

2015 Pre-Budget Submission from the Canadian Institute for Advanced Research (CIFAR)

Executive Summary

The Government of Canada has recognized the important role that research plays in supporting a sustainable, innovative economy and competitive businesses. Recent enhancements to the research landscape, such as the Canada First Research Excellence Fund, are strengthening capacity in Canada's research institutions.

The Government of Canada also recognizes the critical imperative to adapt to structural changes taking place in the global economy and broaden Canada's access to key foreign markets. The Global Markets Action Plan entrenches economic diplomacy as a critical motivator of international activities.

The 2015 Budget presents an opportunity to support both world-class research and economic diplomacy, and thereby improve the long-term competitiveness of Canadian businesses, by embracing global networks of research collaboration with both established and emerging markets. Global research networks increase the effectiveness and impact of leading researchers, develop promising young research talent and build cross-border relationships that support further partnerships.

Based on its historical activities and accomplishments in these areas, the Canadian Institute for Advanced Research (CIFAR) is uniquely positioned to assist the Government of Canada in achieving these goals. CIFAR, a non-profit organization funded by public investment and private philanthropy, has built high calibre, cost effective, international research networks since its incorporation in 1982. There are currently CIFAR Fellows in over 100 institutions in 16 countries. CIFAR Fellows belong to one of our 11 programs, working together on topics ranging from quantum computing to children's brain development. CIFAR researchers are at the forefront of their fields, with 15 Nobel Prize winning Fellows and advisors.

CIFAR proposes that the 2015 Budget continue to invest in Canada's competitiveness through an increased commitment to global research networks that:

- Enable top Canadian researchers to create transformative knowledge by collaborating with the best in the world
- Tap into global pools of young research talent and develop and retain homegrown researchers
- Build research relationships that will form the basis of further partnerships with both established and emerging markets
- Engage stakeholders to take advantage of new discoveries

The Importance of Global Research Networks

The era of the lone scientist developing research breakthroughs is long past. Today, major discoveries increasingly arise from collaboration within large research teams, frequently based in multiple countries. In 1981, over 30% of significant scientific papers had a single author, but by 2012 this had dropped to just 11%. Today, scientific papers regularly include over 50 authors, and some papers have teams that number in the thousands.

As research becomes more collaborative and interdisciplinary, it also has become more global. The proportion of science and engineering papers with multinational authors almost tripled from 8% in 1988 to 23% in 2011. Being part of these international collaborations is critical: according to a 2011 study published in *Nature*, “institutions that do not form international collaborations risk progressive disenfranchisement and countries that do not nurture their talent will lose out entirely.”

As a smaller nation, Canada must be proactive in order to play a central role in the global networks of the future by taking deliberate actions to connect to both established and emerging countries. Emerging nations are rapidly growing their output and influence in global research: the number of papers in the top 1% of global importance published in the BRIC countries more than tripled from 2002 to 2011.

The Government of Canada has recognized the importance of international research collaboration in the service of economic development. The Global Markets Action Plan acknowledges the role that linkages to international research can play in promoting market access. The Government of Canada has recognized this new reality through the signing of international MOUs and formal agreements on cooperation in science, technology, and research. Making a commitment to developing global research networks would demonstrate leadership in achieving the goals set forth in these agreements and deliver benefits to Canada and its partners.

CIFAR's Role in Global Research Networks

Since its inception in 1982, CIFAR's unique mission has been to bring together extraordinary researchers from around the world to address questions of global importance. Thanks to \$5 million per year in funding from the Government of Canada, and contributions that leverage this investment three-fold from additional public and private sources, CIFAR brings together 350 fellows, scholars and advisors from more than 100 institutions in 16 countries.

These 350 members, across 11 interdisciplinary programs, are all global leaders in their field. In addition to CIFAR's 15 Nobel Prize winners, it currently has 22 members named to Thomson Reuters list of the world's most highly cited researchers. CIFAR's unique model builds on and complements the research capacity at Canada's leading institutions, including the University of Toronto and the University of British Columbia, with 20 and 19 most highly cited researchers, respectively.

CIFAR's Unique Model

Every CIFAR program holds one to three interaction meetings per year. These meetings provide a 'safe space' for research presentations, intense debate, and informal interaction. This environment is highly conducive to putting forward new and provocative ideas, sparking innovative collaborations and inspiring researchers to take a different view of their own work. Meeting with the same core

participants regularly over several years is instrumental to building a level of trust and respect where researchers feel free to openly share ideas and explore new approaches to important issues, without the risk experienced in other venues.

CIFAR's global networks create value for Canada in 4 ways: research impact, global relationships, building the next generation of researchers, and knowledge outreach.

Research Impact

CIFAR brings the best Canadian researchers together with the best in the world, exposing Canadian researchers to new ideas, and creating opportunities to work with colleagues they otherwise do not have access to. By bringing the best in the world together to tackle topics of importance, CIFAR's networks develop knowledge that leads to new industries and healthier citizens. Through its history, CIFAR has contributed significant research breakthroughs, including:

- The discovery of quantum oscillations in superconductors, advancing the development of high-temperature superconductors that can carry electrical current with unprecedented efficiency
- Identification of how and why health outcomes vary across a population based on social and economic status, leading to a greater understanding of non-medical health interventions
- The development of an entirely new approach to building artificial intelligence based on the structure of the brain, now used by Facebook and Google
- Identification of a critical set of genes involved in the development of autism, and an algorithm that can help predict whether mutations in these genes will lead to the disease

Global Relationships

Global relationships between the best researchers are at the core of CIFAR's mandate. CIFAR has worked to expand its global reach through new partnerships with both established and emerging markets. It also plays a formal role in international research: Of Canada's 6 currently signed bilateral science and technology agreements, CIFAR is involved in international meetings for 3 of the agreements, and was recently designated the responsible organization for the Information Technology sector in the *Agreement for Scientific and Technological Cooperation Between the Government of Canada and the Government of the People's Republic of China*. CIFAR has also received considerable interest from the European Commission, France, Germany, and Japan.

CIFAR looks to accelerate these efforts by prioritizing the recruitment of new researchers from outside North America, and building relationships with strategically important nations through research collaborations. Expanding CIFAR's global reach will lead to enhancement of Canada's reputation as an innovation nation and establish foundations for additional research partnerships.

Building the Next Generation

CIFAR recognizes that it isn't sufficient to engage the world's best today, there must also be a plan for the future. CIFAR is committed to developing young Canadian and global research talent, and improving Canada's ability to attract and retain this talent. In 2013-14, CIFAR Fellows supervised 403 postdoctoral fellows and 987 graduate students. In the same year, 169 students and postdoctoral fellows attended CIFAR program meetings, allowing them to interact with some of the world's top researchers.

In addition, CIFAR's newly redeveloped Canada CIFAR Global Scholars program will identify up to 45 of the world's very best early career researchers to participate in CIFAR programs for 2-year terms. This new program represents an unparalleled opportunity to develop global research talent by interacting on an ongoing basis with some of Canada's and the world's very best. To ensure that CIFAR is developing truly global connections for the next generation of researchers, the program will target 15 researchers each from Canada, established countries, and the developing world. Besides participating in CIFAR program meetings, these global stars will be brought to Canada for an annual Canada CIFAR Leadership Conference for Global Scholars.

The new Canada CIFAR Global Scholars program provides a unique approach to positioning Canada as an innovation nation, developing the pipeline of Canadian research talent, engaging some of the most promising researchers in the world with Canadian institutions and researchers, and attracting and retaining outstanding research talent to Canadian institutions.

Knowledge Outreach

To maximize the social and economic return on research investments, it is critical that discoveries are put into action in the private and public sector. CIFAR recognizes this and has recently expanded its knowledge outreach efforts to ensure that stakeholders are positioned to act on the discoveries and new insights arising from CIFAR's programs.

CIFAR's knowledge outreach activities have included targeted publications, academic symposia, public lectures, and carefully designed interactions between researchers and decision-makers, including officials at Industry Canada and the Department of Foreign Affairs, Trade, and Development. New knowledge outreach activities at CIFAR include plans for health practitioner engagement, private sector partnerships, policy discussions, and community-based solutions development.

Future Global Research Networks

In Economic Action Plan 2012, the Government of Canada recognized the importance of global research networks and CIFAR's unique role in establishing and maintaining these networks. Since then, CIFAR hasn't rested on its laurels. CIFAR recently completed its first ever Global Call for Ideas. To identify the most promising areas of high potential emerging research, CIFAR received over 260 proposals from research teams in every continent. After multiple reviews of scientific merit and strategic value, 4 were selected to move into an exploratory start-up phase as membership and funding are put in place:

Biology, Energy, Technology: Developing next-generation solar energy harvesting technologies for sustainable energy solutions by taking inspiration from photosynthesis. The program is led by Ted Sargent (University of Toronto).

Microbes and Humans: Charting microbial populations within the human population and their role in human development, behaviour and evolution. The program is co-led by Brett Finlay (University of British Columbia) and Janet Rossant (Hospital for Sick Children).

Brain, Mind and Consciousness: Understanding the underlying basis of consciousness, guided by the biological, psychological, psychiatric and philosophical perspectives of an interdisciplinary team of

neuroscientists, philosophers, ethicists and clinicians. The program is co-led by Adrian Owen (Western University) and Melvyn Goodale (Western University).

Molecular Building Blocks of Living Systems: Understanding the structure and functions of the molecules that are the basis of life through newly developed ultra-high speed imaging tools. The program is led by Dwayne Miller (University of Toronto and the Max Planck Institute, Germany).

Partnered Global Call

While CIFAR's first Global Call was open to all topics and fields, its next Global Call will focus on areas of strategic importance to CIFAR's partners, including the Government of Canada. These targeted Global Calls will build global interdisciplinary teams to address critical questions of importance to the world. These areas will be determined in conjunction with CIFAR's partners; possible examples include the arctic, energy sustainability, and the wellbeing of the world's children.

Keeping Canada at the Cutting Edge

By strategically enhancing its role in global research networks, Canada can maintain and advance its position as a competitive, innovative nation. These global networks allow Canada to build on and enhance its significant domestic investments in research, develop the next generation of global talent, address questions that are of importance to Canadians and people everywhere, contribute to our nation's innovation agenda and further our recent commitments to open up new economic opportunities through economic diplomacy.