# Evaluation of the Business-Led Networks of Centres of Excellence (BL-NCE) Program

## *Final Evaluation Summary Report*

**Prepared for:**

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# List of Acronyms

| | |
|---|---|
| BL-NCE | Business Led Networks of Centres of Excellence |
| CECR | Centres of Excellence for Commercialization and Research |
| CIHR | Canadian Institutes of Health Research |
| HQP | Highly Qualified Personnel |
| IP | Intellectual Property |
| KTEE | Knowledge and technology exploitation and exchange |
| LOI | Letter of Interest |
| NCE | Networks of Centres of Excellence |
| NSERC | Natural Sciences and Engineering Research Council of Canada |
| PSAB | Private Sector Advisory Board |
| R&D | Research and Development |
| SNG | Strategic Network Grants Program |
| SSHRC | Social Sciences and Humanities Research Council of Canada |
| S&T | Science and Technology |
| ST&I | Science Technology and Innovation |

# Executive Summary

## Objectives, Scope and Methodology

The Business-Led Networks of Centres of Excellence (BL-NCE) program, established in 2008, is one of a suite of four programs managed by the NCE Secretariat to create virtual multidisciplinary and multisectoral networks designed to fund large-scale collaborative research networks and support private sector innovation. BL-NCE networks are unique in that they must be led by a not-for-profit consortium of industrial partners, and their research agenda must help address major R&D and commercialization challenges. Matching requirements mean that, at a minimum, one-half of a BL-NCE network's research costs are paid by partners. The BL-NCE program was established with funding of $46 million as a pilot over four years beginning in 2008-2009. Four BL-NCE networks were funded in 2009 and are included in the study.

The BL-NCE evaluation was conducted jointly with the NCE evaluation to allow for comparisons between the two programs. The evaluation of the BL-NCE program was undertaken to meet the information needs of program management and delivery personnel (i.e., the NCE Secretariat) and to comply with the Treasury Board *Policy on Evaluation* (2009) and *Financial Administration Act* regarding evaluation coverage. A previous evaluation of the BL-NCE program was undertaken in 2012 to inform the renewal of funding and continuance of program authority. The 2012 evaluation addressed issues related to program relevance, implementation and effectiveness. The current joint evaluation builds on this recent activity rather than duplicates this work and covers the networks funded within the period under study: 2008-09 to 2012-13. The evaluation adhered to the *Policy on Evaluation* and its associated Directive and Standards relating to the core evaluation issues of relevance and performance.

Five methods were employed for the evaluation of the BL-NCE program: a document review; administrative data analysis; 14 key informant interviews and one group interview; web-based surveys with BL-NCE (and comparator networks) researchers, partner organizations and HQPs; and case studies of all four 2009 BL-NCE funded networks.

## Summary of Findings

Following are the conclusions based on the findings from the evaluation of the BL-NCE program.

### Relevance

The evaluation confirms the continued need for the BL-NCE program. Demand for the program, as evidenced by increased numbers of applications for program funding, is strong and the network approach to research funding was found to have many advantages, fostering synergies

and unique solutions to complex research problems that could not be achieved by individual researchers working in isolation. The program is distinguished by geographic reach, scale/length of funding, and program design features including its unique business-led model. The research networks and projects funded by the networks are unlikely to have occurred in the absence of the BL-NCE program.

The BL-NCE program in particular, with its business-led model that seeks to engage industry directly and expand business R&D investments through leveraged funding, was found to be consistent with government priorities that highlight the ongoing federal commitment to research and development (R&D) and innovation as key drivers of prosperity and responds to Canada's deficit in business R&D. The 2014 Science, Technology and Innovation Strategy signals the continued federal role and priority for these investments, and underscores the BL-NCE program's specific role in supporting the government's ST&I core principles as well as its research priorities.

## Effectiveness

The evaluation evidence indicates that the BL-NCE program is achieving or making progress toward achieving intended outcomes in a manner that is reflective of its unique business model.

***Research, development and innovation***. BL-NCE networks have engaged many researchers and partners from various sectors. BL-NCE network research expenditures have been enhanced by leveraged contributions from partners which have increased the overall investment in research projects[1]. The networks have rigorous project selection criteria in place and monitoring mechanisms to ensure excellence of research quality. The Private Sector Advisory Board (PSAB), unique to the BL-NCE and the Centres of Excellence for Commercialization and Research (CECR) programs within the NCE program suite, plays a critical role in selecting networks and monitoring their progress. According to researchers and partners, projects funded by the BL-NCE networks are leading to the creation or extension of knowledge, the extension/application of technology, and were more likely than comparator networks to result in the creation of new technology and new research methodologies.

***Multidisciplinary, multisectoral and international collaborations***. BL-NCE researchers (largely industry researchers) are mostly drawn from NSERC disciplines. Many BL-NCE researchers and most network partners indicated multidisciplinary collaborations occurred. The evaluation indicates that BL-NCE networks engaged partners from across sectors, with the majority coming from industry; the number of partners has grown steadily since program inception. BL-NCE networks employed a wide variety of activities/methods to engage their partners. There is

[1] Leveraged contributions refer to the cash and in-kind contributions that are provided by sources other than the granting agencies to match the eligible expenses of the BL-Network grant while respecting the stacking limit. Source: http://www.nce-rce.gc.ca/ReportsPublications-RapportsPublications/BLNCE-RCEE/ProgramGuide-GuideProgramme_eng.asp

evidence that many project collaborations were new. There is also some evidence of international collaboration. According to researchers, their collaborations are generally viewed as successful. Partners' involvement in the BL-NCE networks seeded interest in future collaborations.

***Meeting the needs of partner organizations***. The BL-NCE networks have put in place mechanisms to engage and identify the needs of partners through their governance, planning and networking activities. Partners are typically involved in the research definition phase and dissemination and mobilization; BL-NCE private sector partners are more likely than their NCE counterparts to lead in all project phases. There is an overall positive impression that BL-NCE networks are meeting business needs and the needs industry researchers. When the BL-NCE networks did not meet the needs of industry researchers, the following were identified: the need for more support; a desire for more oversight/monitoring of funded projects; improve criteria for funding projects (e.g., higher risk); and assistance with intellectual property (IP). For some partners, perceived benefits have not yet been realized, which is attributable, in part, to the early stage of their network involvement. The business-led model of the BL-NCE networks appears to yield an alignment between network research and the needs of partner organizations.

***Impacts on the attraction, training, retention and employment of highly qualified personnel (HQP)***. Most researchers and partners indicated that their project or network had resulted in the training of HQP. Anecdotal evidence points to BL-NCE's positive influence on the attraction and retention of HQP. BL-NCE HQP are primarily graduate and post-doctoral students. Key distinguishing features of network HQP training include opportunities to conduct industry-relevant research, have access to cutting edge technology/research facilities and to interact with private sector researchers. Students are generally pleased with the quality of the training. A gender skew in the BL-NCE HQP is consistent with the male-dominated fields that are represented by the networks (e.g., aviation, forestry, oil and gas). Impacts of employment could not be rigorously assessed however there is a perceived positive impact on job readiness.

***Knowledge and/or technology mobilization by partner organizations*.** The BL-NCE networks demonstrate broad dissemination of network research through traditional media (publications, conferences) and researchers and partners agree that the networks accelerate the exchange of these results. Mobilization activities are also taking place through the execution of non-disclosure or confidentiality agreements and other commercialization activities, such as patent applications. Universities play an important role in knowledge mobilization for BL-NCE researchers, although BL-NCE researchers engage the private sector for mobilization to a greater extent than their NCE counterparts. There is some evidence of commercialization of network developed technology; there has been steady growth in knowledge and technology exploitation and exchange (KTEE) and commercialization activities since BL-NCE program inception. While acknowledging successes in the area of knowledge mobilization for some networks, key informants encouraged the networks to continue to embed knowledge translation and exchange in research that is incremental (i.e., higher risk that companies would not undertake on their

own). A key suggestion for improvement cited by researchers and partners during the survey and echoed by key informants, is that the program continue to emphasize knowledge translation and exchange, including finding ways/incentives to share best practices among the networks

***Impacts on partner organizations and the user sector*.** Increasing the knowledge base of network organizations is the most common impact of network research; BL-NCE partners also cite impact on R&D of network organizations as a common impact. Other impacts of network research indicated by a minority include an impact on products and /or services of network organizations, and, for BL-NCE partners in particular, impact on processes and /or practices of network organizations and impact on competitiveness of network organizations. Partners confirmed in case study examples that the information they accessed through the networks allowed them to become one of the first in their field to apply a technology, which provided them a (temporary) competitive advantage.

***Long-term economic, social, health and environmental benefits to Canada***. Given the short funding timeline of the recently created BL-NCE networks, evaluation evidence is limited on longer-term benefits, although there is anecdotal evidence of longer-term benefits leading to innovations in aviation and drug development.

## Efficiency and Economy

The administrative efficiency of the program is reasonable, suggesting that significant efficiency improvements are not required (although some concerns were expressed regarding the capacity of the NCE Secretariat to support the networks which was perceived to be due to turnover and understaffing during the period under study.

Leveraging from partners is significant (1:2.5), surpassing program requirements, and demonstrates that the network research is of interest to partners.

Key informants believe the program to be working well and perceive many of the elements of the program to be well-executed. Among researchers and partners with some familiarity with the program, however, only modest satisfaction is was observed. Researchers are generally more satisfied than BL-NCE partners with all aspects of program delivery, however, both researchers and partners were less satisfied with IP guidelines.

BL-NCE partners generally view the BL-NCE networks to be successful, and the case studies and observations of key informants suggest that this is more likely to occur when there is strong and engaged leadership at network level, a compelling niche that attracts breadth and balance of partners and researchers, and robust engagement of industry/partners. Inhibiting factors included challenges navigating governance issues and complex and protracted negotiation of intellectual property or network membership agreements.

# Recommendations

1. **The BL-NCE program is relevant and is achieving its key intended immediate and intermediate outcomes, as well as demonstrating progress towards meeting its long term outcomes. It should therefore be considered for continued support at the federal level** The BL-NCE program is addressing a continued need using a network approach that has been shown to have many advantages; the program also underscores and supports the federal government's private sector R&D goals. Demand for the program is strong.

2. **The sharing of best practices among networks is recommended in three areas: management of IP; knowledge and technology exploitation and exchange (KTEE); and governance principles in networks' research funding practices.** The sharing of best practices on negotiation of IP agreements is recommended as this is an area in which there is the least satisfaction. Best practices in the area of KTEE drawn from across the network funding programs**,** including tools and resources, should be developed and shared broadly among the BL-NCE networks to embed and maximize translation of network research to meet partner needs. Knowledge translation is an area of strength for many networks, with tools and resources being developed by several networks to encourage mobilization of research results which could be shared and adopted by other networks. Finally, networks governance structure, leadership and strong management practices (e.g., business practice knowledge, ability to successfully build a truly networked structure and to navigate governance) were perceived as critical to network success. These three areas are particularly important and challenging given the level of industry involvement, and because issues in these areas can hamper smooth functioning of the network and trust among partners.

3. **Performance measurement, specifically record keeping of the participation of researchers and partners in the BL-NCE program should be undertaken with greater accuracy and based on a common understanding across networks.** Assessment of the networked approach is based, in part, on how and to what extent researchers and partners are engaged by the network. As such, these data templates should be populated with a higher degree of reliability and accuracy, while balancing networks' reporting burden. The conduct of the survey of researchers and partners was hampered by outdated lists of program participants and would have benefited from a validation phase with the networks. Improved post-project HQP employment data would be beneficial to demonstrate NCE's role in supporting the federal government's "People Pillar."[2]

[2] Government of Canada (2014). *Seizing Canada's Moment: Moving Forward in Science Technology and Innovations.* Ottawa: Industry Canada.

# 1.0 Introduction

The purpose of this document is to present the findings from the evaluation of the Business-Led Networks of Centres of Excellence (BL-NCE) Program. The evaluation contributes to meeting the coverage requirements of Treasury Board's Policy on Evaluation (2009) and the requirements of the *Financial Administration Act*.

## 1.1 Program Description

The BL-NCE program, established in 2008, is one of a suite of four programs managed by the NCE Secretariat to create virtual multidisciplinary and multisectoral networks to address challenges that matter to Canadians.[3] The program is designed to fund large-scale collaborative research networks and support private sector innovation in order to deliver economic, health, social and environmental benefits to Canadians and encourage an entrepreneurial advantage. The program focuses on five priority areas[4]: environmental science and technologies; natural resources and energy; health and related life sciences and technologies; information and communications technologies; and management, business or finance.

A BL-NCE network must be led by a not-for-profit consortium of industrial partners and the network's research agenda must help address major research and development (R&D) and commercialization challenges identified by an industrial sector. Matching requirements mean that at least one-half of the BL-NCE network's research costs are paid by partners. BL-NCE grant funds can flow to private sector as well as Canadian based post-secondary institutions. The program is governed by the NCE Steering Committee, and involves a Private Sector Advisory Board (PSAB) to evaluate applications and make funding and policy recommendations. The BL-NCE program was established with funding of $46 million as a pilot over four years beginning in 2008-2009. Grant amounts vary between $8 and $11.8 million. BL-NCE networks that were funded from 2013 are excluded from the scope of the evaluation. Four BL-NCE networks were funded in 2009 and are included in the scope of the evaluation period. The networks are presented in Exhibit 1.1.

[3] Other programs in the suite are the Networks of Centres of Excellence (NCE), Centres of Excellence for Commercialization and Research (CECR) program, and the Industrial Research and Development Internship (IRDI) program.

[4] The target areas align with federal S&T priority areas, with the exception of "Management, business or finance" which is included in part because all BL-NCE networks develop management expertise in innovative approaches to collaboration between sectors and organizations although there are currently no networks funded under this target area.

**Exhibit 1.1: Currently Funded BL-NCE Networks**

| Network | Funding Period | Funding Amount |
|---|---|---|
| Canadian Forest NanoProducts Network – ArboraNano | 2009-2013 | $8.99M |
| Green Aviation Research and Development Network – GARDN | 2009-2013 | $11.82M |
| Quebec Consortium for Drug Discovery – CQDM | 2009-2013 | $8M |
| Petroleum Technology Research Centre – Sustainable Technologies for Energy Production Systems – PTRC-STEPS | 2009-2013 | $10.5M |

# 1.2 Objectives and Scope of the Evaluation

The evaluation of the BL-NCE program was undertaken to: meet the information needs of program management and delivery personnel (i.e., the NCE Secretariat) and to comply with the Treasury Board *Policy on Evaluation* (2009) and *Financial Administration Act* regarding evaluation coverage. A previous evaluation of the BL-NCE program was undertaken in 2012. The period under study is 2008-09 to 2012-13.

The evaluation adhered to the *Policy on Evaluation* and its associated Directive and Standards relating to the core evaluation issues of relevance and performance. Five evaluation questions covering Treasury Board's five core issues under the Policy were defined for the BL-NCE evaluation. The questions were approved by both the NCE Management Committee and the NCE Steering Committee. The evaluation questions are presented in Exhibit 1.2.

**Exhibit 1.2: Evaluation Questions**

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| 1. To what extent is there a continued need for the BL-NCE program to fund a network approach to research, development and innovation? |
| 1.1 Is there a necessary role for the federal government in providing the BL-NCE program? |
| 1.2 To what extent is the BL-NCE program aligned with federal government priorities and granting agencies' strategic outcomes? |
| 2. To what extent has the BL-NCE program enhanced research, development and innovation in the areas of funded networks? |
| 2.1 To what extent has BL-NCE program facilitated multidisciplinary, multisectoral and international collaborations between the research community and partner organizations to address research challenges? |
| 2.2 To what extent does the research undertaken by BL-NCE networks meet the needs of partner organizations? |
| 3. What impact has the BL-NCE program had on the attraction, training, retention and employment of highly qualified personnel (HQP)? |
| 3.1 To what extent have HQP acquired skills and experience (research, professional and international) relevant to the private, public and/or not-for-profit sectors? |
| 3.2 To what extent are HQP employed in user sectors and research areas of the BL-NCE networks? |
| 4. To what extent has the BL-NCE program resulted in long-term economic, social, health and environmental benefits to Canada? |

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|---|
| 4.1 To what extent has knowledge and/or technology been mobilized by partner organizations? |
| 4.2 What impact has the BL-NCE program had on partner organizations and the user sector? |
| 5. To what extent are efficient and effective means being used to deliver the program? |

# 1.3 Methodology

A total of five methods were employed for the evaluation of the BL-NCE program by a hybrid evaluation team composed of the Natural Science Engineering Research Council-Social Science Humanities Research Council Evaluation Division and an external consultant, including:

- **Document Review.** A review of NSERC-SSHRC compiled and publically available documents, as well as of literature.
- **Administrative Data Analysis**: Analysis of financial and other data on the BL-NCE program as a whole.
- **Key Informant Interviews.** Fourteen key informant interviews and one group interview were conducted with program staff, expert panel members (including the monitoring and evaluation committee), the PSAB, Industry Canada, and external experts.
- **Web-based Surveys**: Surveys were conducted with BL-NCE researchers, partner organizations[5] and HQPs as well as with their counterparts in comparator networks funded by the tri-agencies, NSERC and SSHRC.
- **Case Studies**: All four 2009 BL-NCE-funded networks were included in the case studies which consisted of a document review; integration of key administrative data; a network website review (if available); a review of available papers, articles and grey literature; and interviews with five to seven network members (lead and partners, staff, researchers and HQP).

The methodology for the evaluation of the BL-NCE program included a comparative design component with similar programs: the Networks of Centres of Excellence (NCE) program, the NSERC Strategic Networks Grants (SNG) program and the SSHRC Major Collaborative Research Initiative (MCRI) and the Community University Research Alliance (CURA) programs were selected as comparators and researchers, partners (NCE and SNG only) and HQP that participated in each of these network programs were included in the web-based survey component of the evaluation methodology.

The evaluation of the BL-NCE program is based on a multiple lines of evidence approach that included internal and external perspectives, gathered using a mix of quantitative and qualitative methodologies. The focus of the evaluation was on immediate and intermediate outcomes, as it is

[5] Partners include network members and other participant organizations of the BL-Network.

still early to measure achievement of ultimate outcomes, and difficult to measure these outcomes aggregated at a program level. Some limitations were encountered in the response rate for the survey of researchers and partners, resulting in a small sample size, and also a limited number of survey responses from HQP which could not be assessed for representativeness. This was considered during the analysis and taken into account when reaching conclusions. Second, there were some inconsistencies across the networks in recording of network participants and some performance measures.

## 1.4 Limitations

Overall, the evaluation methodology, based on multiple lines of evidence and a comparative group design, is sound and provides the basis for reaching conclusions for all issues and questions. However, several limitations with the evaluation methodology should be noted in interpreting the study findings.

***Survey Response Rates and Sample Sizes for Some Segments***

Given that the program only supports four networks, the population of researchers and partners is not large, coupled with response rates of 22 and 28% for partners and researchers, this led to a small number of respondents, particularly for BL-NCE partners (n=25); bivariate analyses are therefore limited for this group. With respect to HQP, the survey is based on a 'snowball' approach; researchers were asked to circulate the survey link to HQP. Thus, the representativeness of the HQP sample cannot be determined given potential biases both amongst researchers who elected to circulate the link and HQP who elected to complete the survey. Given that the number of HQP who completed the survey is a small proportion of HQP reportedly involved in the networks, these survey results have been treated with caution and, where available, have been supplemented by other lines of evidence (e.g., case studies).

***Quality of Performance Data***

There were some issues with the consistency in performance information produced by the networks for the NCE Secretariat. For example, the networks gather a wide range of participation data, including the involvement of researchers and partners. These lists formed the sampling frame for the survey. While listings of researchers and partners were vetted by the NSERC-SSHRC Evaluation Division, they were not validated by the networks themselves according to common criteria.

***Challenges in Aggregating Outcomes***

Examining the outcomes of the BL-NCE program presented challenges in aggregating the results of individual networks to determine the achievement of outcomes at the program level. The program is comprised of only four networks, which represent complicated structures, situated in various sectors, and are differentiated in terms of their research investment model, researcher and

receptor communities and degree of maturity. Complex program outcomes such as "facilitating a path to market" or "improved competitive position" are difficult to measure at the network level and then to attribute and aggregate outcomes across networks to the BL-NCE program. Immediate and intermediate outcomes are more amenable to this type of analysis, while the assessment of longer-term outcomes in this evaluation remains more anecdotal and illustrative.

# 2.0 Key Findings

## 2.1 Relevance

### 2.1.1 Continued Need

***KEY FINDING: All lines of evidence support the continued need for the BL-NCE program to fund research networks to continue to foster innovation which, in turn, drives competitiveness and quality of life. The network approach is widely perceived to have many advantages and is consistent with literature on the efficacy of research collaborations. Demand for the program is strong.***

***The R&D and Innovation Environment***

R&D and innovation are widely recognized as critical to productivity grown, competitiveness of business and citizens' quality of life. "[6]. However, Canada's R&D record is mixed. While investments in higher education R&D compare favourably to other countries and have increased since the early 2000s, commercial outcomes such as patents and licensing have not risen in tandem, suggesting that the productivity of technology transfer may be weak and declining.[7] Moreover, Canada's gross domestic expenditures on R&D have been declining, pushing its rank down from 16th position in 2006 to 17th in 2008 and to 23rd in 2011 (among 41 economies).This is attributed to weak business spending on R&D in Canada which is concentrated in a small number of sectors. As well, the 2009 Council of Canadian Academies report correlates Canada's low proportion of workers with advanced degrees to Canadian business's poor innovation performance[8]

The overarching aim of the federal NCE programs, including the BL-NCE program, is to mobilize Canada's best R&D talent through collaborative networks to build a more advanced

[6] Association of Universities and Colleges of Canada (2008). Momentum: The 2008 Report on University Research and Knowledge Mobilization. Retrieved August 28, 2013 from: http://www.aucc.ca/wp-content/uploads/2011/05/momentum_2008.pdf.

[7] Council of Canadian Academies. The State of Industrial R&D in Canada. The Expert Panel on the State of Industrial R&D in Canada, 2013. OECD (Organisation for Economic Co-Operation and Development). OECD Economic Surveys: Canada. Paris, France: OECD, 2012.

[8] Council of Canadian Academies (2009), Innovation & Business Strategy: Why Canada Falls Short, http://www.scienceadvice.ca/uploads/eng/assessments%20and%20publications%20and%20news%20releases/inno/(2009-06-11)%20innovation%20report.pdf

healthy, competitive and prosperous country. The BL-NCE program, in particular, with its business-led model seeks to engage industry directly and expand business R&D investments through leveraged funding to address a known deficit in Canada. The literature commonly cites relationships between the business and higher education sectors as fruitful grounds for effective research collaboration. This entails linking the source of new research, training and discoveries (i.e., the higher education sector) with organizations dedicated to exploiting the commercial potential of these discoveries (i.e., the business sector).[9] Nichols et al. (2013) note that strong collaborative relationships between and among institutional, community, non-profit and business actors "are seen as important drivers of social change." This is in part because these collaborations bring the diversity of experience and perspectives necessary to address complex and multi-dimensional problems. These partnerships are also seen to maximize resources, reduce inter-institutional fragmentation, reduce duplication and increase overall engagement.[10]

### *Advantages of the Network Approach*

The documentary and key informant evidence suggests that the research network approach that is a distinguishing feature of the BL-NCE program has many advantages. The 2011 *Review of Federal Support to Industrial Research and Development*, for example, calls for greater collaboration among businesses, governments and the higher education sector thereby enhancing knowledge exchange, R&D risk-sharing, human resources skill-sharing, commercialization and improving access to new markets.[11] The *Federal Review* recommendation reflects broader trends evident in the literature on R&D and innovation, which commonly cites linkages between the business and higher education sectors as a fruitful area of effective research collaboration.

Key informant and case study evidence indicates that the network approach provides a catalyst and financial means and incentive for research collaborations to occur; collaborations supported by the research networks such as the BL-NCE lead to advances, synergies and unique solutions to complex research problems of interest to industry and user communities that could not be achieved by individual researchers working in isolation. The program was noted by key informants to be particularly important for Canadian research communities or business areas that are small and geographically dispersed. Some key informants noted that the formal institutional basis of the networks that operate and develop at arm's length from government to decide where and how research investments are made is also important to ensure networks are informed and responsive to the unique aspects of their sector.

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[9] Association of Universities and Colleges of Canada (2008). Momentum: The 2008 Report on University Research and Knowledge Mobilization. Retrieved August 28, 2013 from: http://www.aucc.ca/wp-content/uploads/2011/05/momentum_2008.pdf.

[10] Nichols, N., Phipps, D.J., Provençal, J. & Hewitt, A. (2013). Knowledge Mobilization, Collaboration, and Social Innovation: Leveraging Investments in Higher Education. Canadian Journal of Nonprofit and Social Economy Research, 4(1), 25-42.

[11] Government of Canada (2011). Innovation Canada: A Call to Action: Review of Federal Support to Research and Development – Expert Panel Report. Retrieved August 27, 2013 from: http://rd-review.ca/eic/site/033.nsf/vwapj/R-D_InnovationCanada_Final-eng.pdf/$FILE/R-D_InnovationCanada_Final-eng.pdf.

### *Interest in the Program*

Data suggests that there is a high level of interest in the BL-NCE program within Canada's R&D community. Funding competition announcements have generated a significant and increasing number of Letters of Interest (LOI). The BL- NCE competition received 37 LOIs in its inaugural year (2008) and significantly more (54 LOI) in 2014.

### *Overlap/Duplication*

***KEY FINDING: The NCE network funding programs, including the BL-NCE, are distinguished in terms of the size and stability of the network grant, national scale and multidisciplinary and multisectoral approach. The research networks and projects funded by the networks are unlikely to have occurred in the absence of the BL-NCE program.***

In addition to the BL-NCE program, the research funding landscape in Canada includes various other programs that fund research networks including within the tri-agencies themselves (e.g., NCE, SNG); there are also other examples of network or sector-focused research programs both federally and at the provincial level. Previous evaluations of the BL-NCE (2012) and the NCE (2013) programs found that there was limited duplication across these research funding programs and key informants confirmed that the NCE Secretariat programs are distinguished from other programs by their size and duration of the grant, national scale, inclusion of all tri-agency research domains and focus on relevance to industry.

Potential duplication and overlap among the granting programs are also addressed through program terms and conditions. Indeed, the application for funding must discuss any overlap or reasonable potential for perceived overlap between the network and currently or previously funded initiative(s). The BL-NCE networks are further distinguished by their business-led governance and eligibility of private industry researchers for funding.

External key informants and staff were of the view that the BL-NCE networks would not have been established without NCE funding. Key informants argued that the geographic scale, research scope and progress of the work would not occur at the same level in the absence of the funding and administrative resources. At the level of network-funded projects, the vast majority of BL-NCE researchers indicated that if funding had not been available for their project, it would have had a major negative impact on their project; most often, researchers indicated that the project would not have proceeded at all.

### 2.1.2 Necessary Role for Federal Government

***KEY FINDING: Documentary and key informant evidence support the importance of the federal government's role in funding research and development to foster innovation and economic growth. The federal government's role in funding research networks is consistent with approaches used internationally.***

Canada's most recent and thorough examination of the federal role in research funding programs such as the BL-NCE is the *Review of Federal Support to Industrial Research and Development* (2011). This report, which calls for the establishment of a "clear federal voice for innovation", states that one of the key roles of the federal government in fostering innovation is providing appropriate support for business and commercially oriented research and development. A key recommendation of the report was for the federal government to include in its suite of supports funding for public sector or non-profit bodies conducting research of relevance to the private sector. These criteria are consistent with the characteristics of the BL-NCE program.

The federal government recently released an updated Science, Technology and Innovation Strategy, in December 2014, to guide federal investments and priorities: *Seizing Canada's Moment: Moving Forward in Science, Technology and Innovation 2014*.[12] The Strategy builds on the 2007 framework *Mobilizing Science and Technology to Canada's Advantage*[13], signaling a continued federal role and commitment to "keep science, technology and innovation at the forefront of government policy" in the coming years and to build on the Canadian legacy of innovation and scientific breakthroughs.

The updated Strategy continues to emphasize the importance of partnerships; among its tangible commitments is "support across the full spectrum of research endeavours in universities, colleges and polytechnics, including the enhancement of established networks and the fostering of new collaborations among post-secondary institutions, researchers and companies, as well as government scientists and engineers" to increase research. Within the Strategy, the federal government points to the BL-NCE program, specifically, as evidence of the federal government's commitment "To mobilize knowledge from the lab to the marketplace, to address business challenges and to seize new societal opportunities".

All external key informants agree that it is important that the federal government continue to play a role in research funding programs such as the BL-NCE and recommended continued, if not increased, investment in the program. Some respondents added that the BL-NCE networks leverage economic and social benefits that accrue to Canada as a whole.

[12] http://www.pm.gc.ca/eng/news/2014/12/04/canadas-science-technology-and-innovation-strategy

[13] Government of Canada (2007). *Mobilizing Science and Technology to Canada's Advantage: Summary*. Ottawa: Public Works and Government Services Canada

Expert key informants noted that Canada is not alone in the national research network approach, citing examples of similar national-in-scale multidisciplinary, multi-institution or multisectoral research network programs including the Australian Research Council's Centres of Excellence, New Zealand Centres of Research Excellence, European Union Knowledge and Innovation Communities and South African Centres of Excellence programme.

### 2.1.3 Alignment with Federal Priorities

***KEY FINDING: The objectives of the BL-NCE program are consistent and aligned with federal government priorities and strategic outcomes of the tri-agencies.***

The 2007 S&T Strategy aimed to foster three distinct Canadian S&T advantages: an Entrepreneurial Advantage, whereby knowledge is translated into commercial applications that deliver benefits to Canadians; a *Knowledge Advantage*, whereby Canadians are on the cutting edge of knowledge development and acquisition; and a *People Advantage*, which involves Canada's attractiveness as a destination of choice in the modern global economy[14]. The 2014 Strategy builds on the 2007 framework, retaining the *People* and *Knowledge* pillars from the earlier framework, and broadening the *Entrepreneurial* pillar to encompass *Innovation*.

Through investments in R&D, training of HQP and knowledge mobilization, the BL-NCE program meets the Knowledge, People and Entrepreneurial / Innovation Advantages outlined in the 2007 and 2014 strategies to varying degrees. Notably, the BL-NCE target areas align well with the research priorities identified in the 2014 Strategy: natural resources and energy, health and life sciences, information and communications technologies and the environment (all of which are carried over from the 2007 Strategy), although the newly added priority of advanced manufacturing is not yet identified as a BL-NCE priority.

Successive Speeches from the Throne have reiterated the federal priority on R&D and innovation that is the raison d'être of the BL-NCE program. Federal Budgets have underscored that priority: in 2010 the Budget acknowledged that improvements were still needed in the translation of research discoveries into new goods, services and technologies, and that this was an area to which added resources should be prioritized[15]. That Budget increased the annual budgets of the three granting councils of the tri-agencies by an additional $32 million per year. The 2013 Budget stressed the importance of strengthened industry-academic collaboration, and specifically cited the BL-NCE as an example of the government's efforts to support business innovation and technology adoption.[16]

[14] Government of Canada (2007). *Mobilizing Science and Technology to Canada's Advantage: Summary*. Ottawa: Public Works and Government Services Canada

[15] Government of Canada (2010). Budget 2010: Leading the Way on Jobs and Growth. Retrieved August 27, 2013 from: http://www.budget.gc.ca/2010/pdf/budget-planbudgetaire-eng.pdf.

[16] Government of Canada (2013). Jobs Growth and Long-term Prosperity: Economic Action Plan 2013. Retrieved August 27, 2013 from: http://www.budget.gc.ca/2013/doc/plan/budget2013-eng.pdf.

Each of the tri-agencies has a mandate that aligns with the NCE programs, including the BL-NCE. The NCE program addresses the innovation and knowledge translation mandates of each of the agencies and specifically falls under the following program areas of the tri-agencies: Innovation: Research Partnerships (Program 1.3) (NSERC); Connection: Mobilization of Social Sciences and Humanities Knowledge (Program 1.3) (SSHRC); and Health Research Commercialization (Program 1.3) (CIHR).

# 2.2 Effectiveness

## 2.2.1 Enhanced R&D and Innovation

***KEY FINDING: The four BL-NCE networks leveraged and expended $123M toward research and development through the engagement of industry and academic researchers. The networks put in place mechanisms to ensure research excellence and industry relevance, with PSAB playing a role in network selection and monitoring. Network-funded research is leading to the creation or extension of knowledge and technological advances.***

BL-NCE grant expenditures on research during the study period were $35.6M; with partner contributions of $87.6M, BL-NCE network investment in research and development totalled $123M. The number of researchers funded by BL-NCE networks was variable, ranging from 277 in the inaugural year to 51 in 2012 (sunsetting year for 2 of the 4 networks). BL-NCE researchers include a mix of academic and industry researchers: one-third of surveyed BL-NCE researchers were industry researchers (and, therefore, in some ways reflect a "partner perspective").

Excellence of BL-NCE network-funded research was assured through various mechanisms, including peer review, governance structure and project selection criteria. At the program level, the PSAB plays an important role in selecting BL-NCE networks and monitoring their progress toward meeting commercialization and/or business needs objectives.

Most BL-NCE researchers and partners indicated that their network project (researchers) or the network as a whole (partners) resulted in the creation of new knowledge (84% and 83%, respectively) and/or the extension/ application of existing knowledge (83% and 82% respectively). Three-quarters of BL-NCE researchers (73%) and partners (75%) indicated their network project/the network resulted in the extension/application of existing technology. About three in five researchers and partners also indicated their project/the network resulted in the creation of new technology, and/or the creation of new research methodologies.

## 2.2.2 Collaborations

***KEY FINDING: While there is less disciplinary diversity among the BL-NCE researchers (unlike NCE, multidisciplinary collaboration is not required), many researchers and most partners indicated multidisciplinary collaborations occurred. BL-NCE networks engaged partners from across sectors, with the majority coming from industry; the number of partners has grown steadily since program inception. There is evidence that many project collaborations were new. Collaborations are generally viewed as successful and seeding interest in further collaborations.***

One-half of BL-NCE network researchers (50%) come from academia and one-third come from the private sector (33%); this is markedly different from the make-up of NCE researchers who primarily come from academia (93%). Of the BL-NCE academic researchers, four in five identified natural sciences and engineering (78%) and one-quarter identified health sciences (25%) as best describing their research interest (multiple responses possible).

Although it is not a requirement that BL-NCE networks must be multidisciplinary, six in ten BL-NCE researchers indicated that multidisciplinary research collaborations resulted from their network-funded project (62%) as did most BL-NCE partners rating in terms of the network overall (81%). Both the number of university partners and industry partners grew steadily over time ranging from 82 to 163 partners involved in the four networks annually.

At the project level, research collaborations involved seven organizations, on average, drawn from academia and the private sector and the vast majority of collaborations involved at least some organizations that had never worked together previously. Numerous activities/methods were used to foster multisectoral collaboration (e.g., use of "industry champions" for funded research and use of funding-model incentives to encourage more diverse multisectoral collaborations).

AboraNano encouraged multi-party partnerships in its funded research through a sliding scale of program funding; the ratio of BL-NCE funding support increased for those research projects that attracted multiple network participants. Conversely, projects focused on activities leading to proprietary products with well-protected IP owned by a single partner received lower BL-NCE support.

Almost six in ten BL-NCE researchers (56%) indicated that their network-funded project had increased the visibility and reputation of researchers involved in the project. Overall, researchers indicated that their collaborations with partner organizations were successful.

### 2.2.3 Meeting the Needs of Partner Organizations

***KEY FINDING: The BL-NCE networks have put in place mechanisms to engage and identify the needs of partners and to overcome competitive positioning. BL-NCE networks are meeting the needs of some partner organizations and most industry researchers. Partners are particularly involved in the early stages of research projects and in the final mobilization stage. For some partners, perceived benefits have not yet been realized, which is attributable, in part, to the early stage of their network involvement.***

BL-NCE networks were structured and operated to ensure their research aligned with the needs of businesses by significantly involving industry representatives in the governance, management and strategic direction of the network and across all network activities and projects, including project approval. The Board of Directors of each BL-NCE network includes substantial industry representation (ranging from 53% to 57% industry members ).

A challenge to meeting the needs of industry is generating collaboration between businesses which naturally have competitive postures, particularly in certain industries. To achieve this, BL-NCE networks focused on pre-competitive research.

BL-NCE researchers were more likely to indicate that private sector research partners play a leadership role in all project phases than their NCE counterparts. In the early stages of the project, planning and development of research questions, private sector organizations that collaborated were almost as likely as the university to be identified as the lead. Significantly, in the final mobilization stage, BL-NCE private sector organizations are more likely to lead this phase than the university involved in the collaboration. A similar pattern was evident in the 2012 BL-NCE evaluation.

At CQDM, each funded project benefits from the involvement of up to seven mentors who are senior scientists from CQDM's pharmaceutical global organizations, who are the ultimate end users of tools and technologies in development. Mentors are well positioned to help researchers develop technologies that respond positively to the needs of industry, and provide industry-specific expertise, offer valuable resources for researchers and project sponsors within their respective organizations.

A majority of BL-NCE researchers (84%) and partners (71%) indicated that BL-NCE networks are addressing significant research challenges that meet business needs, while more than one-half of researchers (57%) and partners (56%) indicated the network is addressing significant research challenges that meet public or non-profit organizations' needs. One-half of BL-NCE partners (50%) say that the network has addressed their organization's needs to a good or great extent (35% don't know/too early to tell).

A large majority (87%) of BL-NCE researchers consider their project to be successful. Most BL-NCE industry researchers (81%) indicated the network has met their needs by, for example, providing funding (often for higher risk, longer-term projects), opportunities for networking and for sharing of information. For industry researchers who indicated the network was not meeting their needs, the following issues were mentioned: need for more support; a desire for more

oversight/monitoring of projects; better (more innovative) criteria for funding projects; and assistance with intellectual property (IP).

### 2.2.4 Impact on HQP

***Participation of HQP***

***KEY FINDING: Although it is not a key focus for all BL-NCE networks, training of HQP has been increasing. Anecdotal evidence points to BL-NCE's positive influence on the attraction and retention of HQP. Key distinguishing features of network HQP training include opportunities to conduct industry-relevant research, interact with private sector researchers and have access to cutting edge technology and research facilities. Students are generally pleased with the quality of the training. Reflecting the male-dominated fields that are the focus of the 2009 BL-NCE networks, women are underrepresented among surveyed HQP.***

Over the four-year history of BL-NCE, participation of HQP in network projects increased significantly: 64 HQP (typically Master's or PhD students) were engaged in 2009/10, 221 in 2010/11, 441 in 2011/12 and 880 in 2012/13.[17] Men were overrepresented among BL-NCE HQP. The majority of BL-NCE HQP was Canadian; approximately two in ten foreign students were engaged as BL-NCE HQP each year.

Within the BL-NCE program, most researchers (85%) and partners (85%) indicated that their project (researchers) or the network overall (partners) had resulted in the training of HQP. BL-NCE network researchers reported that the BL-NCE program, in comparison to other projects they have been involved in, offered superior training opportunities for HQP to conduct research relevant to the private sector (75% indicated BL-NCE HQP had more or much more opportunity in this area compared to other research projects), interact with private sector researchers (56%), have access to cutting edge technology and research facilities (55%), enhance job readiness for employment within partner organizations or elsewhere in the field (52%) and have exposure to industry/hospital/not-for-profit organization practices (51%).

Based on the case study evidence, BL-NCE networks supported HQP training and professional development through numerous and varied activities in addition to research (e.g., networking opportunities, attendance at network conferences, scholarships, and industry mentorship and internship programs).Overall, BL-NCE HQP were very positive about the quality of their research experience (25/29), the training provided (23/29), and the quality of cutting edge technology/research facilities they were able to access (23/29) with most rating these indicators to be excellent or very good**.**

[17] HQP are identified as undergraduate, master's and doctoral students, and postdoctoral fellows.

***Acquisition of Skills and Experience***

***KEY FINDING: BL-NCE HQP were likely to develop research skills leading to the application or extension of existing knowledge and technology, and to the development of new technology. Notable training opportunities were related to KTEE, multidisciplinary and multisectoral collaborations, and networking. Many BL-NCE HQP felt their participation led to opportunities to contribute to economic growth.***

Two-thirds or more BL-NCE HQP indicated that their training resulted opportunities to work with other student or post-doctoral fellow researchers in the research network (20/29 rated this factor 4 or 5 on a 5-point scale) and opportunities to participate in multidisciplinary research collaborations (19/29)[18]. Three in five reported having opportunities to work with other researchers in the research network (private sector partners, hospital, not-for-profit or government) and to work with other academic researchers in the research network. Almost one-half indicated they had the opportunity to participate in multisectoral research collaborations.

Most BL-NCE HQP indicated that their training gave them the opportunity to participate in projects leading to the extension/application of existing knowledge (25/29 rated this factor 4 or 5 on a 5-point scale), while a similar number (23/29) indicated they had the opportunity to participate in projects leading to the extension/application of existing technology and in projects leading to the creation of new technology (22/29 each). Two-thirds indicated they had the opportunity to participate in projects leading to the creation of new knowledge and slightly fewer indicated they had opportunities to contribute to economic growth for Canada.

Almost all BL-NCE HQP indicated that their participation in a BL- NCE network project allowed them to develop research skills, and most indicated gaining skills in interpretation of findings and development of research ideas/questions, undertaking knowledge translation/mobilization activities, developing research protocol and gaining skills in the coordination of resource resources (e.g., laboratory equipment, instruments).

## 2.2.5 Mobilization

***KEY FINDING: As BL-NCE networks become more established, network dissemination activities are increasing, primarily using refereed and non-refereed publications. Mobilization is also increasing over time, through patenting, copyrights, licensing and prototype/standards development. There is some evidence of commercialization of network developed technology.***

Many BL-NCE researchers and most partners agree that the BL-NCE network with which they are affiliated accelerated the exchange of research results among members of the network (69% and 78% respectively). Most BL-NCE researchers have shared the results of their project with network organizations, typically through traditional media such as reports, meetings,

[18] Note that multidisciplinary collaboration was not defined and, therefore, may have different meanings depending on the research domain, discipline and funding program.

presentations, and informal discussions and/or correspondence (mentioned by about three-quarters of researchers or more). BL-NCE partners mentioned similar channels for sharing information, although BL-NCE partners are more likely than BL-NCE researchers to be aware of sharing of results through formal correspondence and direct involvement of personnel from network organizations in the project. Almost all BL-NCE researchers and most BL-NCE partners indicated network research results are being mobilized.

Refereed publications are the most often mentioned means of knowledge translation for BL-NCE researchers (57% indicated this method is how the results of their research project has been mobilized) and partners (54%). BL-NCE researchers are most likely to also transfer their research results through network agreements regarding intellectual property (39%), execution of non-disclosure confidentiality agreement (31%) and non-refereed publications (27%). BL-NCE partners indicated that network research results are transferred through refereed publications more than any other method (54%), however, they are far more likely than BL-NCE researchers to indicate that execution of non-disclosure of confidentiality agreements, network agreements regarding intellectual property, the issuing of patents and licenses are employed by the network with which they are affiliated.

BL-NCE administrative data confirm that refereed publications are the most important means of disseminating research results, although non-refereed publications are almost as prevalent. In total, during the study period, 228 refereed and 173 non-refereed contributions were published. Not surprisingly, as BL-NCE networks become more established, the number of publications they are producing is increasing. Case studies confirm dissemination of research results occurs through production of refereed and non-refereed contributions, and also some specialized publications.

Because the study period covers the BL-NCE networks' inaugural four years, commercialization activities are in the early stages. During the period under review, BL-NCE networks recorded that 20 patents were filed (although only 1 had been issued) and 22 copyrights granted. Six licenses to industry were also granted, and 3 start-up companies can be traced to BL-NCE research and development. There is significant variability in the reported number of products, goods, services, policies, processes, technologies, standards or prototypes developed/approved which has increased from just 6 in 2009-10, to 1,342 in 2012-13.

Case studies indicate that the forms of mobilization varied extensively across the networks, reflecting their different foci. There is some evidence of commercialization of network developed technology; there has been steady growth in knowledge and technology exploitation and exchange (KTEE) and commercialization activities since BL-NCE program inception. However, despite successes in the area of knowledge mobilization, a key suggestion for improvement cited by researchers and partners during the survey and echoed by key informants,

is that the program continue to emphasize knowledge translation and exchange, including finding ways/incentives to share best practices among the networks.

### 2.2.6 Impacts on Partners

***KEY FINDING: The BL-NCE program is having a positive impact on the knowledge base of partner organizations, as well as R&D receptivity, capacity and investment. Impacts on network organizations' products and services and processes or practices are also occurring.***

BL-NCE partners indicated that the most common impact of the BL-NCE networks is on R&D of network organizations (61% of partners indicated their network resulted in this outcome) and on an increased knowledge base of network organizations (55%). BL-NCE researchers indicated increased knowledge base of network organizations was the most common impact (71%), followed by impact on R&D of network organizations (40%), most likely in terms of receptivity, capacity and investment. About one in three researchers and partners reported impacts of the research project or the network on products or services, and/or processes or practices. Of note, 39% of BL-NCE partners and 57% of researchers did not indicate any further impacts on partners beyond increasing the knowledge base of network organizations.

There were some examples of commercial impact resulting from network research, although the competitive nature of industry made it difficult to determine the extent to which and the mechanisms through which research results were being applied. Case studies show that beyond commercialization, through network research and discoveries, there were some examples where BL-NCE networks supported the creation/growth of companies and improved their competitive position.

Research in GARDN has led to a substitute for chromium plating; a novel design for a low emissions combustor; technologies to lower nitrogen oxides produced during combustion; and innovative spray evaluation hardware. GARDN members were also active in the development of two disruptive environmental technologies related to biofuel that could fundamentally change the industry.

CQDM-funded research has created the potential for the first non-invasive diagnostic test for early pulmonary hypertension, PulmoBind, will facilitate patient recruitment and early treatment of pulmonary hypertension with the potential for better drug efficacy.

In the case studies, partners from industry confirmed that the information they accessed through the networks allowed them to become one of the first in their field to apply a technology, which provided them a (temporary) competitive advantage. Some networks mobilized SMEs in research and development activities, contributing to strengthen their positioning along the value chain.

### 2.2.7 Long-term Benefits

***KEY FINDING: Given the short funding timeline of the recently created BL-NCE networks, evaluation evidence is limited on longer-term benefits, although there are some illustrations of benefits from two networks.***

Having been funded for a shorter duration than most NCEs included in the study, BL-NCE researchers and partners were less likely to indicate that longer-term, environmental, health or policy benefits had occurred (2%-35%). Interestingly, BL-NCE partners were more likely to indicate network impact on economic, social and cultural benefits (35%) than did their NCE counterparts (9%). About one in ten partners indicated that the network had led to the creation of a spin-off or start-up company (11%). Partners and researchers note that some of the long-term benefits of the networks lie in the training of HQP who have the ability to integrate well into the industry labour market.

The open-ended survey responses and case studies provide some anecdotal evidence that the work of each BL-NCE has or will contribute to long-term benefits to Canada. For example, R&D at GARDN is supporting the aerospace industry's compliance with European aircraft noise and emissions standards and results are leading to reduction in fuel consumption, emissions and noise pollution; current research on new products and flight path algorithms have the potential to reduce fuel burn anywhere between 15% and 30% per passenger. At CQDM, a Virus-Like Particles (VLP) Express platform is a new technology developed through CQDM research that has allowed Medicago to play an international leadership role in the field and expand its portfolio of vaccine products in development (with vaccines against rabies and Ebola). The company dramatically expanded its internal pipeline of viruses based on the technology, attracting new investors and creating new jobs in Quebec.

## 2.3 Efficiency and Economy

***KEY FINDING: The BL-NCE program is delivered efficiently, with a low and relatively stable administrative cost. Networks leverage contributions from partners to expand their scope and research productivity. The evidence on return on investment for partners is positive for the BL-NCE program.***

Efficiency and economy of the BL-NCE program was examined using analyses of administrative efficiency, leveraging of partner contributions and perceptions of program stakeholders about the efficiency and effectiveness of the delivery of the programs.

### 2.3.1 Administrative Efficiency

The ratio of operating expenses relative to the total amount of grants is a common method to evaluate the operational effectiveness of grant programs. This ratio represents the cost to deliver

one dollar of grant funds awarded. Funding agencies have also commonly calculated their operating expenses as a percentage of total program expenditures.

Exhibit 2.1 summarizes the estimated operating expenses under the BL-NCE program for fiscal years 2008-2009 to 2012-2013. The actual operating expenditures of the BL-NCE program are not available because some expenses are assessed at the level of the NCE Secretariat, which manages four programs. The proportion of the operating costs of the NCE Secretariat which is attributed to the BL-NCE program was estimated using the percentage of the total BL-NCE grant compared with the total grant NCE Secretariat. Program data indicate that the BL-NCE's administrative ratio for the funding period 2008-2009 to 2012-2013 is 5.5 cents per $1 of grants available.

## Exhibit 2.1: Estimated Operating Expenditures of the BL-NCE Program

| Expenditures (in $) | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | Total |
|---|---|---|---|---|---|---|
| Total Direct | $346 724 | $277 930 | $299 114 | $333 836 | $322 960 | $1 580 564 |
| *Direct Salary* | *$146 346* | *$179 049* | *$192 028* | *$193 697* | *$170 347* | *$881 467* |
| *Direct Non-Salary* | *$200 378* | *$98 881* | *$107 086* | *$140 139* | *$152 613* | *$699 097* |
| Indirect + Direct Non-Attributable | $190 889 | $199 722 | $215 139 | $213 413 | $261 277 | $1 080 440 |
| Total Admin Cost | $537 613 | $477 652 | $514 253 | $547 249 | $584 237 | $2 661 004 |
| Grant Funds Awarded | $9 743 875 | $10 134 750 | $11 134 750 | $11 032 500 | $6 116 468 | $48 162 343 |
| **Total Program Expenditures** | $10 281 488 | $10 612 402 | $11 649 003 | $11 579 749 | $6 700 705 | $50 823 347 |
| *Operating Ratio (¢:$1) Expenditures to Grant Funds awarded* | *5,52¢* | *4,71¢* | *4,62¢* | *4,96¢* | *9,55¢* | *5,53¢* |
| *Operating Expenditure as a percentage of Total Program Expenditure* | *5,23%* | *4,50%* | *4,41%* | *4,73%* | *8,72%* | *5,24%* |

The significant jump in operating ratio results for 2012-13 is explained by the granting to the BL-NCE networks of an additional year of operation to enable them to invest grant funds unspent at the end the fourth year since the allocation of funds in the first year of operation was made at the end of the fiscal year 2008-2009. As a result, a lower amount of grants was awarded in 2012-13. As well, an additional competition was held during this year to target small and medium businesses.

At up to 5.2% of total program expenditures, operating costs are also low and similar to those of other programs administered by the NCE Secretariat and NSERC. The following table shows the comparative administrative ratios for the BL-NCE, NCE and SNG. It should be noted that the NCE program overhead, which appears to be comparatively lower, is reflective of efficiencies gained due to the larger size of the overall program and of the size and frequency of grant awards.

**Exhibit 2.2: Comparative Data BL-NCE, NCE and SNG Programs**

| Program | Administrative expenditure (in $) | Grant Expenditures (in $) | Total Expenditures (in $) | Operating Ratio (¢:$1) | Operating Expenditure (in %) |
|---|---|---|---|---|---|
| BL-NCE | $2,661,004 | $48,162,343 | $50,823,347 | 5,5¢ | 5.2% |
| NCE | $12,373,996 | $371,939,990 | $384,313,986 | 3,3¢ | 3,2% |
| SNG | $8,423,633 | $165,378,989 | $173,802,622 | 5,1¢ | 4,8% |

### 2.3.2 Leveraging

Leveraging is defined as the value of the contributions made by partners in relation to funding provided by the BL-NCE grant. The Terms and Conditions for the BL-NCE program require that matching funds are obtained from partners. The BL-NCE program provides up to 75% of all operational expenses, and 50% of research expenses incurred by the network and the remaining funding must be contributed by other government sources or non-NCE sources.

For the purposes of this analysis, partner contributions during the period under study were compared to network direct and administrative expenditures during this time. BL-NCE total cash and in-kind partner contributions from 2008-09 to 2012-13 were $87.6M, as compared to a BL-NCE total network expenditures of $123M. BL-NCE networks have therefore leveraged partner contributions in a ratio of approximately $1:$2.5, exceeding program requirements.

In terms of the return on the investment for partners, almost 7 in 10 (68%) of BL-NCE partners indicate that participation in the network has been a worthwhile investment for their organization to a good or great extent (substantially more than their NCE counterparts (45%)); three-quarters (74%) of BL-NCE industry researchers concur.

### 2.3.3 Perceptions of Efficiency and Effectiveness

***KEY FINDING: Key informants perceived the program to be working well and many of the elements of the program were viewed as well-executed. Among researchers and partners with some familiarity with the program, however, only modest satisfaction was observed. At the network level, partners generally view the BL-NCE networks to be successful and a number of success factors can be identified, with strong and engaged management/leadership and governance of the network being a key factor.***

Based on results of the networks to date, 92% of BL-NCE partners consider the network to be successful to a great or good extent. The large majority of BL-NCE researchers (87%) consider their project to be successful to a good or great extent.

Among BL-NCE researchers and partners who indicated some familiarity with the BL-NCE program *per se* (as opposed to the network), only modest levels of satisfaction with the delivery of the *program* were observed (note the sample size for is very small for this question 19

researchers and 20 partners).[19] Researchers were generally more satisfied than BL-NCE partners with all aspects of program delivery: researchers and partners expressed greatest satisfaction with reporting requirements (13 of 19 and 10 of 20 respectively). Partners were least likely to express satisfaction with financial administration guidelines (5 of 20), whereas researchers were least satisfied with the accessibility of NCE Secretariat staff (6 of 19). Both researchers and partners were less likely to express satisfaction with guidelines for the management of intellectual property (10 of 19 and 6 of 20 respectively).

Researchers and partners identified the same top three factors as facilitating the performance of the network (albeit in a slightly different order): network project selection process (53% vs. 64% of researchers and partners respectively); network leadership (50% vs. 59%); and the four-year funding duration (56% of both researchers and partners). Both researchers and partners were least likely to rate the management of intellectual property as a facilitating factor (roughly one quarter each) and most likely to be rated an inhibiting factor (roughly one quarter each).

The findings from key informants and the case studies echo the survey responses, with strong and engaged management/leadership and governance of the network being a key factor of success. Other success factors mentioned in open-ended survey questions, include but are not limited to: rigorous and industry-relevant project selection processes; breadth and balance in the institutions and partners involved in the network; multi-disciplinary/-sectoral connections fostered through networking events; and establishing an industry/research champion or mentor for research projects. Similarly (and not surprisingly), poor management was identified by key informants as a factor that can *inhibit* the success of a network; this included a lack of business practice knowledge and /or lack of ability to successfully shift the traditionally independent practices of individual researchers and businesses to build a truly networked structure. Other inhibiting factors mentioned include: challenges navigating governance issues; complex and protracted negotiation of intellectual property or network membership agreements; downturn in the economy/health of the sector, which can stymie investment by potential partners and pose challenges in engaging SMEs as partners; and, a poor incentive structure within academic institutions that does not encourage multidisciplinary work.

In terms of suggestions for improvement, key informants encouraged the networks to continue to embed knowledge translation and exchange in research that is incremental (i.e., higher risk that companies would not undertake on their own). Key informants favoured increasing staffing (turnover and understaffing of Secretariat staff is perceived to be problematic) and funding for

[19] BL-NCE program satisfaction questions were administered only to those surveyed researchers who were involved in network governance or committees and to partners who indicated in a screening question that they were at least somewhat familiar with the program. Nevertheless, there was a high proportion of respondents (between 27 and 41% of researchers (which includes industry researchers who are less likely to be familiar with the program) and 27 and 57% of partners for each item) who did not provide a rating (i.e., responded don't know).

the program. Suggestions for improvement of surveyed researchers and partners focused on program funding, clarity of guidelines/selection processes and IP issues.

# 3.0 Conclusions and Recommendations

## 3.1 Relevance

As the broad R&D and innovation environment and program funding landscape has remained stable over the last five years, the evaluation confirms the continued need for the BL-NCE program. Demand for the program, as evidenced by increased numbers of applications for program funding, is strong and the network approach to research funding was found to have many advantages. There was no evidence of problematic duplication with other funding programs; the program is distinguished by geographic reach, scale/length of funding, and program design features including its unique business-led model. The research networks and projects funded by the networks are unlikely to have occurred in the absence of the BL-NCE program.

The federal government role in funding research and development to foster innovation and economic growth was found to be important considering Canada's small and geographically dispersed research and industrial communities, and consistent with approaches used internationally. The BL-NCE program, in particular, with its business-led model that seeks to engage industry directly and expand business R&D investments through leveraged funding, was found to be consistent with government priorities that highlight the ongoing federal commitment to R&D and innovation as key drivers of prosperity and responds to Canada's deficit in business R&D. The 2014 ST&I Strategy signals the continued federal role and priority for these investments, and underscores the BL-NCE program's specific role in supporting the government's ST&I core principles as well as its research priorities. The program also aligns well with the strategic outcomes of the tri-agencies.

## 3.2 Effectiveness

The evaluation evidence indicates that the BL-NCE program is achieving or making progress toward achieving intended outcomes in a manner that is reflective of its unique business model.

***Research, development and innovation***. The entities established by the BL-NCE have created networked approaches to research and development through the engagement of many researchers and partners from various sectors. BL-NCE network research expenditures have been enhanced by leveraged contributions from partners which have increased the overall investment in research projects. The networks have rigorous project selection criteria in place and monitoring mechanisms to ensure excellence of research quality, including peer review, governance structure and project selection criteria. The PSAB, unique to the BL-NCE and CECR programs

within the NCE program suite, plays a critical role in selecting BL-NCE networks and monitoring their progress toward meeting objectives. According to researchers and partners, projects funded by the BL-NCE networks are leading to the creation or extension of knowledge, the extension/application of technology, and were more likely than comparator networks to result in the creation of new technology and new research methodologies.

***Multidisciplinary, multisectoral and international collaborations***. BL-NCE researchers (largely industry researchers) are mostly drawn from NSERC disciplines. Many BL-NCE researchers and most network partners indicated multidisciplinary collaborations occurred. The evaluation indicates that BL-NCE networks engaged partners from across sectors, with the majority coming from industry; the number of partners has grown steadily since program inception. BL-NCE networks employed a wide variety of activities/methods to engage their partners.

There is evidence that many project collaborations were new. There is also some evidence of international collaboration. According to researchers, their collaborations are generally viewed as successful. Partners' involvement in the BL-NCE networks seeded interest in future collaborations.

***Meeting the needs of partner organizations***. The BL-NCE networks have put in place mechanisms to engage and identify the needs of partners through their governance, planning and networking activities. When they are involved in network research projects, partners are typically involved in the research definition phase and dissemination and mobilization; BL-NCE private sector partners are more likely than their NCE counterparts to lead in <u>all</u> project phases. BL-NCE networks are meeting the needs of some partner organizations who are involved in projects that are led by and mobilized by industry and there is an overall positive impression that BL-NCE networks are meeting business needs. However, when the BL-NCE networks did not meet the needs of industry researchers, the following issues were identified: need for more support; a desire for more oversight/monitoring of projects; better criteria for funding projects; and assistance with intellectual property. For some partners, perceived benefits have not yet been realized, which is attributable, in part, to the early stage of their network involvement. The business-led model of the BL-NCE networks appears to yield an alignment between network research and the needs of partner organizations (since industry researchers who are funded by the program, in fact, represent partner interests).

***Impacts on the attraction, training, retention and employment of HQP***. Although HQP training is not a key focus for BL-NCE networks, most researchers and partners indicated that their project or network had resulted in the training of HQP. Anecdotal evidence points to BL-NCE's positive influence on the attraction and retention of HQP. BL-NCE HQP are primarily graduate and post-doctoral students. Researchers and HQP agree that participation in the network provides benefits in terms of opportunities to conduct multidisciplinary, multisectoral research, knowledge translation and to network and interact with other researchers, including with the private sector.

Key distinguishing features of network HQP training include opportunities to conduct industry-relevant research, have access to cutting edge technology/research facilities and to interact with private sector researchers. Students are generally pleased with the quality of the training. A gender skew in the BL-NCE HQP is consistent with the male-dominated fields that are represented by the networks (e.g., aviation, forestry, oil and gas). Impacts of employment could not be rigorously assessed given the sampling approach and small sample size; however, there is a perceived positive impact on job readiness.

***Knowledge and/or technology mobilization by partner organizations*.** The BL-NCE networks demonstrate broad dissemination of network research through traditional media (publications, conferences) and researchers and partners agree that the networks accelerate the exchange of these results. Mobilization activities are also taking place through the execution of non-disclosure or confidentiality agreements and other commercialization activities, such as patent applications. Universities play an important role in knowledge mobilization for BL-NCE researchers, although BL-NCE researchers engage the private sector for mobilization to a greater extent than their NCE counterparts. BL-NCE partners are far more likely than BL-NCE researchers to indicate that execution of non-disclosure of confidentiality agreements, network agreements regarding intellectual property, the issuing of patents and the filing and issuing of patents and licenses are employed to mobilize information. There is some evidence of commercialization of network developed technology; there has been steady growth in KTEE and commercialization activities since BL-NCE program inception. While acknowledging successes in the area of knowledge mobilization for some networks, key informants encouraged the networks to continue to embed knowledge translation and exchange in research that is incremental (i.e., higher risk that companies would not undertake on their own). A key suggestion for improvement cited by researchers and partners during the survey and echoed by key informants, is that the program continue to emphasize knowledge translation and exchange, including finding ways/incentives to share best practices among the networks.

***Impacts on partner organizations and the user sector*.** Increasing the knowledge base of network organizations is the most common impact of network research; BL-NCE partners also cite impact on research and development (R&D) of network organizations as a common impact. Other impacts of network research indicated by a minority include an impact on products and /or services of network organizations, and, for BL-NCE partners in particular, impact on processes and /or practices of network organizations and impact on competitiveness of network organizations. In the case studies, partners confirmed that the information they accessed through the networks allowed them to become one of the first in their field to apply a technology, which provided them a (temporary) competitive advantage.

***Long-term economic, social, health and environmental benefits to Canada***. Given the short funding timeline of the recently created BL-NCE networks, evaluation evidence is limited on

longer-term benefits, although there is anecdotal evidence of longer-term benefits leading to innovations in aviation and drug development.

## 3.3 Efficiency and Economy

The administrative efficiency of the program is reasonable, suggesting that significant efficiency improvements are not required (although some concerns were expressed regarding the capacity of the NCE Secretariat to support the networks which was perceived to be due to turnover and understaffing during the period under study.

Leveraging from partners is significant (1:2.5), surpassing program requirements, and demonstrates that the network research is of interest to partners.

Key informants perceived the program to be working well and many of the elements of the program to be well-executed. Among researchers and partners with some familiarity with the program, however, only modest satisfaction is was observed. Researchers are generally more satisfied than BL-NCE partners with all aspects of program delivery, however, both researchers and partners were least satisfied with intellectual property guidelines.

BL-NCE partners generally view the BL-NCE networks to be successful, and the case studies and observations of key informants suggest that this is more likely to occur when there is strong and engaged leadership at network level and robust engagement of industry/partners. Inhibiting factors included challenges navigating governance issues and complex and protracted negotiation of intellectual property or network membership agreements.

## 3.4 Recommendations

1. **The BL-NCE program is relevant and is achieving its key intended immediate and intermediate outcomes, as well as demonstrating progress towards meeting its long term outcomes. It should therefore be considered for continued support at the federal level.** The BL-NCE program is addressing a continued need using a network approach that has been shown to have many advantages; the program also underscores and supports the federal government's private sector R&D goals. Demand for the program is strong.
2. **The sharing of best practices among networks is recommended in three areas: management of IP; knowledge and technology exploitation and exchange (KTEE); and governance principles in networks' research funding practices.** The sharing of best practices on negotiation of IP agreements is recommended as this is an area in which there is the least satisfaction. Best practices in the area of KTEE drawn from across the network funding programs**,** including tools and resources, should be developed and shared broadly among the BL-NCE networks to embed and maximize translation of network research to meet partner needs. Knowledge translation is an area of strength for many networks, with tools and resources being developed by several networks to

encourage mobilization of research results which could be shared and adopted by other networks. Finally, networks governance structure, leadership and strong management practices (e.g., business practice knowledge, ability to successfully build a truly networked structure and to navigate governance) were perceived as critical to network success. These three areas are particularly important and challenging given the level of industry involvement, and because issues in these areas can hamper smooth functioning of the network and trust among partners.

3. **Performance measurement, specifically record keeping of the participation of researchers and partners in the BL-NCE program should be undertaken with greater accuracy and based on a common understanding across networks.** Assessment of the networked approach is based, in part, on how and to what extent researchers and partners are engaged by the network. As such, these data templates should be populated with a higher degree of reliability and accuracy, while balancing networks' reporting burden. The conduct of the survey of researchers and partners was hampered by outdated lists of program participants and would have benefited from a validation phase with the networks. Improved post-project HQP employment data would be beneficial to demonstrate NCE's role in supporting the federal government's "People Pillar."[20]

[20] Government of Canada (2014). *Seizing Canada's Moment: Moving Forward in Science Technology and Innovations.* Ottawa: Industry Canada.