M in additional investments from Canadian sources and $206M in foreign investment. While annual reports do not identify the source of investments, the case studies found investments were accessed from a variety of sources, which could include private sector investors, public funding (e.g., other Centres, government investment funds) and the funds invested in start-ups by the Centre itself.

The role of the Centres in assisting participants to obtain financing is confirmed in the survey results: 41 per cent of Centre participants received assistance in seeking other funding sources (a service second only to receiving advice/expertise on commercialization).

Examples of Other Forms of Investment

Other examples of investments obtained by some of the Centres drawn from the case studies include:

- Investment agreements with industry (in return for first rights on technologies);
- Co-investors in pre-seed and seed funds; and
- Accessing other grant funds to support infrastructure development (e.g., CPDC and McMaster University grant award of $22M for campus infrastructure upgrade).

C3E offers programs that support all of the phases in the value chain, from the R&D phase to the commercialization phase, including network and business development, research and development and investment funds. A key investment activity of the C3E is participation in the Fond Cycle-C3E investment fund which supports the commercialization of energy efficiency technologies and processes, as well as the commercialization of clean technologies and new energy sources. Its focus will be on filling the existing funding gap between the technology demonstration phase and the marketing phase of new products or solutions. Funding for the Fond Cycle-C3E is provided by various partners, totalling $33 million to date. As a founding partner, C3E acts as an observer on the Cycle-3CE's Advisory Committee and its Investment Committee.

Provide High Quality Post-graduate and Post-doctoral Training in Innovative and Internationally Competitive Research

A total of 53 FTE Highly Qualified Personnel (HQP) were funded by the CECR funding during the first three years of the program, while another 271 FTEs have been associated with the Centres through other funding. As with research personnel, most HQP have been hired within Centres in the health S&T priority area; 50 FTEs through CECR funds and 216 FTE HQP through other funding. Nearly all HQP have been hired by research and commercialization Centres; only one FTE HQP has been associated with a commercialization Centre (through other funding).

Table 2.6: HQP FTEs Funded by the CECR Grant and Other Funds

	Postdoctoral Fellow		Graduate Student		Undergraduate Student		Total	
	CECR Funds	Other Funds	CECR Funds	Other Funds	CECR Funds	Other Funds	CECR Funds	Other Funds
2008-2009	0	31	0	32	2	28	2	91
2009-2010	10.5	33.8	8	32.8	5	39	23.5	105.5
2010-2011	10.2	34.4	3.3	36.3	13.7	3.6	27.2	74.3
Total	**20.7**	**99.2**	**11.3**	**101.1**	**20.7**	**70.6**	**52.7**	**270.8**

About two-thirds of the Centres included in the case studies provided training to HQP through a variety of internship or trainee programs (e.g., Michael Smith Foundation for Health Research, NSERC's Collaborative Research and Training Experience (CREATE) Program) and hiring arrangements. As noted, the numbers of HQP involved are modest, although variability existed by priority area, with some health sector Centres (AAPS, PROOF, CDRD, PC-TRIADD) providing more training than non-health related Centres. On the other hand, this intended outcome of the CECR Program was not perceived to be relevant by several of the Centres – particularly the commercialization Centres. There were also a small number of Centres that noted that HQP were provided training opportunities through organizations served by the Centre or through non-CECR funds. An example of this is Tecterra, where provincial funds are utilized by the Centre to implement structured training and employment placement programs for graduates in fields related to geomatics.

The HQP who were interviewed as part of the case studies (n=16) were uniformly satisfied with the training they received through the Centre. HQP who were interviewed represent graduate students and post-doctoral fellows who were working (or had worked) for the Centre or were hired for Centre-funded projects. HQP identified several benefits of the training they received through the Centre, including: advancing their research/scientific skills beyond their educational training; providing an opportunity to work in industry (a preference over a career in academia as articulated by a few HQP); development of industry networks (in Canada and elsewhere); training on new equipment; knowledge of the commercialization process (e.g., markets, patenting, regulatory affairs); and professional development (e.g., communications skills). About half the HQP interviewed indicated that the employment opportunity provided by the Centre played an important part in keeping them in Canada as there were perceived to be few other options in Canada given their specialized training.

AAPS' projects provide HQP (post-doctoral fellows and graduate and undergraduate students) with the opportunity to work on cutting edge technologies for industrial and real world applications. Examples include the development of the detectors for the Muon Geotomography project, exposure of HQP to the mining sector and ion source development work, and cross-training in the field of medical isotope research. Students were also exposed to entrepreneurship training, and, through this venue, to the investment community. During the first three years of operation, AAPS provided training opportunities to nine HQP, eight of these funded by the CECR grant.

Open Up New Opportunities to Access World-class Research Equipment, Facilities and Networks and Develop Relationships with Major International Centres and Research Programs

The Centres have enhanced the research and commercialization capacity of their relevant sectors. The survey of Centre participants indicates that they have accessed a range of support/assistance. Overall, 35 per cent of Centre participants report that they or their organization received financial (cash) support from their Centre of affiliation and 51 per cent indicated that they had received another form of support from the Centre. With respect to other forms of support/assistance, access to commercialization expertise (e.g., technology evaluation, business/commercialization plan) was mentioned most often (by 61 per cent of Centre participants who received assistance), followed by assistance to access funding from other sources (mentioned by 41 per cent of Centre participants who received assistance). Support for IP management, business development, coaching/mentoring and access to facilities/equipment (each mentioned by about one-third of Centre participants who received services).

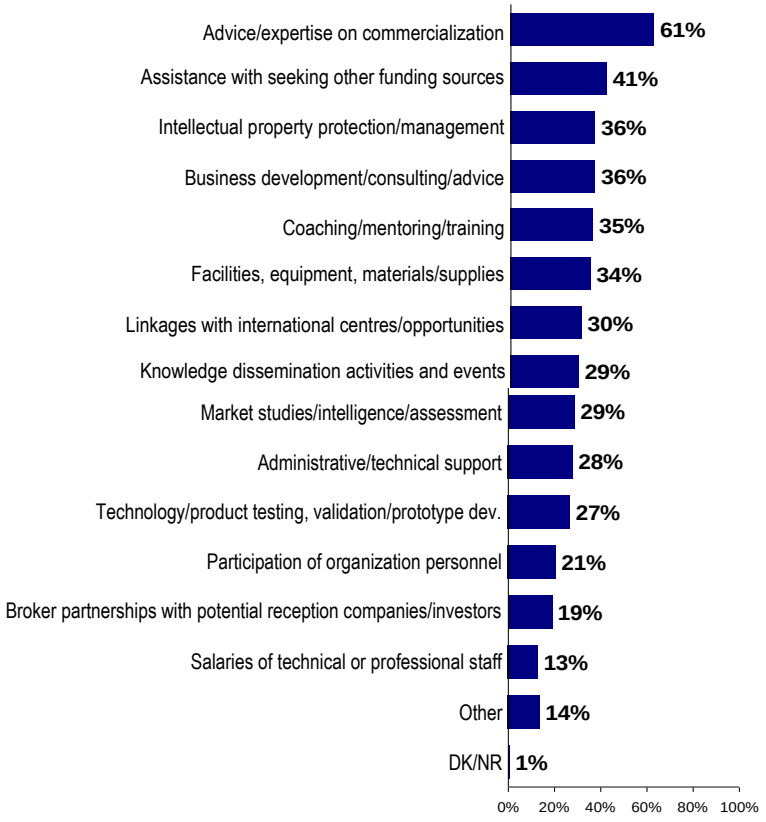
Financial support (pre-seed or seed funding) was more frequent among participants of Centres in the natural resources priority area. With respect to other forms of supports, participants in health priority area Centres were more likely to have received a variety of services such as assistance with seeking funding, administrative/technical support and use of facilities/equipment/material. Participants in research and

commercialization Centres were more likely to have used facilities/equipment/material provided by the Centre, while participants in commercialization Centres more often received advice/expertise on commercialization.

With respect to development of relationships with major international centres and research programs, these results are discussed below (under the intended outcome: "Brand Canada as the host of internationally recognized centres of excellence in research and/or commercialization of research results").

Type of Assistance or Supports Provided

"What types of assistance or supports were provided by the Centre?"



EKOS Research Associates Inc. n=107 Survey of Centre Participants, 2012

Create Centres with a Strong Research Orientation that Yield Significant Public Benefits by the End of the Funding Period

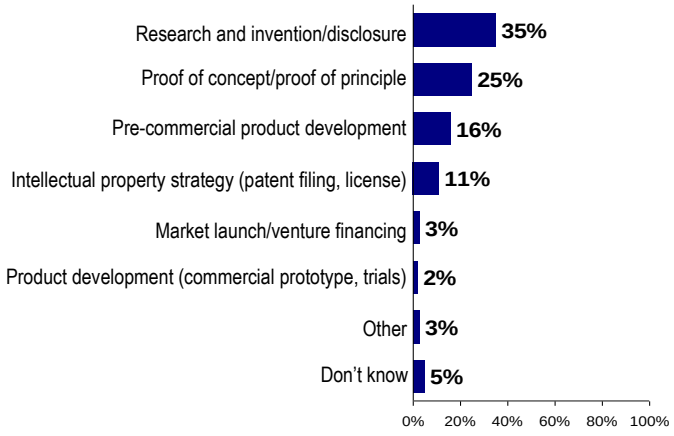
Of the 22 Centres funded by the CECR Program, 14 Centres are "research and commercialization" centres and eight are commercialization centres.[14] According to program guidelines, CECR Program funds may not

[14] In the 2010 CECR Program competition, all five funded Centres were commercialization (only) centres, consistent with the criteria for this competition.

be used to fund research. Only two of the 17 Centres included in the case studies indicate research expenditures that are unrelated to CECR funds. Based on the nature of participants' interactions with the Centres, it is clear that research activities occur more broadly. For example, of those Centre participants who received support or assistance from the Centres as part of collaborative project with the Centre, 28 per cent characterized their project as research only, 19 per cent as commercialization only and 37 per cent indicated the project was both research and commercialization related. The significant level of research activity may owe, at least in part, to the fact that the projects that are being developed by the Centres are still in their early stages. In the survey, 60 per cent of participants indicated that prior to their collaboration with the Centre, their project was in one of the two earliest stages of the commercialization cycle – research and invention/disclosure (including early stage R&D) or proof of concept/proof of principle. According to Dalziel (2010), this is often the case with university inventions that, even following licensing, are "embryonic" as further development and testing detracts from the primarily research focus of the researcher and academic institution. Participants were also more likely to indicate that their projects were trying to commercialize a product or technology (64 per cent and 58 per cent, respectively) than a process or service (28 per cent and seven per cent, respectively).

Stage of the Research and Commercialization

"At what stage of the research and commercialization process was the project prior to collaborating with the Centre…?"



EKOS Research Associates Inc.

n=102

Survey of Centre Participants, 2012

The evaluation evidence suggests that achieving 'significant public benefits by the end of the funding period' from research is an ambitious outcome for the program. The research and commercialization projects that are being developed by Centres are in the earliest stages of the commercialization cycle. Due to the extensive time required for new technologies to reach the commercial market (particularly in the health area where timelines are estimated at 10 to 15 years), it is unlikely that research undertaken by the Centres will yield significant public benefits by the end of the funding period. Still, there are some early examples of benefits such as new products to market (BIC), attraction of clinical trials to Canada (CPDC), and there is optimism among Centre managers and partners of the potential for other public benefits in the longer term (in areas such as vaccines, medical robotics, green technologies).

CPDC is a "one-stop shop" for probe research and development, and commercialization. As of 2010-2011, the Centre has validated and manufactured three emerging probes for clinical trials in Ontario, including 18F-Fluoroazomycin Arabinoside (18F-FAZA) for Ontario's first clinical trial to assess tumour hypoxia and help physicians determine most effective treatment. The Centre was selected by GE Healthcare Canada as one of the world's first sites to test a molecular breast imaging technology to detect cancer in high risk patients. For key partner, GE Healthcare, the partnership with CPDC has added value to their products and expanded business opportunities for increased sales and licensing of IP.

Create Centres with a Strong Commercialization Orientation that Are Expected to be Self-sufficient by the End of the Funding Period

Program- and Centre-level key informants indicate that it is unlikely that any of the Centres will achieve self-sufficiency by the end of the five-year funding period. Estimates provided by Centre managers suggest that self-sufficiency may be achieved for some Centres with one more funding cycle (self-sufficiency occurring within seven to ten years of the initial grant). Centres have developed a number of strategies, which are often used in combination and vary by Centres' sector and model, to create potential revenue streams to work towards achieving self-sufficiency, including:

- Memberships fees (e.g., industry sponsors exchange financial and/or in-kind support to the Centre in fee-for-service development contracts);
- Product manufacturing/product supply and distribution (e.g., the development and sale of products by the Centre or a spin-off company);
- Contract research/fee for service/user fees (e.g., research contracts and/or service agreements with companies to conduct research and/or develop products);
- Returns from IP – licensing, royalties, milestone payments;
- Access to capital – loans, investment funds, innovation funds (e.g., Centres, in partnership with industry or public sector partners, provide funding to spin-off or start-up firms in exchange for first rights to technology, an equity position, royalties, repayment and/or convertible debenture); and
- Partners contributions.

Achieving self-sufficiency within the five-year period has been hindered as the Centres often experienced a delay during their inaugural year with administrative and governance tasks, and later as a result of the economic downturn. While an assessment of the likelihood of self-sufficiency of each of the Centres was beyond the scope of the evaluation (and, indeed, the annual report data on this aspect is limited), it is notable that the literature

indicates that there is little experience among other commercialization intermediaries to support an expectation of self-sufficiency of the Centres. This is because the business model of the Centres (devised to address the objectives of the CECR Program) includes activities such as fostering collaborations, knowledge transfer, and training of HQP that are "sunk investments" – that is, investments that do not generate a return to the Centre itself. Contracted or fee-for-service arrangements are generally cost-recovery and not sufficient to support the operation of the Centre overall or to cover "sunk investments". Revenue from IP, therefore, is a key anchor for self-sufficiency, but difficult to predict. Data from North American technology transfer offices (from the Association of University Technology Managers - AUTM) have shown that direct returns to technology transfer offices only in rare instances are able to generate self-sufficiency[15] and are associated with offices with high levels of "idea-to-product pipeline deal flow", strong private partnerships and the longevity of the organization (10+ years).[16] For Centres that are intermediaries and adopt no IP position with respect to their research and commercialization activities, transition towards self-sufficiency would be even more difficult to try to achieve. This is not to say, though, that the Centre's research and commercialization activities are not supporting company start-ups, and stimulating growth and job creation among the organizations that it serves.

b) Achievement of Intended Long-term Outcomes

Evaluation Question 5. What progress has the program made towards the achievement of long-term outcomes?

Key Finding: With respect to commercialization outcomes, there is good evidence that the CECR Program has accelerated the commercialization of new technologies (including filing and issuing of patents and negotiating licenses, company creation) and participants indicate the Centres are having a significant impact both on their projects and their relevant sector more broadly. Generating further social, economic, health and environmental benefits for Canadians of a more ambitious nature is anticipated only in the much longer term. The CECR program does not have any significant unintended negative outcomes.

Create Centres with Sufficient Scale and Focus to Position Canada at the Forefront of International Research Breakthroughs that Will Yield Economic, Social, Health or Environmental Benefits to Canadians

As mentioned previously, 14 of the 22 funded Centres are focused on research and commercialization and, as such, the commercialization Centres are not expected to achieve this CECR Program's intended outcomes pertaining to research breakthroughs. The case studies indicate that research and commercialization Centres are demonstrating progress (meeting research milestones) in areas such as medical robotics and personalized medicine. On the whole, as this outcome was not expected to occur within the funding period, there is limited evidence to address questions relating to its achievement.

[15] Returns of this nature for university UILOs/TTOs usually plateau around three per cent of the level of research performed and do not cover all UILO/TTO costs except where is at least one exceptional commercial success.

[16] Cornford, A and Gardner Pinfold, Five-year Review of the Telecom Applications Research Alliance (TARA), 2003

Accelerate the Commercialization of Leading Edge Technologies, Goods, Services in Priority Areas where Canada Can Significantly Advance its Competitive Advantage

Program performance data captures commercialization outcomes for the Centre itself, as well as organizations served by the Centre. The table below summarizes these outcomes for the first three years of the CECR Program. During this time, 332 patents were filed by the Centres or the organization they serve and 107 patents were issued. Licences for 101 new technologies are currently under negotiation and 34 licences were granted. Note that the patent-related outcomes cannot be attributed to CECR funding and Centre activities alone; the patent application process from filing to issue is complex often taking two to three years (making it likely the Centres have contributed to existing patent portfolios that are in various stages of application and issue prior to the establishment of the Centre).

Table 2.7: Commercialization Outcome: FY 2008-09 to FY 2010-11

	2008-09	2009-10	2010-11	Total
# of patent applications filed	29	117	186	332
# of patents issued	11	31	65	107
# of licences under negotiation	6	23	72	101
Licences granted	0	2	32	34
# of copyrights	0	1	7	8

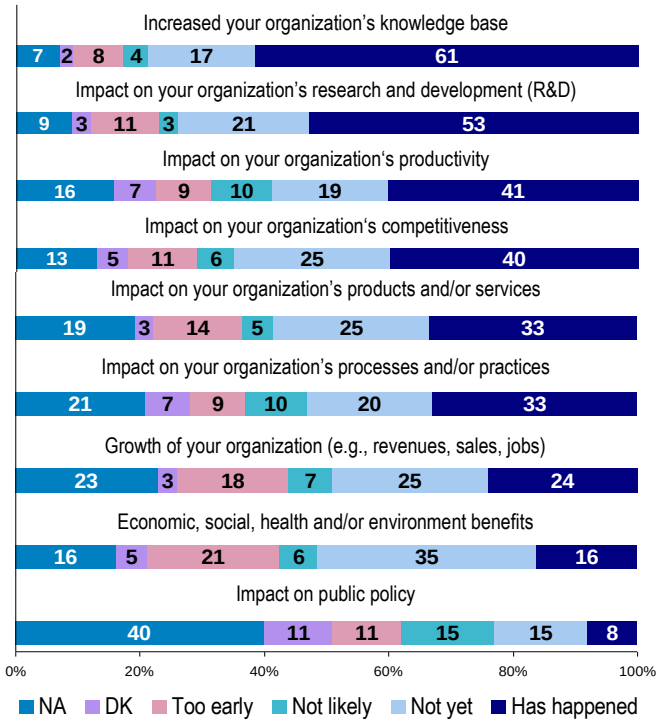
A survey of Centre participants suggests that Centres are helping to accelerate the commercialization of new technologies. Seven of the ten (69 per cent) Centre participants surveyed who received funding or other support/assistance from the Centre indicated that the Centre helped to address their commercialization challenges to a great extent (responded 4 or 5 on a 5-point scale). The same proportion indicated that if assistance or support had not been provided by the Centre, it would have had a major negative impact on their project (an outcome identified more often by participants affiliated with Centres in the health priority area).

With respect to impacts on their organization, Centre participants were most likely to cite benefits relating to any increased knowledge base and increased R&D (respectively, 61 and 53 per cent say this impact has occurred.) Fewer impacts were noted in relation to longer-term organization-level benefits such as productivity and competitiveness, and fewer still were noted in relation to broader economic, social, health, environmental and policy benefits.

Centre participants affiliated with Centres in the health priority area were more likely than those working in other priority areas to say that their involvement with the Centre resulted in an increase in their organization's knowledge base, productivity, or competitiveness (also reflective of the higher propensity of health related Centres to have been funded earlier, in 2008). Participants affiliated with Centres funded in 2009 are more apt to indicate that it is "too early to tell" if results will occur in these areas.

Rated Organizational Impacts Resulting from Involvement with Centre

"Please indicate whether your involvement with the Centre has resulted in the following?"



n=135 (participants who received funding or other support from Centre)

EKOS Research Associates Inc.

Survey of Centre Participants, 2012

Between one in three and one in four Centre participants indicated other impacts of involvement with the Centre, including execution of non-disclosure or confidentiality agreements, filing of patent application(s) and refereed publication. Four in ten also noted that involvement with the Centre has led to increased investment in R&D. One in four mentioned other impacts that included, for example, increased visibility/contacts or networks, negotiation of agreements or impacts that may occur in the future (e.g., patent filing, company creation) or that it was too early to realize impacts.

Participants affiliated with Centres in the health priority area (the majority of Centres funded in 2008, with a longer time frame to achieve impacts) are more likely than those in other priority areas to have had non-disclosure or confidentiality agreements executed, refereed publications, the filing of patent applications or patents issued as a result of their involvement with the Centre.

Other Impacts Resulting from Involvement with Centre

n=135 (participants who received funding or other support from Centre)

EKOS Research Associates Inc.

Survey of Centre Participants, 2012

Create, Grow and Retain Companies in Canada that Are Able to Capture New Markets with Breakthrough Innovations

Of the 17 Centres included in the case studies, six have created or led to the creation of a start-up.[17] For another seven Centres, new company creation may occur by the end of the CECR funding period.

In its first three years of operation, MaRS Innovation (MI) created and incorporated four spin-off companies (XagenIC, VitalHub, Bedside Clinical Systems, OtoSim) for the advancement of early stage technologies in molecular diagnostics, e-health and physical sciences. The companies are now focused on raising funds and MI estimates exit (sale of the company) to be in less than five years. MI reports that 21 jobs have been created across the four companies.

To date, 55 start-ups have been created or assisted by Centres between 2008-09 and 2010-11. The Centres' 2010-11 Annual Reports indicate that companies served by the Centres indicate that 1,186 new jobs have been created by these organizations. A large portion of this job growth was from organizations served by the CCR and CDRD (509 and 380 jobs created, respectively).

[17] A start-up company is an organization that was not functioning as a business prior to the assistance of the Centre.

Table 2.8: Jobs Created by Companies Served by Centres: FY 2010-11

Centre	Number of Jobs Created*
BIC	26
C3E	12
CCR-OCE	509
CDMN	24
CDRD	380
CEPMED	5
MI	22
PC-TRIADD	75
PREVENT	11
PROOF	49
Tecterra	16
Wavefront	57
Total	**1,186**

Source: NCE Secretariat Administrative Data, 2012.

*Figures are based on Centre-reported job creation in Annual Reports. A methodology for calculating jobs created is not defined in the program documentation and jobs created have not been verified with the Centre or with the organizations served.

Deliver Economic, Social and Environmental Benefits to Canadians

In 2008-2009, CCR and the Waterloo Accelerator Centre at the University of Waterloo entered into a joint venture called the Accelerator for Commercialization Excellence (ACE). This single integrated facility provides expertise, services and support spanning the commercialization process to generate economic activity from academic intellectual property commercialization. In 2010-11, 307 jobs were created by 28 CCR-funded companies through the partnership with ACE.

The CECR Program guidelines identify benefit to Canada as a selection criterion for funded Centres. Benefits to Canada are incremental economic activity and improved quality of life. As presented previously, there is some evidence in the performance data that Centres' research and commercialization activities are beginning to have economic impacts in the form of new company creation and job creation. In addition, several Centres have noted economic benefits to regional economies by way of contributing to strengthening the local sector and thereby attracting new businesses, but it is far too early to quantify most of these and their degree of impact/benefit. Another benefit to Canadians is the clinical trial activity in which some Centres in the health priority area have been engaged. Research and commercialization capacity as a result of the CECR Program has attracted clinical trials to the country, enabling Canadians to have early access to promising drug and medical device discoveries.

In general, however, program- and Centre-level key informants were of the view that economic, social and environmental benefits to Canadians are longer-term outcomes that will not be fully realized by Centres within the first five years. The potential for Centres to contribute to this intended outcome is related to the extent to which they embody an integrated model of innovation.[18] However, there was limited evidence on the extent to which

[18] An integrated model of innovation includes technological, economic and social dimensions. The model integrates research and training in the social sciences and humanities (e.g., entrepreneurship, design, marketing, public policy, urban planning and community development)

Centres use an integrated model of innovation. The notion of an integrated model of innovation is unfamiliar language to many, though in practice, many of the Centres illustrate aspects of this approach. The mandates or missions of many Centres incorporate clear statements regarding the intended social benefits of innovation, many are explicitly 'customer focused' in their commercialization endeavours, and have engaged staff that include expertise in business, marketing and communications to assess and respond to industry and market needs. Further, as outlined above, the Centres are providing an array of supports and assistance that indicates a multidisciplinary approach to commercialization, including: advice/expertise on commercialization, business development/consulting/ advice, coaching/mentoring/training, facilities, equipment, material/supplies, technology/product testing, validation/prototype development, and market studies/intelligence/assessment. Still, program key informants note that far more could be done in terms of Centres integrating Canadian expertise in areas such as IP, ethics and other areas of business, social science or humanities.

It should also be noted that, while many of the Centres' mission or vision incorporates "benefit to Canada" or to Canadians, there can be a disconnect between this goal and the self-sufficiency imperative. When asked about the integrated model of innovation and benefits to Canada, several Centres noted that their current focus is strictly on commerce and achieving the 'early wins' to ensure the sustainability of their Centre.

Brand Canada as the Host of Internationally Recognized Centres of Excellence in Research and/or Commercialization of Research Results

The evaluation evidence on Canada's brand as a host of centres of research and commercialization excellence is largely indirect, using proxy indicators related to Centres' international interactions and collaborations. The program guidelines encourage funded Centres to develop a strong communication strategy to raise their profile among a broader community. Like other ultimate outcomes of the CECR Program, 'brand' develops over time. To date, communication planning has received varying degrees of attention by the Centres, although all Centres have websites, are active in their scientific and business communities, and some have engaged communications expertise to promote their Centres through other media.

The number of international collaborations undertaken by the Centres was reported in the 2008-09 and 2009-10 annual reports only. In 2008-09, 11 Centres engaged in 45 international collaborations that increased to 80 collaborations by 17 Centres in 2009-10. The nature of these collaborations varies widely as illustrated in the case studies. A frequently noted accomplishment in the international arena is the establishment of the International Commercialization Alliance (ICA) in 2011. Several Centres – CCR, C3E and CDMN – are founding members[19] of the ICA which is a formal, structured alliance that will focus on exemplary practices and emerging models to build sustainable, innovative companies that are based on the results of publicly funded research. CCR hosted (and will host again in 2012) the International Commercialization Forum, a gathering of academia, government and industry leaders to improve capitalizing on the commercialization potential of publicly funded research and enhance the state of innovation in Canada and around the world.

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into the innovation process and, as result, tends to be interdisciplinary, with products and services resulting in broader human and social benefits.

[19] The ICA has 47 founding members from 18 countries.

Other international activities that Centres are engaged in include:

- Hosting/attending international conferences. The Centres' annual reports highlight many examples of invited conference presentations at international forums.
- Participation in international collaborations or formal agreements with similar centres or institutes in other countries.
- Awards and commendations.
- Media coverage.
- Licensing arrangements negotiated with multi-national companies.

c) Unintended Outcomes

The CECR Program has not resulted in any negative unintended outcomes for the Centres or for industry or partners.

With respect to positive unintended outcomes, the case studies of the Centres noted:

- The role played by CPDC is replacing isotope capacity when the Chalk River facility producing nuclear reactor-based isotopes was shut down. The Centre's cyclotron capacity was utilized for the manufacture of medical isotopes to provide a reliable supply of probes for Ontario's imaging Centres during this shortage. CPDC is now collaborating with a national team of experts to develop alternative, non-reactor based sources of medical isotopes from cyclotrons.
- By virtue of their niche expertise or leadership in strengthening their sector, several Centres such as CEPMed and CDMN report playing a policy role through interactions with government with respect to their industry (digital media) or providing advice and guidance on regulatory issues affecting their sector (personalized medicine).

While not an unintended outcome per se, program- and Centre-level key informants frequently noted some surprising and particularly effective types of collaborations that have resulted from the establishment of the Centres, including collaborations with regional initiatives, other Centres, other NCE Secretariat initiatives (such as the BL-NCEs and classic NCEs), and international organizations (the International Commercialization Alliance). Similarly, Centres have initiated some unexpected directions in programming, including, for example, using Centre funds to fill a gap in the availability of seed funding for new enterprises and the creation of youth mentoring programs by some Centres.

2.3 EFFICIENCY AND ECONOMY

a) Effectiveness and Efficiency of Program Delivery

Evaluation Question 6. To what extent are efficient and effective means being used to deliver the program?

Key Finding: Key informants and Centre participants view many elements of the CECR Program's design as sound and appropriate to achieve the program's goal of advancing the commercialization of research. A strong majority of Centre participants are satisfied with their experience, support the work of the Centres and agree that their involvement has been worthwhile. Administrative efficiency of the program is consistent with the costs of delivering other NCE Secretariat programs. A key program strength is the level of industry involvement in the program. While Centres have encountered a number of implementation issues, at the program level, the self-sufficiency expectation at the end of the five-year grant is viewed as a significant challenge in the program design for commercialization Centres.

Satisfaction with the CECR Program

Satisfaction with the CECR Program was assessed from the perspective of program key informants and Centre management, as well as satisfaction of Centre participants with their interactions with the Centres. These views are discussed, in turn, below.

Program key informants and Centre management are generally satisfied with the design and operation of the CECR Program. Nearly all Centres expressed satisfaction with the CECR Program, with a few Centres praising its' "flexibility" and its' "unique" or "visionary" approach. Centre-level key informants generally believe that the CECR Program represents an important advancement in the federal government's attention to commercialization and addressing the gap between research and the commercial market. Centre managers and partners particularly appreciated the flexibility of the program, allowing them to develop and deliver a unique suite of offerings tailored to the needs of their sector.

While the Centres were generally positive about the support and guidance received from NCE Secretariat staff, concerns were raised about the level of turnover and resulting lack of continuity of support by the NCE Secretariat to the Centre. Some NCE managers and staff similarly noted a need for additional administrative resources for staffing and travel, and the merit of extending opportunities to perform outreach with provinces and regions, and professional development for staff to provide Centres with greater guidance or access to guidance in some aspects of commercialization (e.g., IP management).

Centre participants expressed a consistently high satisfaction with their interactions with the Centres. Over eight in ten Centre participants (83 per cent) indicated that participation in their Centre of affiliation had been a worthwhile investment (higher among participants affiliated with research and commercialization centres funded earlier in 2008). Three-quarters of Centre participants (76 per cent) consider that the Centre has been successful to a significant extent (responded 4 or 5 on a 5-point scale). When asked about weaknesses of the Centre, most often, Centre participants were unable to name any (46 per cent) or recommended that the Centre receive more funding (16 per cent), expand its network/partners (seven per cent) or extend timelines (three per cent). One in ten felt that commercialization expertise within the Centre could be improved.

Implementation

Of the 17 Centres included in the case studies, 13 indicated that their Centre had been implemented as planned. Three of these Centres indicated that implementation had unfolded as planned, but with minor adjustments due to delays or minor management issues. Several Centres indicated that implementation had, in fact, exceeded expectations (demand for services exceeding capacity of the Centre to respond, interest of industry and approaches to partner greater than expected, or the inclusion of programming enhancements based on identified need/ gap). Four of the 17 Centres that were included in the case studies indicated that the implementation of the Centre had diverged more significantly from the original application. The nature of the departure was typically in terms of scope of the operation (e.g., restricting the model from an intended national delivery to regional delivery) or the envisioned business model (e.g., focusing the business model away from research and IP development, to an "enabler" role with respect to commercialization).

Supporting Factors/Program Strengths

Key informants mention a variety of factors, external and internal to the CECR Program, that have been important to the effective and efficient delivery of the program, and to the achievement of intended outcomes. These factors most commonly relate to the level of industry involvement and expertise within the program (e.g., the PSAB) and within the funded Centres (Centre management and Board of Directors) (e.g., commercialization expertise, good business leadership and buy-in from the sector). Other factors, identified by a small number of respondents each, include the following:

- Program flexibility that allows for different business models to develop, as industry sectors have different technology development cycles and business risks, thus increasing their potential success;
- Funding criteria (i.e., in later rounds of funding there was more focus on commercialization Centres and less on research), which has enhanced the ability of the program to address commercialization outcomes (but placed less focus on achievement of research outcomes);
- Existence of the Centre prior to CECR funding or a history/existing infrastructure or sectoral strength which allowed for a more rapid start-up and access to existing networks/technologies/expertise;
- Supportive complementary policy (e.g., supporting access to international markets, access to capital) or other supports (e.g., regional commercialization centers (e.g., OCE)); and
- Opportunities for the Centres to learn from another through NCE Secretariat annual meetings and informal mentoring relationships.

Inhibiting Factors/Implementation Challenges

As mentioned previously, workload and continuity of staff at the NCE Secretariat have posed periodic challenges in the delivery of the CECR Program. However, implementation challenges were more apt to occur at the Centre level.

Case study analysis found the following Centre-level challenges:

- ***Five year mandate:*** A number of Centres stated that five years was insufficient time to become self sustaining and in a few cases, pointed to the projection for commercial application of certain

technologies as "overly optimistic". The lack of clear direction on the future of the program (and potential for Centres to extend or renew their five-year grant) has created planning challenges as they near the mid-point of their grant or beyond.

- ***Financial landscape:*** The majority of Centres cite the current financial climate as a factor in the challenges of securing partners, attracting venture capital (due to greater adversity to risk, especially for early stage technologies), and limiting the ability to create spin-out companies. A specific challenge in the health and life sciences sector was the restructuring of pharmaceutical companies.
- ***Human resources/personnel:*** Most Centres noted that hiring a highly qualified management team and staff to be a challenge, citing the greater than expected time to fill positions with qualified individuals with appropriate research understanding, business acumen, and leadership qualities. A few Centres also pointed to a dearth of management skills for spin off companies.
- ***Facility space:*** The majority of Centres noted there were delays in securing or renovating adequate facility space. This, along with hiring staff and establishing the appropriate legal and governance structures, often led to delays in the Centres' start-up.
- ***Partner/relationship development:*** The majority of Centres mentioned that most partner-related challenges related to challenges in solidifying partners identified in the original proposal (include a 'pause' or suspension of the proposed relationship), the time required to develop partnership relationships, or the effort involved in "streamlining" relationships. A number of Centres noted initially poor or ineffective relationships with university TTOs/UILOs (alliances that are important to avoid duplication in the knowledge/technology transfer functions) and addressing cultural differences between industry and academic partners.
- ***Growing demands on staff:*** A few Centres indicated their growth has attracted interest and inquiries from other organizations or countries, which is difficult to manage in light of intensive time and resource constraints.
- ***Regulatory/bureaucracy issues:*** The time required to register a product was noted as a barrier by a few Centres. Likewise, the review and approval processes for licensing agreements was noted as a time and resource consuming process, which was greater than anticipated.

Program Efficiency

A common measure of the efficiency of grant programs is to assess the ratio of operating expenditures to the total amount of grant funds awarded. This ratio represents the cost of administering $1 of grant funds awarded. The granting agencies also commonly report operating expenditures as a percentage of total program expenditures. Table 2.9 presents an estimate of the operating expenditures for the CECR program over the period from 2007-2008 to 2010-2011. The actual operating expenditures for the CECR program are not available because some expenditures are only captured at the level of the NCE Secretariat, which manages four programs. As a result, the proportion of NCE Secretariat operating expenditures that correspond to the CECR Program were estimated using the percentage of total CECR program grant funds to total NCE Secretariat grant funds. The operating expenditures for the program include both the direct and indirect costs of administering the program: direct costs are comprised of

salary[20] and non-salary costs, which are related primarily to the adjudication of the program grant; and non-salary costs also include a share of the costs related to corporate representation and general administration for the NCE Secretariat. Other direct costs associated with administering the program, such as post-award management and indirect costs, such as common administrative services provided by NSERC (e.g., finance, human resources and IT) are not available at the program level. These other direct and indirect costs have also been included in the total calculation of costs and were estimated using the ratio of total CECR grant funds to total NSERC grant funds. It should be noted that the estimation of operating expenditures only accounts for cost incurred by the NCE Secretariat and therefore does not account for service provided without charge (e.g., time volunteered by selection panel members, audit services provided by the Office of the Auditor General). At less than three cents[21] for every 1$ of grants awarded for the period under review, the administrative efficiency ratio is very low for the CECR Program and comparable to other programs administered by the NCE Secretariat. For example, over the same period (2007-2008 to 2010-2011) the operating ratios for the NCE Program and BL-NCE Program were 3.0 cents and 5.5 cents to every $1 of grants awarded, respectively. The low administrative cost of the program owes in large part to the relatively small number of large sized grants that are awarded by the program.

Table 2.9: Estimation of CECR Program Operating Expenditures

Operating Expenditures	2007-08	2008-09	2009-10	2010-11	Total
Direct Salary	$669,576	$555,424	$461,635	$397,234	$2,083,869
Direct Non-Salary	$824,099	$486,261	$284,961	$461,523	$2,056,844
Total Direct	$1,493,675	$1,041,685	$746,596	$858,757	$4,140,713
Indirect and Direct Non-Attributable	$1,436,053	$724,478	$514,933	$445,042	$3,120,506
Total	$2,929,727	$1,766,163	$1,261,529	$1,303,800	$7,261,219
Grant Funds Awarded	$163,360,750	$35,025,635	$27,485,125	$29,813,625	$255,685,135
Operating Ratio (¢:$1) (Expenditures to Grant Funds Awarded)	**1.79¢**	**5.04¢**	**4.59¢**	**4.37¢**	**2.84¢**
Operating Expenditure as a Percentage of Total Program Expenditures	**1.76%**	**4.80%**	**4.39%**	**4.19%**	**2.76%**

b) Alternative Models or Approaches

With respect to alternative models or approaches to the CECR Program, a number of recent reports on Canada's innovation performance (cited in Section 2.1(a)) have provided many recommendations to address an innovation or commercialization gap in the country (e.g., re-balancing direct and indirect R&D support programs, adjustments to the Scientific Research and Experimental Development tax credit system, rationalization of innovation supports program by a common service platform, supporting a more vigorous financing ecosystem). These approaches are generally proposed as concurrent or complementary rather than alternative approaches to improve innovation capacity.

The CECR Program was identified as playing an important intermediary role by the recent R&D Panel Review of Federal Support to Business Innovation, and the program generally aligns well with the broad

[20] Salary estimates exclude employee benefits (EBP).

[21] The total operating ratio for the period under review is influenced by significantly higher grant expenditures in the first year of operations. The operating ratio excluding this first year was 4.69¢.

recommendations respecting a renewed focus on innovation and reflects the key features of a supportive climate for new ventures outlined by the Council of Canadian Academies (CCA) (2009). In their report, the CCA recommends that Canadian public policy create more favourable conditions for the creation and viability of start-ups. These conditions include availability of risk capital funding, support for commercializing university research including better infrastructure for identifying and mobilizing potentially commercializable knowledge through well-designed partnerships between universities and private sector businesses and/or government labs; and supporting innovation clusters by creating local innovation ecosystems through geographic concentrations, based on pre-existing advantages and a strong local catalyst. The Mowat Centre (2011) has similarly observed an "emerging global consensus around the need for innovation policies to be place-based, to support the existing comparative advantages of the community and to take advantage of local and regional networks and knowledge".

The majority of key informants at the program- and Centre-level agree that the CECR Program's approach to commercialization is generally a good model (with some improvements suggested), with few suggestions for alternative approaches that are more efficient or effective. Some alternative models described, or specific approaches used in other countries, include:

- Private capital approaches. Key informants mention a number of approaches that feature high levels of private capital/venture capital models that represent an alternative to commercialization intermediaries such as the CECR Program. However, Canada is generally not viewed as having critical mass and strength in this area compared to other countries such as the US. The analysis of the CCA (2009) notes a dearth of angel financing in Canada and that "Canada's (venture capital) industry is still relatively young and thus has not yet developed sufficient breadth and depth of experience to select and mentor the best potential investment candidates". Moreover, the recent economic downturn was noted in key informant interviews as only reducing the feasibility of this type of model.

- Policy-based commercialization that responds to changes in the regulatory environment or policy objectives. In this scenario, new regulations are supported by research and commercialization of research to address compliance with regulations. Another example is to identify a policy objective (e.g., reduce transportation costs) and then fund research and commercialization to support the achievement of objectives.

Key informants and a review of international documentation provided other specific examples of international research and commercialization programs. Many of these programs (e.g., the Fraunhofer Centres in Germany and the Catapult Centres in the UK) have characteristics similar to the CECR Program centre of excellence approach: operate as commercialization intermediaries between the business and research communities; are targeted to selected sectors; and engage in a mix of technology development (including contract research) and commercialization support services. However, the effectiveness and efficiency of these models in comparison with the CECR Program are difficult to assess. In general, there is an absence of evaluation data on these models, though annual reports offer broad metrics and discussion of successes. The transferability of these models to the Canadian economic and governance context may also have limitations (e.g., Finland does not have strong provincial/state jurisdictions and therefore national programs are more prevalent in this context; the US has a strong history of foundation funding that is absent in Canada).

c) Delivery Models/ Management Practices

Evaluation Question 6.1. To what extent have Centres implemented effective delivery models and management practices to achieve expected outcomes?

Key Finding: The quality of the leadership of the Centres and strength of governance were highlighted as key ingredients of Centre success, viewed as important for relationship-building with partners, companies and individual investigators within the sector. A customer focus/commercial relevance and focused organizational objectives and strategy were also noted as critical success factors.

The PSAB report on the activities and impacts of the CECR Program concluded that "there is no one size fits all model when it comes to commercialization, nor should there be. Different industry sectors have different technology development cycles, business risks and market considerations that require a flexible approach specific to each sector's needs". The majority of program- and Centre-level key informants agree that the flexibility of the CECR Program has allowed for the development of a variety of commercialization models, with each Centre designed to respond to specific challenges in their sector in a somewhat unique way. While a comparative assessment of Centre management and delivery models is premature and may not be fruitful given this variability, the case studies of the 2008 and 2009 Centres are suggestive of a number of best practices.

Notably, while recruiting strong Centre leadership can be time-consuming and was noted as a challenge by most Centres, they also indicated that the resulting management team was an important facilitating factor of the Centres. Most Centres indicated that the "high calibre", "experienced", "visionary" CEOs and Directors; along with the "balanced and strong", "independent" Board of Directors (which include industry representatives) were an asset to the Centre and inspired the interest and confidence of potential partners. Similarly, when Centre participants were asked to identify the key strengths of the Centre with which they are affiliated, 49 per cent said their Centre's knowledge expertise and 39 per cent mentioned the management/leadership of the Centre.

Other best practices mentioned by a few centres include:

- ***Providing direct, ongoing support:*** including a customer focus, providing advice, contacts and opportunities to investee companies. Work with start-ups to help them to identify needs and solutions. For example, one Centre's *Accelerator Program* provides office facilities, coaching, mentoring, education, connections to capital networks, networking, R&D support, talent recruitment, tech transfer services, and commercialization expertise.
- ***Communications:*** provided to stakeholders to promote investments. Centre websites are critical to building awareness; speaking engagements promote activities; and conferences/workshops bring stakeholders together.
- ***Build on already existing and solid platforms:*** for example, build on existing programs and infrastructure, make use of existing collaborations, build on existing research or trials. Having existing Centres provide mentorship or assistance to new Centres increases efficiency.

- ***Flexible and diverse IP management:*** including in-house development of IP, educate researchers on the commercialization process, and work with academics (no IP position) and industry. Use of specialized external legal counsel for IP management was noted as a best practice.
- ***Stay focused:*** on 1) the goals of the organization, and 2) on developing and maintaining commercialization activities at the forefront.

The PSAB's review of the CECR Program identified a number of other best practices:

- Micro-loans;
- Flexible repayment options;
- Investment funds that are co-managed and co-funded with industry;
- Projects led by an SME or other proponent;
- Projects that link large companies with SMEs; and
- Funding applications vetted by expert review panels that include industry/receptor participation.

d) Performance Monitoring and Risk Management

6.2. To what extent is the program collecting the appropriate information to monitor centre performance and manage risk?

Key Finding: There are some challenges in capturing the commercialization outcomes of the Centres due, in part, to the diversity of their business models and inherent challenges in measuring the impacts of commercialization intermediaries. While the performance measures for the program have improved, some challenges remain, including inconsistencies in how Centres are reporting aspects of their operations and insufficient NCE Secretariat resources to vet and clarify these inconsistencies. The use of qualitative narratives to capture the impacts of the Centres would be welcomed by Centres and consistent with other trends in reporting for commercialization intermediaries. The risks identified for the CECR program continue to be relevant (with the exception of peer review). Risks related to intellectual property management and conflicts of interest are managed at the Centre level. Risks related to meeting the program's matching funding requirement remain relevant, particularly with the economic downturn and current cautious investment climate.

Performance Monitoring

As one of the requirements of the CECR Program grant, each Centre must provide the NCE Secretariat with an annual report that has been approved by its Board and outlines operations during the previous fiscal year. This report must be submitted within four months of its financial year-end.[22] The annual reporting template has been assessed annually to determine if the CECR Program is effectively and efficiently capturing the required information from Centres to appropriately monitor and manage program performance and to clarify the definition of

[22] CECR Funding Agreement, Version – December 2008.

commercialization (fulfilling two of the recommendations in the 2009 formative evaluation of the program). This assessment and consultations with the Centres have led to changes to the annual report template in each year since the program's inception in order to more meaningfully capture the program's commercialization outcomes and the diversity of Centre business models.

Feedback from program- and Centre-level key informants on performance monitoring most commonly noted that while the template has improved over successive revisions, performance measurement data for the program are now limited by year-to-year inconsistencies in the metrics. For a few Centres, the lack of clarity of reporting expectations combined with the changes to the template have created confusion. This confusion was evident during the review of administrative data which revealed some inconsistencies across the Centres in how the annual report templates were populated.[23] Some Centres indicated that the current indicators are too focused on outputs or "bean counting" and not sufficiently focused on economic or societal outcomes and impacts (an opinion that was echoed by program key informants). At the same time, for program funders, the annual reports do not appear to convey the essential information pertaining to what activities the Centres are engaged in, and the impacts they are having in terms of commercialization.

Other challenges in the collection of program performance data mentioned by a few program key informants include:

- Appropriateness of some current performance measures given the increasing commercialization focus of the program (particularly as the program has evolved and funded fewer Centres with a research and commercialization focus). For example, training of HQP is a more appropriate measure of a research-focused program such as the NCE Program than the CECR Program (the exception being the more research intensive Centres in the health area that are successfully training HQP). However, it should be noted that as the CECR Program focus has evolved toward a greater focus on commercialization, evolving program metrics should not penalize research-focused Centres.
- Assessing incremental impacts of the CECR Program for Centres that operate with significant resources in addition to the CECR grant. For example, for Centres such as the CCR, which is funded by the Ontario Centres of Excellence, it is difficult to isolate the impact of the CECR Program grant from the impact of the CCR overall. Given the matching requirement of the CECR Program funding model, this is an issue for all Centres to some degree.

The development of performance measures for the activities of commercialization intermediaries such as the Centres funded by the CECR Program is a significant challenge. Dalziel (2010) notes that "there are no universally accepted indicators for measuring progress on transforming new technologies into states of commercial readiness". Thus, the reporting templates for the CECR Program are, not surprisingly, a work in progress and tend to focus on 'inputs' (partner contributions, recruitment of talent) as opposed to impacts. In Canada, the Consortia Advancing Standards in Research Administration Information (CASRAI) (of which the NCE Secretariat and NCE Networks and Centres are members) is helping researchers, their institutions and their funders establish standards

[23] For example, a consistent definition of 'partner' or 'organizations served', reporting of investment accessed by organizations served (which may or may not include the Centres own investment in start-ups/projects), calculation of Centre-generated revenue (which does not consistently include or exclude interest income).

for data through the life cycle of research activity. Internationally, the OECD, as well, has offered guidance in developing measures of innovation activity and results.[24]

Still, moving forward, there are a number of avenues for improvement. This first is supplementing the existing indicators in the template with additional guidance to the Centres on their meaning to clarify confusion, enhance the consistency in their use, and to increase confidence in the data that are reported. Concepts such as 'partners' and measures such as 'investment accessed' or 'jobs created' by organizations served should be accompanied by some broad guiding criteria for their calculation (but that do not place undue burden on Centres for validation). Second, as the program has evolved toward a greater commercialization focus (in the selection of the Centres) expectations regarding reporting of commercialization outcomes have increased. This presents a challenge for Centres that were approved early in the program and that have maintained a greater research focus. At the same time, there are aspects of the program's intended outcomes that are not currently well-represented in the reporting template (for example, recruitment of business talent). In this vein, some Centres suggested that the NCE Secretariat develop a clearer definition of "commercialization"[25] and the intended commercialization outcomes of the CECR Program. Finally, Centres also proposed that the template provide greater opportunities to incorporate more qualitative information that would better reflect or illustrate Centre operations and achievements. The use of qualitative measures of research and commercialization activities was highlighted in the PSAB's report on the CECR Program and was noted as a theme that is emerging internationally, with the OECD and the National Science Foundation calling for more qualitative metrics to capture medium- and longer-term impacts.

Other suggestions include:

- More performance measures related to the demonstrated value of the Centre and progress toward sustainability (e.g., centre-generated revenue, IP ownership).
- Stability in the metrics for the program to promote year-over-year consistency in data collection.
- Continued improvement in the feedback memo provided by the NCE Secretariat to Centres on the basis of the annual report to facilitate course corrections. A recent practice has been to incorporate feedback from PSAB in the NCE Secretariat memo to Centres so that credibility and robustness of the memo is improved. More time for senior program managers to review Centres' annual reports to ensure accuracy and consistency of reporting and tailoring of the feedback memo would be useful.
- A stronger link between the objectives of the CECR Program and the reporting that is provided by the Centres.

[24] For example: OECD, Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition, 2005

[25] A definition of commercialization was a recommendation of the formative evaluation of the CECR Program, to which the program responded with a definition based on the 2006 Industry Canada Expert Panel on Commercialization in the 2010-11 Program Guide as follows: "In the context of the CECR program, commercialization is defined as everything a firm does that transforms knowledge and technology into new goods, processes or services to satisfy market demands and providing more opportunities for flexibility in the template to incorporate more qualitative information that would better reflect or illustrate Centre operations and achievements".

Risk Management

The CECR Program integrated RMAF-RBAF provides results based management and accountability information for all the CECR Program's activities.[26] It also provides an assessment of risk and mitigation strategies for managing key risk areas. The key risk areas identified in the joint RMAF and RBAF for the CECR Program are: peer review, matching funds, intellectual property, and conflict of interest.

- Peer Review

As outlined in the RMAF-RBAF, peer-review is based on two successive steps including review of each application by arms-length Expert Panels, followed by review by the PSAB. PSAB reviews each Expert Panel report, the comments from the parties consulted, and recommend to the NCE Steering Committee the full applications to be funded. The NCE Steering Committee approves the full applications to be funded and works with the granting agencies to prepare an integrated submission to the Treasury Board to appropriate the funding to the granting agencies for approved full applications. An identified risk of the program is the potential for the quality, credibility, and robustness of decision-making for the allocation of grants to decline due to time and workload pressures.

Risks pertaining to the effectiveness or quality of the peer review process are now assessed by program key informants as a low risk area for the program. The NCE Secretariat peer review process is perceived to be well-established, transparent and effective. While the CECR Program was established very quickly during the first year, subsequent proposal solicitation and adjudication processes have not, to date, presented significant risks in terms of quality or effectiveness due to workload or timelines.

- Matching Funds

As stipulated in the Funding Agreement and the Program Guide, CECR funds must be leveraged. CECR funds may provide up to 75 per cent of other total eligible costs and up to 50 per cent of total eligible commercialization costs over the funding period. The balance in funding must come from other non-federal sources. The total funding from federal sources (including CECR funding) may not exceed 75 percent.

The CECR Program financial data up to 2010-11 indicate that for both other total eligible costs and total eligible commercialization costs, Centres funded in 2008 and 2009[27] are within the maximum eligible percentage that can be covered by CECR funds. For these 17 Centres in the first two/three years of operation, CECR funds are, on average, covering 47 per cent of other eligible costs and 25 per cent of eligible commercialization costs. Centres overall are also well below the maximum total funding from federal sources (at 40 per cent of total expenditures). However, looking across the 17 Centres, at the end of 2010-11, two Centres exceeded the maximum CECR contribution for other eligible costs and five Centres exceeded the maximum CECR contribution for eligible commercialization costs. Here, it is important to note that the annual report data provided limited information on the precise nature of the expenditures of partner contributions on commercialization costs – while the program offers

[26] Joint Results-based Management and Accountability Framework and Risk-Based Audit Framework for the Class Grants Program for Centres of Excellence for Commercialization and Research (CECR Program), Prepared by: The Networks of Centres of Excellence Secretariat.

[27] Centres funded in 2010 are excluded from this analysis as expenditures, particularly commercialization costs, tend to be very low in the first year of operation.

categories (e.g., capital expenditures, market studies/ business development, intellectual property protection), the Centre case studies showed that often expenditures were recorded in the "other" commercialization costs category.

Program key informants acknowledged that the achievement of matching funds by the Centres is a moderate risk area that has become of greater concern with the recent economic downturn. In their initial years, many Centres have reportedly experienced challenges in securing matching funds to the levels anticipated in their proposals due to increased caution or budget constraints on the part of partners from other levels of government or industry. An additional issue is that because some Centres have moved CECR grant funds from the first and second year of operation (due to slower than anticipated start-up) to later years, a higher fund utilization rate is expected in the latter years of the grant, which will exert pressure to secure matching funds to these higher levels.

The NCE Secretariat captures information on grant utilization and matching funds on a yearly basis to monitor this issue and sends comments to the Centres in a feedback memo (the annual report assessment letter). These data indicate that for Centres funded in 2008 (at the end of FY 2010-11, 60 per cent of the way through the five-year CECR grant), 48 per cent of the CECR grant has been expended on average (though this varies significantly across the Centres from 24 per cent to 65 per cent). For Centres funded in 2009 (40 per cent of the way through the five-year CECR grant), 19.5 per cent of the CECR grant has been expended on average (varying from eight per cent to 36 per cent). With respect to the 2010 cohort, the five Centres have expended three per cent of awarded grant funds on average.

Related to the issue of matching funds is the distinction in matching funds between public and industry matching funds and financial and in-kind matching funds. Noted by a small number of key informants, contributions from industry and contributions in the form of cash point to a Centre's established value and relevance, and are more helpful in terms of the longer-term sustainability of the Centre. As mentioned earlier, currently, 90 per cent of partner contribution expenditures are in the form of cash. However, this varies substantially from Centre to Centre; among the 17 Centres included in the case studies, four had no cash contributions at all or cash contributions represented less that 20 per cent of total partner contribution expenditures. With respect to industry contributions, overall, industry contributions represent 33 per cent of Centres' total partner contribution expenditures. Across individual Centres included in the case studies, this figure ranges from no industry contributions (four of 17 Centres) to a high of over 85 per cent of total partner contribution expenditures (two Centres).

Table 2.10: Matching Funds: 2008-09-2010-11

Year of Operation	CECR Expenditures			Partner Contribution Expenditure			% CECR	
	Commercialization			Commercialization			Contributions	
	Other Eligible	Capital	Other	Other Eligible	Capital	Other	Other	Commercial
2008 Centres	$61,222,344	$1,966,639	$15,423,158	$61,951,321	$17,936,261	$30,427,629	49.7%	26.5%
2009 Centres	$9,762,842	$522,141	$1,896,730	$17,482,360	$6,728,500	$3,205,220	35.8%	19.6%
Program Total	$70,985,186	$2,488,780	$17,319,888	$79,433,681	$24,664,761	$33,632,849	47.2%	25.4%

Table 2.11: Federal Government Assistance and CECR Grant Utilization Rates: 2008-09-2010-11

Year of Operation	Gov't Assistance Federal	Total CECR Expenses from Grant
2008 Centres	45%	48%
2009 Centres	39%	19%
Program Total	40%	36%

- IP Management

Program- and Centre-level key informants have mixed views on risks related to IP management. The CECR Program has largely taken a 'hands off' approach to IP management, allowing Centres to develop expertise in the area and to negotiate IP agreements that are appropriate to their sector. The survey of Centre participants indicates, for example, the execution of non-disclosure/confidentiality agreements and patent filing assistance are services frequently offered by Centres. Centres have used various methods to mitigate IP management risks such as: implementation of an IP policy and protocols; hiring of a patent firm or IP legal specialist to assist with IP management; development of internal expertise; and limiting IP management requirements by either retaining or not retaining IP within the Centre depending on the client sector. Areas of ongoing IP challenges reported by a few Centres include: cost of maintaining a large number of patents; lack of harmonization of IP policies among members/partners; and the complexity associated with specialized areas of IP management (e.g., medical sectors).

Some PSAB key informants have concerns about the ad hoc or non-uniform IP policies. An emerging sentiment among several program key informants seems to be that while a standardized approach to IP management would not be appropriate given the diversity of commercialization models used by the Centres and the different IP policies in place in academic institutions, there is room for the NCE Secretariat to provide additional guidance or IP management tools to the Centres. As well, some Centres such as MaRS Innovation have significant expertise in IP management and could mentor other Centres in this area.

- Conflict of Interest

The CECR program guidelines recognize that interactions between university researchers and the private sector are an essential feature of the CECR program. While interactions leading to gains and benefits to the individuals participating in the Centre are desirable and natural outcomes of being involved in the Centre, they may place individuals participating in the Centre in a position of potential, apparent or actual conflict of interest. The guidelines indicate that the responsibility for implementing and managing the Conflict of Interest Policy is under the purview of each Centre Board of Directors.

Almost all Centres indicate that conflict of interest is not relevant to their Centre or that it is being addressed through risk mitigation activities, notably: conflict of interest policies and protocols; an experienced Board; having Board and partners excused from discussions/decisions where there may be conflict of interest; withholding of specific IP aspects of projects from Board members; and implementation of an Ethics Board and/or Code of Ethics. A Conflict of Interest Report is submitted by Centres to the NCE Secretariat with their annual report. In addition, the NCE Secretariat has considerable experience in governance matters to support Centres in this area. Nevertheless, it was noted that as the Centres move more fully into implementation and experience commercial success, conflict of interest considerations are likely to become more frequent and important.

e) Improvements to Design

Evaluation Question 6.3. To what extent can the efficiency of the program be improved?

Key Finding: The CECR Program has many strengths, including its focus on commercialization. Aspects of the program meriting improvement include current guidelines that limit applications for an extension or renewal of funds to research Centres, and the expectation of self-sufficiency of Centres within the funding period. Other improvements concern aspects of program design such as the application and selection process, supports available to Centres, program guidelines and communications.

Overall, the evaluation evidence supports the effectiveness of the CECR Program design, which reflects an evolving focus within the NCE Secretariat (and government-wide) on innovation and commercialization of research. The commercialization focus of the program is widely lauded. The spate of recent analyses of Canada's innovation system agree that while research and invention are well-supported by public funding, there has been less attention on commercialization. This literature and the views of key informants favour a continued emphasis on this aspect of the program in its objectives and design.

Given that the CECR Program is relatively young, a number of improvements to the program were proposed. As mentioned previously, the five-year grant timeline is a high priority issue for Centres. Currently, the CECR program funding agreement indicates that "Centres with a strong commercialization orientation will be expected to become self-sufficient by the end of the funding period. Centres with a strong research orientation that yield significant public benefits within the funding period may be eligible for subsequent support in the event that the program is extended". The Centres uniformly indicate that while the five-year point is an appropriate time to assess the progress of the Centres, self-sufficiency will not be achieved, and sunsetting funds at the end of the five years for commercialization centres will undermine the progress of Centres that are now building momentum and jeopardize achievements to date. Program level key informants, including the PSAB, tend to agree. The PSAB report on CECR Program activities and impacts recommended that while financial sustainability should continue to be a long-term goal of Centres, it recommended that existing Centres that can provide evidence of economic impact and incremental value be permitted to apply for an extension or renewal. Expectations of self-sufficiency must be sensitive both to the industry sector (health discoveries requiring a longer developmental cycle) and the need to develop technologies to a more mature stage prior to venture capital investment.

Some key informants at the program-level and Centre-level also urged a more nuanced treatment of the self-sufficiency issue that recognizes, for example, the difficulties in generating revenue from the services offered by Centre (but are intended outcomes of the CECR Program), the benefits of the "honest broker role" played by a publicly financed commercialization intermediary, and the tension between the "public benefit" objectives and the self-sufficiency objectives of the CECR Program. As mentioned previously, the broader literature suggests that self-sufficiency expectations of commercialization intermediaries should be cautious at best. There are few examples where revenues generated by these organizations such as through contract research, fee for service or royalties are able to cover the costs of their supports to bridge the commercialization gap. The international experience (e.g., the Fraunhofer Centres in Germany and Catapult Centres in the UK) indicates that commercialization intermediaries draw at least a portion of their revenue from public funds. Self-sufficiency is not, in fact, defined in the program literature, leaving open a spectrum that could include no federal funding at all or transitioning of the Centres from the CECR Program to other public funding (e.g., project-based/no core operational funding, core operational funding only or some other combination).

Other suggested improvements to the CECR Program include:

- Centre selection process. With three competitions now complete and the impacts of the Centres becoming known, program key informants are of the view that the Centre funding selection process could be improved.
    - The PSAB report outlined a number of areas where application information could be enhanced to ask the "right questions" to ensure the success of funded applicants: more highly developed business plans (with clearly defined commercialization goals, including detailed work plan, resource costing and approach to intellectual property); ability to leverage funding from provincial and regional partners; demonstrating expected value for the Canadian economy and how the Centre will deliver that value; creating a critical mass of technology expertise in a region; a stronger focus on short-term R&D cycles and projects that are at a later stage of technology readiness; capacity to ramp up operations quickly; commercialization experience; and expertise in intellectual property management.
    - Other criteria suggested by program key informants include: selection of Centres in priority sectors/in areas of national strength (while ensuring that regional/sectoral clusters are not excluded due to limited awareness/grant savvy); national in scope (rather than regional or provincial); evidence of a strong business focus in the Centres in terms of leadership/staff/Board membership/coaching or advisors, and link funding approval to demonstrated industry need/relevance/sector capacity.

- Continue to encourage mentoring relationships among the Centres – e.g., pairing of organizations in similar sectors, or pairing of mature CECRs with newly funded ones to encourage more rapid and successful start-up and prevent duplication. Continued sharing best practices/lessons learned among the Centres and within the NCE Secretariat was noted (also a recommendation from the 2009 formative evaluation of the program and the PSAB report, which recommended that CECRs be encouraged, where appropriate, to collaborate and leverage each other's areas of expertise to accelerate commercialization and be encouraged, from their inception, to share best practices between Centres).

- Guidance to Centres. A minority of interviewees (largely from the program itself) indicate an opportunities for the NCE Secretariat to provide enhanced guidance to Centres, such as additional leadership and more consistent advice to ensure Centres have support for timely establishment of the Centre. Providing access to IP templates and tools, and supporting Centres to work more effectively with partners were also mentioned. Centres are generally receptive to this notion.

- Improvements to program guidelines and administrative elements suggested by Centres include:
    - Improve the effectiveness of the CECR Boards by, for example, lowering the minimum number of board members;
    - Clarify and simplify guidelines around matching funds/in-kind contributions;

- Streamline the application process that is currently paper-based, and judged to be onerous and time-consuming by applicants;
- Ensure that Centres are receiving adequate assistance from host organizations.

- Funding amounts. Regarding funding amounts, a few key informants propose that the CECR Program offer greater variability in the funding amounts to permit Centres of various scale to suit sector need and capacity. In a small number of Centres, the CECR grant was viewed as limited (due to high costs of R&D or unexpected levels of demand). More commonly, however, was a concern among Centres about the number of funded Centres and the ability of the NCE Secretariat to continue to support existing high performing Centres in light of its growing portfolio. When Centre participants were asked to name any weaknesses of the Centre with which they were affiliated, the most commonly mentioned concern (by one in four participants) was a lack of sufficient funding or a lack of long-term stability of the funding.

- Foster greater coordination between the CECR Program and other programs in the federal and provincial research and commercialization funding array as well as with university TTOs/UILOs. This is a frequent comment across all respondent categories, though there are variations in the focus of the comments. Examples of specific suggestions include: coordination between CIHR knowledge transfer/commercialization programs and Centres in the life sciences area; foster greater linkages between Centres and networks funded by the NCE program; and greater alignment of CECRs with provincial priorities.

- Highlight successes of the program – to create awareness of the program e.g., promote the successes of the Centres to the public, research and business communities, as well as internationally to help attract appropriate applicants and support Centres to make connections with industry and international collaborators.

3. CONCLUSIONS AND RECOMMENDATIONS

In order to inform the program renewal process and meet the requirements of the Treasury Board *Policy on Evaluation*, a summative evaluation of the Centres of Excellence for Commercialization and Research (CECR) Program was commissioned covering the period from program inception (2007-08) to 2011-12. The findings of the evaluation led to the following conclusions and recommendations about the relevance and performance (effectiveness, efficiency and economy) of the CECR Program.

3.1 RELEVANCE

a) Continued Need for the Program

The evaluation evidence indicates that there is an ongoing need for the CECR Program to address research and commercialization challenges in priority sectors. The documentary evidence indicates that innovation is lagging in Canada and there is a broad consensus that there exists a commercialization gap between Canadian discoveries and the commercial market. The views of key informants and surveyed Centre participants are also supportive of continued efforts to address research and commercialization challenges. Additional relevant findings include:

- Over the first three years of the program, demand for funding has been healthy, although the number of Letters of Intent and Full Applications has declined over time (owing, in part, to the more targeted eligibility criteria in later funding rounds).
- The CECR Program is an important source of funding for the research and commercialization centres. Most funded Centres would not have proceeded without the CECR grant or would be operating within a narrower scope in terms of geographic and sector reach. Unfunded applicants have not obtained funding at the same level as is available from the CECR Program and have pursued proposed activities to only a limited extent.

The centre of excellence approach to research and commercialization has many advantages and is consistent with cluster approaches that have been used elsewhere to support innovation in areas of local or sectoral strength. Based on a multi-sectoral collaborative approach, the funded Centres build a critical mass of research and commercialization expertise and infrastructure, and offer a suite of services tailored to the needs of their targeted sector, including both academic researchers and small and medium-sized enterprises. There are also benefits in terms of creating visibility for centres of excellence that supports cross-fertilization among the Centres and with other research and commercialization entities, as well as engagement of international collaborators. Possible disadvantages of the centre of excellence approach include the potential to misidentify Centres that exhibit existing strength, merit and industry relevance and that, once funded, Centres may not engage their sector in a balanced way.

b) Program Niche

There is a crowded landscape of programs addressing various aspects of research and commercialization in Canada. However, by virtue of its commercialization mandate and focus on early stage commercialization, the CECR Program occupies a niche in the array of innovation support programs. The program's funding envelope, which provides large grants to cover the operational costs of the Centres, is unique. The program mandate is also consistent with recent reviews of innovation in Canada that have called for greater attention to commercialization of public sector investments in research. While Centres access complementary support from other funding sources (e.g., provinces, other federal programs, municipalities), there were few concerns about an overlap or duplication of the CECR Program with other offerings. Nevertheless, there are opportunities to forge closer links between the CECR Program (and funded Centres) and other the programs offered by other research funding agencies (e.g., Canadian Institutes of Health Research (CIHR)), which are also moving toward a greater commercialization focus.

c) Necessary Federal Role

The CECR Program is consistent with the federal roles and responsibilities, particularly with respect to economic affairs and stimulating innovation-based growth. The Government of Canada's involvement in advancing innovation is consistent with international practices and with the literature that indicates countries with strong innovation policies and supportive programs have comparatively higher rankings on indicators of innovation. The federal level was identified as providing leadership, supporting the national and international linkages that are a feature of the CECR Program, and ensuring federal investments in basic research deliver economic, social and environmental benefits to Canadians.

The federal level is not solely responsible for creating a climate to support innovation. Provinces, as well as some municipalities, are also involved in innovation policy and programs. Many of the Centres have their roots in provincially-funded initiatives, or have leveraged provincial funding for their Centre. At the program level, however, the extent of formal or structured collaboration between the federal and provincial governments, which was identified as a weakness in the formative evaluation of the CECR Program, has not yet been satisfactorily addressed.

d) Alignment with Federal and Departmental Priorities

The CECR Program is consistent with current federal priorities related to economic affairs and is closely aligned with the federal S&T Strategy – specifically, the Entrepreneurial Advantage (and to a lesser extent, the Knowledge and People Advantages) by contributing to the translation of research into commercial applications. It also reflects a core S&T Strategy principle of encouraging partnerships among universities, industry and government.

The program operates in all S&T Strategy priority areas and most STIC sub-priorities. An over-representation of funded Centres in the health priority area in the first funding round has been addressed to some extent in subsequent funding rounds, although the natural resource and energy and environmental science and technologies priorities remain underrepresented to some extent.

While the CECR Program clearly supports NSERC and CIHR priorities, the evaluation evidence indicates a more mixed picture of the alignment of the program with the priorities of SSHRC for service and business innovation. The S&T priority areas themselves and the profile of Centre projects and Centre participants suggest a focus on technology and product innovation over service and process innovation. Still, the services offered by the Centres include a broad range of commercialization and business-related advice/expertise, which suggests that the Centres' staffing complement and commercialization model is multi-disciplinary (though research field of staff could not be quantified in the evaluation).

3.2 Program Performance: Achievement of Program Outcomes

a) Immediate and Intermediate Outcomes

The evaluation evidence indicates progress toward the achievement of immediate and intermediate intended outcomes of the CECR Program. Overall, the CECR Program has been successful in enhancing research and commercialization capacity and strengthening domestic collaboration. During the period under study, $229.6M in CECR Program grant and partner contributions was allocated to address research and commercialization. Centres have adopted a variety of business models to meet sectoral needs including operation of physical infrastructure (specialized equipment and facilities, lab services), and offering commercialization expertise and capital for development and demonstration of new technologies. The Centres have conducted outreach, hosted knowledge translation events and brokered partnerships with a variety of partners from academia, industry, and government. The enhanced research and commercialization capacity available through the Centres has been utilized by Centre participants for research and commercialization projects. Participants have accessed a broad range of support/assistance from the Centres including financial (cash) support and commercialization expertise.

The Centres have attracted research and business talent, though performance data are able to better quantify research talent than business talent. During the first three years, the Centres have used the CECR Program grant to fund over 400 full-time research or other clinician or health professional positions (most of these in research and commercialization Centres in the health priority area). Non-CECR funds have paid for the cost of another 670 full-time positions. A number of Centres have also undertaken youth mentorship programs in science and business disciplines.

The Centres have attracted investment through partner contributions (a leveraging ratio of 1:1.5) from a variety of sectors, as well as Centre-generated revenue (through the use of services), and follow-on investment accessed by organizations served by the Centres. A significant portion of partner contributions (73 per cent) have been in the form of cash contributions. Industry and the provinces are the most significant partner contributors.

The intended CECR Program outcomes relating to research are difficult to assess. Of the 22 Centres funded to date, eight are purely commercialization centres that do not contribute directly to the research outcomes of the program. As well, for those Centres that are involved in research activities, the yield in terms of public benefits is not expected to occur in the short-term. Still, benefits in the short-term were noted in areas such as Canadian

patients' access to clinical trials of new drug discoveries, new products to market and achievement of research milestones in areas such as medical robotics and personalized medicine.

The CECR Program has addressed the intended program outcome of training highly qualified personnel (HQP) to a moderate degree. In the first three years of the program, 53 full-time trainee positions were funded by the Centres using the CECR Program grant. Many of the funded Centres have not undertaken significant training activity as they do not engage in the types of research activities that provide training opportunities to HQP. The exception to this is research and commercialization Centres in the health and life sciences sector, which have a greater focus on training HQP. Other centres are addressing the HQP intended program outcome through the projects that they fund (i.e., HQP are employed with organizations served) or with non-CECR funds (270 HQP full-time positions were funded by non-CECR funds in the first three years of the program). HQP that participated in a training opportunity are satisfied with their experience and advised that it enhanced their research/scientific and commercialization skills.

It is unlikely that any of the Centres will achieve self-sufficiency within the funding period. To try to work towards self-sufficiency, Centres are using a mix of strategies to secure revenue from external sources, including partner contributions, membership fees and Centre-generated revenues. There are a number of challenges, however. For example, the Centres are uneven in the extent to which they have leveraged contributions (in particular cash contributions which are important to sustainable operations) from external partners. This challenge has been exacerbated by the economic downturn and a more cautious investment environment. Second, the provision of services to the sector (foster domestic and international collaborations, knowledge dissemination), while beneficial and addressing the CECR Program objectives, does not typically generate significant revenue for the Centres. Finally, revenues generated through return on intellectual property have been slow to materialize. This is particularly true for Centres in the health and life sciences priority area where time to market for a new technology can take as long as 10 to 15 years.

b) Long-term Outcomes

The CECR program has a number of intended longer-term outcomes. With respect to commercialization outcomes, there is good evidence on the extent to which the Centres have accelerated the commercialization of new technologies. For example, the Centres have supported filing and issuing of patents and negotiating licenses (supported 107 patents issued, 34 licenses granted). In addition, seven in ten Centre participants collaborating on projects with the Centres indicate their respective Centre has had a significant impact in addressing their research and commercialization challenges. Organizational impacts include increases in the organization's knowledge base and research and development capacity. To date, 55 start-ups have been created by or with the assistance of the Centres. Organizations served by the Centres have created over 1,000 new jobs.

Generating further social, economic, health and environmental benefits for Canadians of a more ambitious nature is anticipated only in the much longer term. To some extent, an integrated model of innovation is visible in the Centres' approaches to commercialization through their incorporation of business talent within their organization, and a customer focus that is adopted in evaluating and investing in early stage commercialization projects.

Finally, evaluation evidence to measure the program's performance in branding Canada as a centre of research and commercialization excellence indicates that efforts at the Centre level to increase visibility, particularly in the international arena, are evident with a number of alliances now coming to fruition (e.g., the International Commercialization Alliance).

c) Unintended Outcomes

The CECR program does not have any significant unintended negative outcomes. Some Centres have made unexpected contributions in the policy area (e.g., Health Canada regulatory affairs policies) and in addressing unexpected national challenges in the drug supply chain (e.g., the shortage of medical isotopes during the Chalk River shut down). While not an unintended outcomes, for some Centres, progress in terms new partnerships and interest in the Centre from the sector has exceeded expectations.

3.3 Program Performance: Efficiency and Economy

a) Effectiveness and Efficiency of Program Delivery

The CECR Program's design and delivery mechanics are adequate to support achievement of most of the program's intended immediate and intermediate outcomes, with exceptions noted below. The Centres are highly supportive of the CECR Program approach that advances commercialization of research and are generally satisfied with the delivery of the CECR Program. A strong majority of the Centres' participants also support the work of the Centres and agree that their involvement has been worthwhile (higher among participants affiliated with research and commercialization centres funded earlier in 2008).

Implementation at the Centre-level has unfolded as proposed, though a handful of Centres have adjusted their business model to respond to funding constraints or to ensure their model met the needs and interests of the sector. Industry involvement and sector relevance were widely seen as factors that are important to the success of the Centres. Program challenges include NCE Secretariat workload and lack of continuity of program staff, as well as a variety of implementation challenges at the Centre level (e.g., recruiting high calibre staff, adequate facility space, and partnership development).

The administrative cost of the CECR Program at the NCE Secretariat level is less than three per cent of total program funding, which is in line with other NCE Secretariat programs.

b) Alternative Models or Approaches

Many approaches to improving innovation capacity have been recommended in recent reviews of Canada's performance in this area. The CECR Program was identified as playing an important intermediary role by the recent R&D Panel Review of Federal Support to Business Innovation, and the program elements broadly reflect

both the key ingredients identified in the literature as important for innovation support programs and the characteristics of similar commercialization Centres in other countries.

c) Delivery Models/ Management Practices

The flexibility of the CECR Program to allow Centres to develop commercialization approaches and a business model tailored to the needs of the sector and organizations served was widely praised. There were a number of observations (e.g., from the documentation, views of key informants and case studies of the Centres) on promising delivery approaches and success factors of the Centres. Most often, the quality of the leadership of the Centres – including the Director and senior staff, and strength of governance through the Board of Directors – were highlighted as important for relationship-building with partners, companies and individual investigators within the sector. A customer focus and focused organizational objectives and strategy were also noted as good management practices to ensure the Centres remain on track and progress toward achievement of objectives.

d) Performance Measurement and Risk Management

While a Results-based Management Accountability Framework and Risk-based Audit Framework were prepared for the CECR Programs, and annual performance information is collected for the program, there are some challenges in capturing the commercialization outcomes of the Centres. This is due, in part to the diversity of their business models and lack of universally accepted performance measures to capture the progress of a technology, product or process toward commercialization. While the performance metrics for the program have improved, some weaknesses remain including inconsistencies in how Centres are reporting aspects of their operations (e.g., partner contributions investment accessed by organizations served, Centre-generated revenues). These inconsistencies could be resolved by greater guidance to the Centres on the meaning and intent of the measures, as well as a more thorough vetting process by NCE Secretariat senior program managers to ensure that the material submitted by Centres is consistent and is revised based on feedback offered. Other challenges include the need to align performance measures more closely with the focus of the program on commercialization and the stated outcomes of the program, and to more accurately capture the incremental impacts of the CECR Program grant. The Centres would also welcome the opportunity to provide their performance story through more expansive qualitative narratives that capture the longer-term social, health and environmental outcomes and benefits of their projects.

The risks identified for the CECR program continue to be relevant, with the exception of peer review (the workload of the NCE Secretariat and access to industry and academic peer reviewers was resolved following the initial funding rounds). Risks related to intellectual property management and conflict of interest are managed at the Centre level through policies and guidelines that are developed by the Boards of Directors and consistent with those of the NCE Secretariat. Conflict of interest is projected to require increasing attention as Centres begin to have more commercial successes. The risk area related to possible difficulties of Centres in obtaining matching funds is difficult to assess. Considering the CECR Program as a whole, significant partner contributions have been leveraged from a variety of sectors, including industry. However, at the Centre level, the economic downturn and current cautious investment climate have created difficulties in securing matching funds for some Centres, which are not meeting their matching requirements. This could lead to a significant concern if the Centre has had a low utilization rate of the

CECR grant and expects to increase their spending of both the CECR grant and partner matching funds in the final years of the grant.

e) Efficiency Improvements

The CECR Program has a number of strengths, including addressing a gap in the research and development funding array that has historically had a limited focus on commercialization of research and the inclusion of business or industry expertise in the management of the program and the Centres. The program has also made some progress in addressing recommendations from the formative evaluation (e.g., defining commercialization, addressing imbalances in the S&T Strategy priority areas). Other issues noted in the formative evaluation are more persistent in nature, including cultivating provincial collaboration, the feasibility of the self-sufficiency of the Centres and suitable performance measurement.

Improvements to the CECR Program include a number of adjustments to operational aspects of the program in relation to the application process (streamline and move to an online application process), program guidelines (clarification of guidelines around matching funds/in-kind contributions) and support provided to Centres by the NCE Secretariat (e.g., enhance sharing of lessons learned, communications, increase expertise within the Secretariat to provide guidance to Centres in areas such as intellectual property management).

A key concern is the expectation that commercialization Centres funded by the program be self-sufficient within the five-year period of the grant. This expectation will not be met, and has created uncertainty for Centres in planning and engaging partners. There are few examples of commercialization intermediaries in Canada (e.g., technology transfer/industry liaison offices, applied research alliances, incubators or pre-seed venture funds) that have achieved self-sufficiency, and similar centres internationally rely on a mix of contract/fee for service, royalties and public funding.

3.4 RECOMMENDATIONS

Based on the findings of the evaluation of the CECR Program, the following recommendations are provided.

1. The NCE Secretariat should consider providing an opportunity for Centres in both research and commercialization, and commercialization streams to request an extension of their current five-year grant or apply for renewed funding to allow them to advance implementation of their business model and begin to realize a return on investment. The funding extension/renewal decision should consider factors such as Centres' achievement of objectives outlined in their funding agreement, demonstrated value to the sector (e.g., demand for services, partner contributions) and international interest garnered by the Centre. Given the high degree of variability in the time to market for new technologies, the evaluation of the extension/renewal request should take the sector into consideration.

2. The NCE Secretariat should continue to reinforce the program's focus on commercialization. Commercialization, particularly of early stage innovations to bridge the commercialization gap, is a distinguishing feature of the program, contributing to its niche in the array of federal research and

development programs. Moving forward, it will be important for the program to remain flexible to promote and support a variety of innovation models and approaches, including service, process and social innovations, to achieve its commercialization outcomes.

   a. The NCE Secretariat should review the stated intended outcomes of the CECR Program to ensure that they are more closely aligned with the evolving focus of the program on commercialization and are articulated to avoid redundancies among the outcome statements. This recommendation pertains specifically to the intended research outcomes of the program and the intended outcome for providing training opportunities to HQP.
   b. Given that there are few examples of research and commercialization intermediaries that are self-sufficient, the NCE Secretariat should expand on its expectations and definition of self-sufficiency of the Centres. The rationale for self-sufficiency and successful Canadian and/or international examples that could provide a model for long-term viability of the Centers should be identified.

3. Recognizing that improvements to the performance reporting template have been made over the CECR program cycle and universally accepted indicators to measure progress of a discovery toward commercialization are limited, the NCE Secretariat should continue to seek improvements to Centres' performance reporting. Three areas are identified:
   a. Definitions of key concepts – the NCE Secretariat should work towards providing more detailed definitions of key performance indicators to strive for greater consistency in the way in which Centres populate the reporting template. Ongoing communications and guidance to the Centres on completing the templates is essential to ensure program performance measures are accurate and timely. The creation of a web-based reporting system may be helpful and the feasibility of obtaining regular partner/client feedback on the impact of their interactions with the Centres (such as through an online assessment form or third party assessment) could be explored.
   b. Review of performance measurement needs – the NCE Secretariat should review its current annual report template to ensure that all measures are required and being used for assessment of the Centres' performance and that measures that may be useful to understand the Centres' contributions to the CECR Program outcomes and value to the sector are not overlooked (e.g., recruitment of business talent). Due to the heterogeneity of the Centres, it is recommended that, in addition to measures related to commerce (company creation, jobs), qualitative measures of performance – including broader measures such as impacts on the health care costs – be included for Centres to tell their performance story. Centres could be asked to describe possible economic or societal impacts of the innovations they help to commercialize.
   c. Management practice – ensure that adequate time and effort are available for NCE Secretariat senior program managers to review and vet the performance information provided by the Centres. The feedback memorandums are useful, but could be more tailored to document Centre strengths, as well as weaknesses. This would be an important tool to enhance continuity in the event of turnover of NCE Secretariat staff.

APPENDIX A
EVALUATION MATRIX

Revised Evaluation Matrix for CECR Summative Evaluation

Issue / Question	Indicators	Data Collection Methods and Source
Relevance		
1. To what extent is there a continued need for funding to support the operation of research and commercialization centres?	1. Assessment of the overall need for a centre approach to support research, development, innovation and commercialization 2. Assessment of specific/unique needs addressed by the program (e.g., needs of partners, stakeholders and user community)	▪ Document review *(CECR program documents, federal government documents, literature on other commercialization programs in Canada)* ▪ Key informant interviews *(NCE management, federal granting* agency *representatives, Industry Canada representative, PSAB members, expert review panel members, applicants from non-funded full applications, provincial government representatives, TTO/ILO representatives)* ▪ Case Studies *(Interviews with centre management and partners, Survey of centre partners)*
1.1 What niche, if any, does the program occupy in relation to similar programs at the federal and other levels of government?	1. Assessment of overlap, duplication, complementarity and synergy between CECR program and similar programs/funding opportunities available for research and commercialization purposes (e.g., university TTO/ILO offices) 2. Nature of the objectives, position and role of the program and the funded centres in relation to other government programs and Canadian organizations active in research and collaboration in the relevant priority area, sub-priority areas and sector (e.g., private, public, and not-for-profit organisations)	▪ Document review *(CECR program documents, federal* government *documents, literature on other commercialization programs in Canada)* ▪ Key informant interviews *(NCE management, federal granting agency representatives, Industry Canada representative, PSAB members, expert review panel members, applicants from non-funded full applications, provincial government representatives, TTO/ILO representatives)* ▪ Case Studies *(Interviews with centre management and partners, Survey of centre partners)*
2. Is there a necessary role for the federal government in providing the program?	1. Assessment of the federal government's role and responsibilities in delivering the program 2. Nature and extent of provincial government participation in and support of centre activities	▪ Document review *(CECR program documents, federal government documents, literature on other commercialization programs in Canada)* ▪ Key informant interviews *(NCE management, federal granting agency representatives, Industry Canada representative, PSAB members, provincial government representatives)* ▪ Case Studies *(Interviews with centre management and partners)*
3. To what extent is the program aligned with federal government priorities?	1. Assessment of the alignment of program objectives with federal government priorities in S&T and commercialization (e.g., S&T strategy priorities, STIC sub-priorities) 2. Assessment of the alignment of centre plans and activities with federal government priorities in S&T and commercialization (e.g., S&T strategy priorities, STIC sub-priorities)	▪ Document review *(CECR program documents, federal government documents)* ▪ File review *(letters of intent, full applications, corporate plans, annual reports)* ▪ Key informant interviews *(NCE management, federal granting agency representatives, Industry Canada representative, PSAB members, expert review panel members)* ▪ Case Studies *(Interviews with centre management and partners)*

Issue / Question	Indicators	Data Collection Methods and Source
Performance: Effectiveness, efficiency and economy		
4. To what extent has the program achieved expected research and commercialization outcomes?	1. Assessment of actual program performance against expected research and commercialization outcomes based on types of centres (i.e., research, research and commercialization, and commercialization) funded to date 2. Assessment of incrementality and attribution of CECR program funding to the achievement of expected outcomes 3. Evidence of unintended outcomes (positive or negative)	▪ Document review *(CECR program documents, federal government documents, literature on other commercialization programs in Canada)* ▪ File review *(corporate plans, annual reports)* ▪ Key informant interviews (NCE management, federal granting agency representatives, Industry Canada representative, PSAB members, expert review panel members, provincial government representatives) ▪ Case Studies (Interviews with centre management and partners, Survey of centre partners)
› Enhance research and commercialization capacity and strengthen domestic collaborations (IMM1-R, INT1-R, IMM1-C, INT3-C)	1. Source, type (cash and in-kind) and amount of contributions leveraged by centres for research and commercialization activities 2. Number and type of research and commercialization strengths (e.g., individuals, teams, networks, institutions, infrastructure, equipment) connected or leveraged by centres 3. Number and nature (new vs. existing, research vs. commercialization, technology push vs. market pull, technology vs. social outcomes) of partnerships and collaborations 4. Assessment of the effectiveness of the centres to establish and/or strengthen the domestic collaborations (i.e., approach for engagement and collaboration, participation of relevant researchers, partner organizations, disciplines, institutions and sectors) 5. Extent to which centres are using an integrated model of innovation and commercialization (i.e., involving economic, technological and social approaches) 6. Number and type of spill over of benefits to firms, receptor community, sectors and regions resulting from domestic collaborations 7. Number and type (e.g.,. scientific, technological, social, health) research challenges addressed by domestic collaborations	▪ Document review *(CECR program documents, federal government documents, literature on other commercialization programs in Canada)* ▪ File review *(corporate plans, annual reports)* ▪ Case Studies (Interviews with centre management and partners, Survey of centre partners)
› Attract research and business talent and investment (IMM2-R, IMM2-C, IMM3-C)	1. Number and type of post-graduate students and post-doctoral researchers participating in centre research and/or partner organization research (Canadian vs. international) 2. Number and type of researchers participating in centre and/or partner organization research (Canadian vs. international) 3. Number and type of commercialization professionals (e.g., business leaders) participating in centres and/or partner organizations (Canadian vs. international) 4. Amount of investment leveraged by the centres and/or partner organizations (by type of investment, centre and source)	▪ Document review *(CECR program documents, federal government documents, literature on other commercialization programs in Canada)* ▪ File review *(corporate plans, annual reports)* ▪ Case Studies (Interviews with centre management and partners, Survey of centre partners)

Issue / Question	Indicators	Data Collection Methods and Source
› Provide high quality post-graduate and post-doctoral training in innovative and internationally competitive research (IMM3-R)	1. Number and nature of training opportunities provided by the program 2. Nature of research and business skills acquired by trainees 3. Assessment of the quality and utility of the training opportunities	▪ Document review *(CECR program documents, federal government documents, literature on other commercialization programs in Canada)* ▪ File review *(corporate plans, annual reports)* ▪ Case Studies (Interviews with centre management and partners, Survey of centre partners)
› Open up new opportunities to access world-class research equipment, facilities and networks and develop relationships with major international centres and research programs (INT2-R, INT3-R, INT1-C, INT2-C)	1. Number and type of research and commercialization resources (e.g., research equipment, facilities, information and/or databases, business strategies/services, market intelligence, entrepreneurs-in-residence) and networks accessed by Canadian researchers and firms 2. Number and nature of relationships (new vs. existing) with international centres and research programs	▪ Document review *(CECR program documents)* ▪ File review *(corporate plans, annual reports)* ▪ Case Studies (Interviews with centre management and partners, Survey of centre partners)
› Create centres with a strong research orientation that yield significant public benefits by the end of the funding period (INT4-R)	1. Number and type of centres with strong research orientation (new vs. existing centres, typology of research activities) 2. Nature and extent of benefits (actual and potential; technological, economic or social) resulting from research of centres	▪ Document review *(CECR program documents)* ▪ File review *(corporate plans, annual reports)* ▪ Case Studies (Interviews with centre management and partners, Survey of centre partners)
› Create centres with a strong commercialization orientation that are expected to be self-sufficient by the end of the funding period (INT4-C)	1. Number of centres with strong commercialization orientation (new vs. existing, typology of commercialization activities) 2. Ratio of program funding to total centre funding over current funding period 3. Assessment of the feasibility of centre self-sufficiency within the current funding period 4. Assessment of the timeframe for centre self-sufficiency beyond current funding period	▪ Document review *(CECR program documents)* ▪ File review *(corporate plans, annual reports)* ▪ Case Studies (Interviews with centre management and partners, Survey of centre partners)
5. What progress has the program made towards the achievement of long-term outcomes?	1. Evidence of progress toward long-term outcomes (e.g., social, economic, health and environmental) 2. Assessment of how centres contribute to the achievement of the program's long-term outcomes 3. Assessment of incrementality and attribution of CECR program funding to the achievement of long-term outcomes	▪ Document review *(CECR program documents)* ▪ File review *(corporate plans, annual reports)* ▪ Key informant interviews (NCE management, federal granting agency representatives, Industry Canada representative, PSAB members, expert review panel members, applicants from non-funded full applications, provincial government representatives, TTO/ILO representatives) ▪ Case Studies (Interviews with centre management and partners, Survey of centre partners)
› Create centres with sufficient scale and focus to position Canada at the forefront of international research breakthroughs that will yield economic, social, health or environmental benefits to Canadians (U1)	1. Number and nature of research breakthroughs (e.g., scientific, technological, social, health) resulting from centre activities 2. Economic, social, health and environmental benefits (actual or potential) resulting from research breakthroughs	▪ Document review *(CECR program documents)* ▪ File review *(corporate plans, annual reports)* ▪ Case Studies (Interviews with centre management and partners, Survey of centre partners)

Issue / Question	Indicators	Data Collection Methods and Source
› Accelerate the commercialization of leading edge technologies, goods, services in priority areas where Canada can significantly advance its competitive advantage (U2)	1. Number and type of technologies, goods or services commercialized by centre partners 2. Number of technologies, goods and/or services where centres accelerated commercialization 3. Number and type of commercialization impacts (e.g., economic, social, health and environmental)	▪ Document review *(CECR program documents)* ▪ File review *(corporate plans, annual reports)* ▪ Case Studies (Interviews with centre management and partners, Survey of centre partners)
› Create, grow and retain companies in Canada that are able to capture new markets with breakthrough innovations (U3)	1. Number and type of companies created, grown and/or retained in Canada 2. Number and type of firms capturing new markets with innovations resulting from centre activities	▪ Document review *(CECR program documents)* ▪ File review *(corporate plans, annual reports)* ▪ Case Studies (Interviews with centre management and partners, Survey of centre partners)
› Deliver economic, social and environmental benefits to Canadians (U4)	1. Economic, social and environmental benefits (actual or potential) resulting from the program	▪ Document review *(CECR program documents, federal government documents, literature on other commercialization programs in Canada)* ▪ File review *(corporate plans, annual reports)* ▪ Case Studies (Interviews with centre management and partners, Survey of centre partners)
› Brand Canada as the host of internationally recognized centres of excellence in research and/or commercialization of research results (U5)	1. Number and nature of recognition (national and international) of program and/or centres (e.g., press, awards)	▪ Document review *(CECR program documents, federal government documents, literature on other commercialization programs in Canada)* ▪ File review *(corporate plans, annual reports)* ▪ Case Studies (Interviews with centre management and partners, Survey of centre partners)
6. To what extent are efficient and effective means being used to deliver the program?	1. Factors inhibiting and/or facilitating program delivery 2. Assessment of effectiveness and efficiency of program delivery (e.g., clarity of program objectives in areas of research and commercialization, effectiveness and efficiency of competition and grant administration processes) 3. Comparative assessment of program delivery model with other approaches used to support commercialization 4. Assessment of the program's progress towards the proposed actions to address the recommendations of the formative evaluation to improve program implementation 5. Potential changes to the delivery model to improve efficiency and/or effectiveness	▪ Document review *(CECR program documents, federal government documents, literature on other commercialization programs in Canada)* ▪ Key informant interviews (NCE management, federal granting agency representatives, Industry Canada representative, PSAB members, expert review panel members, applicants from non-funded full applications, provincial government representatives) ▪ Case Studies (Interviews with centre management and partners, Survey of centre partners)
6.1 To what extent have centres implemented effective delivery models and management practices to achieve expected outcomes?	1. Comparative assessment of centre management and delivery (e.g., structure, operation, leadership and governance) 2. Comparison of delivery models and management practices used by pre-existing and new centres 3. Factors facilitating or inhibiting centre performance	▪ Document review *(CECR program documents, literature on other commercialization programs in Canada)* ▪ File review *(corporate plans, annual reports)* ▪ Key informant interviews (NCE management, PSAB members, expert review panel members) ▪ Case Studies (Interviews with centre management and partners, Survey of centre partners)
6.2 To what extent is the program	1. Assessment of the appropriateness of performance information collected from centres	▪ Document review *(CECR program documents, federal government documents, literature on other commercialization programs in Canada)*

Issue / Question	Indicators	Data Collection Methods and Source
collecting the appropriate information to monitor centre performance and manage risk?	2. Identification of improvements to the program's performance measurement system and annual reporting template 3. Assessment of implementation and effectiveness of the risk management plan 4. Processes used by the program and centres to manage risks associated with peer review, matching funds, intellectual property, and conflict of interest	▪ File review *(corporate plans, annual reports)* ▪ Key informant interviews (NCE management, PSAB members, expert review panel members) ▪ Case Studies (Interviews with centre management and partners, Survey of centre partners)
6.3 To what extent can the efficiency of the program be improved?	1. Identification of improvements to program delivery to increase efficiency 2. Ratio of administrative costs to total program costs for the program and comparable programs	▪ Document review *(CECR program documents)* ▪ File review *(corporate plans, annual reports)* ▪ Key informant interviews (NCE management, PSAB members, expert review panel members) ▪ Case Studies (Interviews with centre management and partners, Survey of centre partners)

Appendix B
Bibliography

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