Innovation and Networks of Centres of Excellence

Any consideration of innovation and research in Canada must take into account the successful track record of the federally funded Networks of Centres of Excellence (NCEs), a program specifically designed to overcome innovation gaps.

This submission represents the collective voice of Canada's NCE networks (12 current, 32 former) awarded by the Networks of Centres of Excellence program—all of which were created to fast-track the mobilization of research into tangible impacts that benefit Canadian society and its economic development.

We understand that any major review is wise to gather international perspectives and learn from elsewhere. We applaud this effort.

We make this submission to your review process to highlight that other countries have, in fact, looked to Canada and its NCE program as a model—one specifically designed to overcome innovation gaps.

NCE networks embody six elements that are critical to successful innovation. They provide evidence-based solutions to important problems by bringing the best minds into teams that develop and support innovative ideas. They build multidisciplinary networks needed to move an idea into real-world application, by connecting academia, communities, industry and governments. They train Canada's future experts and leaders to connect across sectors. They transform Canada into a virtual, cutting-edge lab by networking access to state-of-the-art infrastructure and expertise. NCEs actively manage their investments to ensure project teams meet milestones and deliver socioeconomic benefits to Canadians.

Quick facts about NCE networks

- Networks have helped train more than 45,000 highly qualified personnel (HQP) and create 147 spin-off companies.
- Since 1989, the federal government has invested approximately $1.8 billion in NCE networks for research, commercialization and knowledge translation. Those investments have leveraged $1.2 billion in contributions from industry and other partners.
- In 2014-15, there were 2,054 partners involved in the networks, including 567 from industry.

We know it works

For more than a quarter century, NCEs have had a record of success with landmark discoveries and high-impact achievements that include:

- Inspiring countries around the world to follow the lead of the Canadian Stroke Strategy—which promotes and implements organized stroke care, resulting in countless lives saved and improved. (Canadian Stroke Network)
- Creating what is now Canada's largest internship program, Mitacs Accelerate, for graduate students and postdoctoral fellows of all disciplines—a program

that started as a way to connect industry with advanced mathematical sciences graduate students and postdoctoral fellows. It continues as an important legacy of the initial NCE. (MITACS)
- Changing the way bridges and dams are built around the world by merging civil engineering with electronics to create stronger structures and "smarter" structures that monitor their health in real time as they are subjected to the stresses of nature. (Intelligent Sensing for Innovative Structures)

Current NCEs are following in this tradition:
- A major breakthrough for treating early, aggressive forms of multiple sclerosis (MS) that uses stem cells and chemotherapy to eradicate MS in a small subset of patients, which is anticipated to become the new standard of care internationally. (Stem Cell Network)
- A comprehensive suite of studies examining the impacts of climate change on regional ecosystems, societies and human populations is being modelled by the international Arctic Council for its Adaptation Action for a Changing Arctic assessment. (ArcticNet)
- A Canadian-led study used deep genome sequencing to identify genetic underpinnings of autism that could enable diagnosis early enough to provide effective treatment. (NeuroDevNet)

These are but a few examples. There is much to be learned from the accomplishments of this innovative, multi-sectoral, multidisciplinary program. The groundbreaking NCE program is vital to Canada's innovation landscape moving forward—a strong feature to build upon. We strongly encourage those developing Canada's Innovation Agenda and undertaking the Science Review to consider the value of the NCE model to Canada.

Six critical components of innovation—and NCE networks

1. Real solutions to real-world problems

A successful innovation must meet two major criteria: it offers a novel solution that fulfills a real need; and it is a workable solution that people can and will adopt.

- NCEs are awarded for the impact of their research and importance their innovations will have on Canadians.
- NCEs bring together teams that work to understand the ecosystem of a problem—across sectors and disciplines—to accelerate solutions that are necessary, innovative and workable.

"As Canadians, what we want to do is solve problems. We know that it's better to work together as teams and we know that it's better to unite our efforts, because we only have so much money to spend. So, why not focus it on finding solutions to problems that we are all interested in?"

—Dr. John Bell
Scientific Director, BioCanRx

Examples of impact

- AllerGen's CHILD birth cohort study is one of a few studies in the world that can answer questions on the early life origins of allergic and chronic diseases. CHILD has already delivered seminal new knowledge on the role of the infant microbiome, environmental exposures, and prenatal diet on asthma, allergies and obesity.
- Aging rural Canadians have unique health challenges and issues, and, for older frail adults, rural services are underdeveloped resulting in increased feelings of distress and isolation. The Canadian Frailty Network improved healthcare for older adults in British Columbia who wanted to stay in their rural homes by connecting them with a volunteer service navigator. Its success is being rapidly expanded to Alberta and other regions of Canada.
- Canada's vast coastline and proportionally small population poses unique challenges to emergency responders. MEOPAR's re-locatable model project is developing techniques that will allow emergency responders to quickly generate detailed, accurate forecasts of marine conditions in emergency zones. Once testing is complete, the model will guide emergency response to contaminant spills and search-and-rescue operations anywhere along Canada's coastline.

2. More minds and perspectives are better

NCEs bring together expertise from a variety of perspectives, pooling efforts and resources to accomplish what no single group can do alone.

- NCEs knit together academic teams from research institutions across the country.
- Project teams involve the gamut of disciplines, from microbiologists and environmental engineers to ethicists and economists.
- Networks proactively create partnerships and establish productive working relationships between academia, civil society and industry.

"BioFuelNet Canada plays an important role in connecting the different stakeholders along the advanced biofuel value chain (Feedstock, Conversion, and Utilization), policy makers and the investment community."

—Alfred Lam
Associate, Chrysalix Energy

Examples of impact

- Arrhythmias are projected to be the leading cause of death in Canada by 2020. CANet in partnership with the arrhythmia research community, patients, and the world's leading innovative industry partners are creating the VIRTUES platform, which combines wearable biosensor technology and validated analytics that will result in the most efficient and effective personalized care plan for arrhythmia patients.
- MEOPAR is leading the national effort to integrate the tremendous volume of ocean observational data from universities and scientific NGOs across Canada into a centrally accessible space, in coordination with Fisheries and Oceans Canada. This project will overcome the crippling issue of data silos in

the ocean sciences by establishing a national ocean observing system that will allow Canadians to access oceans data from across the country—dramatically improving the efficacy of oceans research and the ability to quickly and accurately respond to government needs for evidence-based decision making.

- BioCanRx is funding a clinical trial using tumour-infiltrating lymphocyte therapy for ovarian cancer, a new technology in Canada. To facilitate introduction of this novel therapy into the healthcare system, BioCanRx ran a knowledge exchange workshop for HQP to highlight the clinical science, as well as the ethical, social and economic challenges and impacts of implementing novel cell therapies.

3. Wraparound support for innovative ideas

Sometimes a great idea finds itself alone: ready for development and growth, but with no clear path. Innovators can see where they want to go, but may not know how to get there.

To help them successfully implement their ideas, NCEs mentor and support innovators by:

- building bridges across the valley of death
- enabling an academic team possessing the best chance of getting to the other side
- paving the way with the support needed (financial and expert) to provide the best chance for success
- making connections with partners outside of academia whose roots run deep into the heart of the society and who are ready to adopt the innovation
- de-risking investment for industry and providing evidence-based solutions for governments and communities

> "De-risking technology is a critical component of GlycoNet's innovation strategy. We pride ourselves in linking scientists, industry leaders and receptors. By providing financial support and expertise, we add significant value for commercialization while protecting IP to facilitate technology transfer and attract industry partnerships."
>
> ***—Dr. Todd Lowary***
> *Scientific Director, GlycoNet*

Examples of impact

- AllerGen's Clinical Investigator Collaborative (CIC), a phase 2 clinical trials group, has created 40 jobs, conducted 26 clinical trials and attracted $22 million in new R&D investment to Canada since 2005.
- Robotics company CrossWing Inc. has promising technology and it's looking to make the leap to a marketable commercial product. AGE-WELL is helping to bridge the gap by giving the Markham, Ontario, company access to world-class research, practical testing opportunities and potential partners. The assistive robot being created will deliver vital services to seniors.
- BioCanRx supports a specialized academic biotherapeutic manufacturing facility by providing business management with a wealth of industry

expertise. This support is enabling the virus manufacturing facility to capitalize on commercial contracts with large pharmaceutical and small biotech companies that might otherwise have been missed.

- "BioFuelNet support came at a critical time in the technology development … allowed the launched company (2013) to leverage additional partners … The network also linked the company to critical expertise … Presentation of the technology at the BioFuelNet symposia also exposed the technology … The result: $9.2 million invested." —*David Bressler, Forge Hydrocarbons*

4. Our future experts and connectors

NCEs train highly qualified personnel (HQP) and trainees to become tomorrow's innovation leaders and form the foundation of networks that are wired to innovate.

- NCEs facilitate lab exchanges, multidisciplinary workshops, travel awards, internships with industry and collaborative pan-Canadian research teams.
- Developing real-world, working relationships results in employment for HQP across the spectrum of sectors involved in advancing research.
- Our HQP boost Canada's research capacity and become the connectors who facilitate the advancement of future innovations—the embedded accelerators.

"Findings of collaborative research projects have been incorporated … into our novel technology that converts wastes into biofuels. A commercial plant is the outcome of the effort. Numerous graduate students and postdocs, trained during the research projects, have joined the ranks of Enerkem. We are grateful to BioFuelNet for the continuing collaboration."

—David Lynch

General Manager, R&D, ENERKEM

Examples of impact

- "Instead of attending conferences or meetings where everyone has a similar background, through MEOPAR I have connected with researchers in social science, political science, natural science, applied science, government, academia, industry and consulting. It has given me a new perspective on where I fit in with the big picture of marine sciences." —*Dr. Nancy Soontiens, Postdoctoral Fellow, University of British Columbia*
- "As an AGE-WELL trainee, I believe the doors opened to me both in academia and industry, and the opportunity to work alongside the leaders of these fields, will come to define my career." —*Zain Hasan, recipient of the AGE-WELL and Mircom Graduate Student Award in Technology and Aging in support of his master's thesis project – a computer-vision system that analyzes walking patterns, path trajectory and wandering in older adults, and predicts the probability of a fall.*
- "Throughout discussions with my mentors, I discovered the value and importance of having an interdisciplinary team in today's research work, especially involving both academics, who focus on theory, and non-academics, who focus on putting research into practice." —*Dr. Eric Chan, CFN*

HQP Alumni and now Associate Director, Patient Reported Outcomes, Janssen Pharmaceuticals

- GlycoNet teamed up with the University of Alberta's Centre for Mathematics, Science, and Technology Education (CMASTE) to produce resources for use in Canadian high schools—a collaboration that has created more than 30 teaching modules now in use throughout Canada.

5. Maximized access to cutting-edge infrastructure

The federal government has invested heavily in the advanced infrastructure required to move innovative ideas forward. Through funding vehicles such as CFI and FedDev programs, these investments are also supported by jurisdictions across the country. NCEs optimize the use of such infrastructure.

- The collaborative, national mandate of NCEs enables access to this valuable infrastructure, no matter the distance separating a researcher and a leading-edge facility.
- Increasing access to cutting-edge infrastructure reduces duplication of investment and increases the efficiency of significant public investments.

"Before joining AllerGen, I published three papers on allergy in seven years. Since 2012, I have published 23 such papers with AllerGen colleagues in journals across several disciplines. I could not have achieved that level and breadth of collaborative productivity without the NCE structure. Joining the network was career-changing."

—Dr. Kelly McNagny
Associate Scientific Director, AllerGen

Examples of impact

- The National Coordinating Centre for AllerGen's CHILD Study supports 3,500 participating children and their families in study sites spanning four provinces. By 2017, CHILD will have collected 500,000 questionnaire responses and 600,000 biological samples that will be available to researchers for decades to come.
- ArcticNet has funded and integrated access across disciplines to Canada's only dedicated research icebreaker, CCGS *Amundsen,* providing over 2,100 days at sea since 2003. This has provided an extraordinary opportunity to monitor our changing Arctic, including community well-being through the Inuit Health Survey '*Qanuippitali?*'
- BioCanRx provides funding and support to five state-of-the-art core facilities (e.g., GMP virus manufacturing, GLP immune monitoring), which in turn makes the virtual lab of Canada and its investigators attractive to industry interested in quickly advancing cancer biotherapies into Canadian clinical trials.
- GlycoNet offers network investigators and industry access to the newly created, state-of-the-art Alberta-BC Glycan Screening Centre. GlycoScreen provides researchers with facilities and equipment to analyze glycans and to develop and optimize targets for drugs and diagnostics, making it a unique resource for regional, national and international glycomics researchers.

6. Managed and accountable

Solid oversight ensures that NCEs are accountable to Canadians and make valuable use of their investments for the greatest impact.

- NCEs have clear goals and objectives, and are accountable to the NCE program for making real progress in achieving these goals.
- NCEs put in place management structures that ensure the best projects go forward and teams are achieving the milestones laid out in their proposals.
- Projects are managed for success by each NCE's management team and its expert review committees.
- NCE board structures ensure that a network's management is kept on track to achieve the goals set out by each NCE.
- International peer review from world-leading organizations provides guidance to keep NCEs on the best path.

Conclusion

The NCE program is a strong demonstration of how the Government of Canada is supporting innovative scientific research in a way that overcomes barriers of geography, disciplines and sectors. The program has a track record of excellence and building a culture of innovation. It has served as a model for other countries. It is the premiere tool for funding integrated 'Big Science' in Canada and exemplifies how scientific funding can advance Canada's economic and social well-being.

We strongly encourage those developing Canada's Innovation Agenda and undertaking the Science Review to understand these benefits of the NCE model for the country, and to build upon its solid foundation.

Respectfully,

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Dr. Daniel Goldowitz, Scientific Director, NeuroDevNet
Philip Welford, Executive Director, Stem Cell Network

Appendix 1: A brief overview of the Networks of Centres of Excellence program

Canada's NCE program is itself an innovation

- When it was created in 1989, there was nothing like it. It was a bold experiment.
- It created coordinated networks of academics, researchers and clinicians working across this vast country, in partnership with government, industry and communities, to solve problems that matter to Canadians.
- The program has been modelled by countries around the world.

Built for innovation

NCEs are designed to accelerate great ideas and innovations from Canadian researchers into real-world solutions. They:

- build networks that bring together all the sectors of an ecosystem surrounding a potential solution,
- provide grants that are managed for success,
- ensure that investments are on track and on point,
- actively cultivate and train the next generation of experts,
- connect researchers with the partners who are important in developing workable solutions, whether that's industry, government or communities,
- actively promote the implementation of innovation by enabling those closest to the problems to work in teams—across sectors and across the country—to develop the best solutions.

Multidisciplinary at its core

The NCE program is a combined program of:

- Natural Sciences and Engineering Research Council
- Canadian Institutes of Health Research
- Social Sciences and Humanities Research Council

The NCE program:

- pools resources from all three federal agencies for greater impact
- provides the strength of a structure, while remaining open to the endless potential innovations being developed in Canada
- has been externally evaluated numerous times, always receiving validation of its success and impact (e.g., the 2007 report from the NCE's International Advisory Committee)

Appendix 2: Currently funded Networks of Centres of Excellence

AGE-WELL – Aging Gracefully across Environments using Technology to Support Wellness, Engagement and Long Life
Toronto Rehabilitation Institute – University Health Network, Toronto, Ontario

AllerGen – Allergy, Genes and Environment Network
McMaster University, Hamilton, Ontario

ArcticNet
Université Laval, Québec, Quebec

BioCanRx – Biotherapeutics for Cancer Treatment
Ottawa Hospital Research Institute, Ottawa, Ontario

BioFuelNet
McGill University, Montréal, Quebec

Canadian Frailty Network (CFN)
Queen's University, Kingston, Ontario

Canadian Water Network (CWN)
University of Waterloo, Waterloo, Ontario

CANet – Cardiac Arrhythmia Network of Canada
Western University, London, Ontario

GlycoNet – Canadian Glycomics Network
University of Alberta, Edmonton, Alberta

MEOPAR – Marine Environmental, Observation, Prediction and Response Network
Dalhousie University, Halifax, Nova Scotia

NeuroDevNet
University of British Columbia, Vancouver, British Columbia

Stem Cell Network (SCN)
University of Ottawa, Ottawa, Ontario