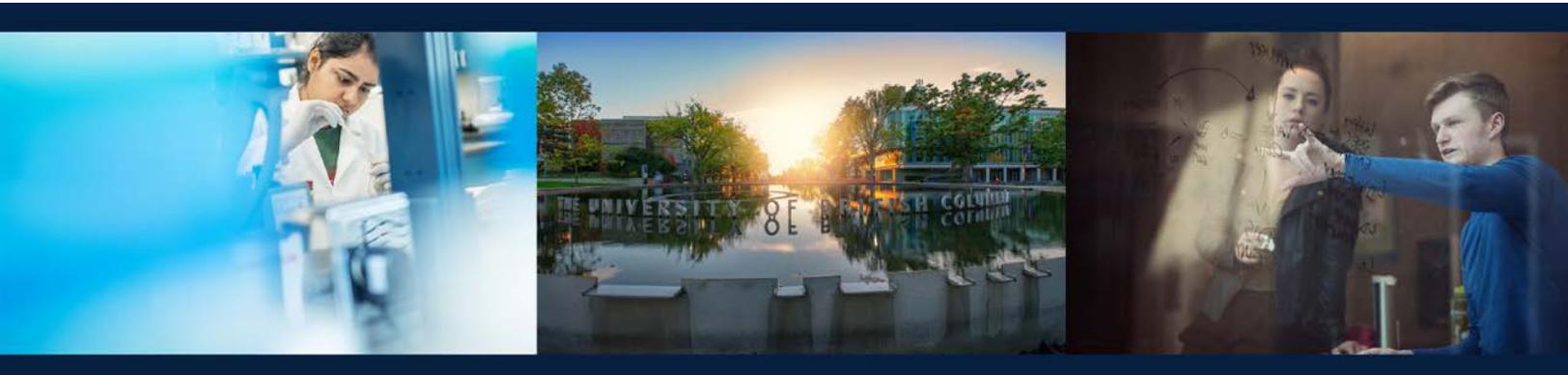




THE UNIVERSITY OF BRITISH COLUMBIA

Submission to the Fundamental Science Review Panel



September 30, 2016

The University of British Columbia

Introduction

The University of British Columbia (UBC) has emerged as one of the world's leading research institutions thanks to the federal government's support for the research Granting Councils, the Canada Foundation for Innovation, important initiatives like the Canada First Research Excellence Fund, and, most recently, the Post-Secondary Institutions Strategic Investment Fund. UBC is now ranked 6th among public universities in North America and carries out almost \$600 million in sponsored research per year. Spread over two large campuses in Vancouver and Kelowna and sites throughout British Columbia, UBC has a diverse and internationally-connected student population of 60,000, and our graduates join a 300,000-strong community of alumni located in 120 countries.

UBC applauds the Government of Canada for initiating the review of federal support for fundamental science—it is timely and builds on successive reviews, including the Expert Review Panel on Research and Development. UBC is grateful for the opportunity to provide the following brief to the Fundamental Science Review Panel.

UBC's submission is informed by a university-wide consultation undertaken in August and September 2016. The university hosted a series of open consultation sessions to gather input and advice from the broad range of individuals actively working in the research and innovation ecosystem at UBC, including researchers, students, technicians, and administrators. These sessions were held on UBC's two campuses in Vancouver and Kelowna as well as at one of UBC's research hospital sites.

The UBC community engaged actively in this consultation process and we present themes and recommendations which emerged on opportunities to improve the nature and impact of fundamental science in Canada. Further insights from UBC's academic leadership builds on the information gathered from the university's research community.

We thank the Panel for its consideration of UBC's input, and hope to work with the panel members and government on final recommendations and their implementation over the coming months and beyond.

Context and Key Recommendations

The global academic research landscape has undergone significant shifts over the last two decades, including a dramatic rise in the volume of research produced as the result of international collaboration and a resurgence of well-funded national-scale research strategies in both advanced and emerging economies.

Research is more internationally collaborative than ever before, while states are concentrating resources to bolster their national research systems. The combined effect is that there is a higher barrier to entry for participation in globally and economically significant research; the quality of research is ever higher and the resource commitments more intense. This has implications for the federal government as it reviews its supports for science and research and builds an innovation agenda. If Canada is to “keep pace with the dynamic nature of contemporary science,” as Minister Kirsty Duncan articulated in launching the review, and to ensure the Canadian scientific enterprise remains globally competitive, the national research system must enable its researchers with sufficient funding levels and the flexibility to collaborate across borders.

Increased global competitiveness is coupled with fundamental shifts in the importance, scale, and speed of data use across nearly all fields of inquiry. The quality of platform technologies, such as digital research infrastructure, high-speed networks and high performance computing, and national population and environmental (including health and genomics) data systems, have never been more important to researchers’ abilities to conduct high quality research. Canada must build and maintain top-quality infrastructure and efficiently and effectively support computationally and data intensive research.

The research community is on the cusp of major revolutions in medicine and biotechnology, energy, materials, and computational power. Alongside the promise of advancement, the world is confronted by evermore-complex changes in social order and concerns of global scale ecological transformations. Canadian researchers are actively involved in these discoveries and innovations and in tackling these global challenges. However, there are a number of indications that Canada’s prominence in research and innovation leadership is stagnating or slipping.¹

Budget 2016 contained a number of significant new measures to bolster science and research, most notably the Post-Secondary Institutions Strategic Investment Fund, and an important increase to the Granting Councils to address persistent sub-inflationary funding growth. However, research funding in the post-secondary sector remains at near stagnant levels, even as time application pressure has more than doubled over the past decade and many international competitors have made sizable new investments in university research. Coupled with lackluster private sector investments in R&D, Canada now faces a generational challenge in how to foster socio-economic wellbeing driven by research and innovation.

While this brief makes a number of specific recommendations, the following five key recommendations represent the most important and prominent changes that can be made to federal supports for fundamental science:

¹ Canada’s place in the OECD on multiple measures of research intensity has been dropping over the past decade or more. Canada registers declines in measures of higher education research spending (HERD to GDP ratio), business spending on research and development (BERD to GDP), and overall research intensity in the economy (GERD to GDP).

1. *Commit to globally competitive levels of research funding*

Canada must significantly increase the overall level of funding for investigator-initiated research. Growth can be directed almost exclusively toward the core fundamental research streams in the three research Granting Councils, with new or improved allowances for interdisciplinary and internationally collaborative projects. This needs to be determined by a peer review system that is robust, transparent, and supported by Canada's community of scientists.

2. *Ensure greater coordination between the key research funding streams*

Canada's research funding agencies must ensure better alignment between elements of funding - project, personnel, infrastructure and operating, and indirect costs support - by requiring active coordination between funding bodies. They must also address gaps between agencies that pose barriers to interdisciplinary areas of research such as in health and social sciences, and Indigenous research initiatives.

3. *Enable international collaboration*

Canada must enable its researchers to collaborate internationally by implementing supportive policies governing the use of research funding, and systematically identifying opportunities for Canada's participation in major global science initiatives.

4. *Develop a comprehensive plan for digital research infrastructure (DRI)*

Canada needs a comprehensive plan and governance framework for digital research infrastructure (DRI) uniting computational power, research data management, and expertise for harnessing computing and data capabilities. Further investment in DRI is required to keep Canada abreast of the wide range of domains in which DRI is required.

5. *Commit to ongoing international best practices and accountability*

On a five or seven year cycle, the Government of Canada should review the effectiveness and efficiency of Canada's research system by convening an independent, international panel of experts to examine specific areas of the Canadian research and innovation ecosystem and to provide recommendations to ensure global competitiveness and a commitment to excellence.

Structure and Governance of Canada's Research System

Canada's public research systems are among the strongest in the world. UBC recognizes the crucial contributions made by government in this area. A well-run and well-funded research system has enabled UBC to transform from a strong regional university into a globally recognized centre of research excellence. Canada's peer reviewed system for allocating research funding, in addition to strategic investments from federal and provincial governments, has seen several Canadian universities reach global preeminence.

While there is much to celebrate, the time is right to consider structural and governance changes to the Canadian research and innovation funding system. We recommend considering the following guiding principles for research funding decisions and structural or governance changes:

1. Broaden the application of peer review mechanisms for research funding

As a general principle, funding decisions must be guided by peer review along with a commitment to transparency, excellence, and professional rigour. Canada would be best served by basing funding decisions that support the research and innovation enterprise on scientific merit across its suite of research funding streams and bodies. This principle, we argue, should also be used by regional economic development agencies.

2. Simplify and foster greater coordination within the granting environment

Government should work to simplify the federally supported research system and refocus on discovery and applied research excellence.

A proliferation of separate, niche funding bodies and programs has duplicated efforts, created inefficiencies, and produced unnecessarily complex and opaque adjudication systems and funding policies. We encourage the review panel to particularly examine programs that do not fall under tri-council and Canada Foundation for Innovation (CFI) mandates (such as Compute Canada, Brain Canada, and Genome Canada).

Government must ensure better alignment between different forms of funding required to successfully conduct research: direct project expenses, personnel costs, infrastructure and operating costs, and indirect costs support. Mechanisms need to be created across federal funding agencies to ensure coordination. While some effective coordination currently exists (e.g. CFI funding for Canada Research Chairs and coordination with some Granting Council funding streams), an overall lack of coordination between the elements of funding is leading to situations where there are projects funded without the required equipment, equipment idled without project or operating funding, and the unpredictable drying up of funding for established lab teams.

As we note in further recommendations below, there is particular need to appropriately fund personnel needs, ranging from graduate student researchers, to post-doctoral fellows, to career laboratory technicians. Predictable funding for technicians is particularly important to attract and retain the qualified staff needed for globally competitive research programs.

Federal programs must also better account for the lifecycle costs of research infrastructure including operating, maintenance, and even decommissioning.

3. *Address unconscious bias towards women and other underrepresented groups in research funding decisions*

There is growing evidence that unconscious bias towards women and other underrepresented groups skews the outcomes of research funding competitions. Unconscious bias involves social stereotypes that individuals develop without intention. It is important for funding agencies to structure competitions in a way that avoids situations that cause and perpetuate inequities. It is also key that funding agencies shares results to allow for determination whether and where inequities exist. The agencies have a responsibility to raise awareness of the impact of unconscious bias during the review process, including training of committee members, chairs, and decision makers, as well as in training curricula for peer reviewers. These recommendations will ensure that funding decisions are based purely on merit and excellence.

4. *Convene an international, independent oversight panel to periodically assess Canada's research system*

Inspired by the work of the current review panel and commitment to the principle of peer review, government should implement a periodic review of Canada's research system. The review should be conducted by an independent, arm's length panel that would report to the Minister of Innovation, Science and Economic Development and to the Minister of Science. We recommend a first review after three years to assess and monitor the impact of changes stemming from newly implemented policies, identify further gaps, provide suggestions on harmonization, and assess global competitiveness. Subsequent reviews could take place every five or seven years.

Funding Levels and Grant Size

Current funding levels for academic research are resulting in success rates in many key research streams that are so unsustainably low that Canada risks a loss of talent (for instance CIHR Foundation Grant rates fell to 11 per cent recently, and success rates have fallen precipitously since 2009). Individual grant sizes also do not reflect the real costs of contemporary discovery and applied research and are often substantially lower than requested in proposals, diminishing the quality and impact of the science. This problem is acute across all funding domains but especially so for the NSERC Discovery Grant program as well as for SSHRC Insight Grants. Funding for personnel costs—generally the single largest category of costs for principal investigators—often suffers the most from inadequate grant sizes. This not only affects research quality, but it also reduces the opportunities available to young researchers who may otherwise become leaders in academic and industrial research and innovation.

Canadian funding mechanisms do not currently cover the full costs of research. These costs include the critical but unfunded work of commercialization and industry liaison efforts, as well as utilities, ethics review, health and safety measures, digital infrastructure, data management, animal care, and others. These are unavoidable but critical activities that support and advance funded research projects and are the only source of funding for commercialization activities.

In its federal pre-budget submissions, UBC advocated for the Research Support Fund to cover indirect costs at no less than 25 per cent of direct costs as a meaningful step to address these funding shortfalls. Even this level, however, falls well below funding the full cost of research, which at most leading universities are approximately 50 per cent of direct costs. As a result, universities are forced to cover these costs from already constrained revenues not intended for this purpose, such as from student tuition fees (which are generally capped). UBC encourages the panel to examine other leading research systems' levels of funding for indirect costs, such as in the United States, United Kingdom, Australia, Japan, and the European Union.

Recommendations:

- Increase grant sizes to reflect the costs of hiring the necessary personnel to carry out high quality research.
- Repurpose funding from 'superstar' research programs like Canada Excellence Research Chairs to support a greater number of investigators with more appropriate grant sizes, and/or support larger team-based research projects, as recommended below.
- Develop new mechanisms to renew and continue funding for successful long-term research programs (suites of project and capital/operating).
- Provide substantially higher levels of funding, through the Research Support Fund, to cover the indirect costs of research at internationally competitive levels.

Support for Interdisciplinary and Team-based Research

While each Granting Council is well attuned to research that fits squarely in its domain, few opportunities exist for interdisciplinary research projects that straddle tri-council mandates, and there is often confusion about the appropriate funding agency for research that crosses disciplinary boundaries, such as in bio-medical engineering, social sciences and health, or research focused on Indigenous communities.

Leading research is increasingly conducted by collaborative teams within and across departments and institutions. However, there are few effective mechanisms for funding team-based research in Canada's research system. Existing opportunities are generally limited to prescribed request for proposals (RFPs) (e.g. for NSERC Strategic Network Grants and CIHR Team Grants) and few are awarded. Wider availability of funding for investigator-initiated team-based projects would support innovative and productive research programs.

There are many areas of Granting Council-funded research that are of vital interest to, and require partnership with, various federal departments. Oceanographic and fisheries research is a prime example, where researchers require access to federal infrastructure and resources, such as ship time (largely in coordination with the Department of Fisheries and Oceans and the Canadian Coast Guard). Researchers in these areas must navigate a complex and often poorly coordinated funding and bureaucratic landscape in order to conduct these important research projects.

Recommendations:

- Create clear cross-domain/interdisciplinary funding mechanisms spanning the Granting Councils. This would further entail a degree of harmonization between the major types of grant programs (e.g. Discovery Grants and their equivalents) and of intake and funding cycles.
- Establish new mechanisms or allowances in existing funding streams for investigator-initiated (rather than RFP-driven) 'team based' research projects.
- Identify the means to allow investigators to apply for infrastructure required to support cross-domain/interdisciplinary funding.
- Create and appropriately resource mechanisms to better facilitate researcher access to federal resources, such as ship time for oceanographic research.

Knowledge Mobilization and Research Commercialization

Funding cutting-edge research is the most promising means of producing revolutionary, innovative and marketable research outputs. While programs that support direct partnerships with industry certainly have value in helping firms make incremental advances, a clear message from UBC's consultations was that such programs are not producing high quality research or significant new technologies. Part of the reason for this is that current program parameters restrict projects to partnerships only with Canadian firms, limiting projects to a relatively small number of companies that have the need and capacity to partner with post-secondary researchers. Supporting international industry partnership brings the benefits of increasing the likelihood of funding high-quality research projects, and helps develop and promote Canadian expertise in areas relevant to growing economic sectors globally.

To effectively mobilize knowledge and commercialize research, Canada must do more to adequately support researchers in their efforts to form and develop companies around their research discoveries. Currently, supports for research commercialization and venture formation are left to universities to cover via already inadequate indirect costs of research funding or by attracting in an ad hoc fashion funding from regional development agencies or other orders of government. Some of the most promising innovations and technologies are being generated directly in university research laboratories, but there is little funding available for the risky early stages of ideation, proof of principle, and business planning.

Recommendations:

- Increase funding to Granting Council programs, focusing almost exclusively on investigator-driven discovery and applied research.
- Fund applied research by re-instating a program based on the Proof of Principal grants scheme that was initiated, but then dropped, by CIHR. The revised program should extend to all tri-councils and provide long-term (at least three years) funding.
- Amend industry partnership program funding restrictions to allow for partnership with international firms.
- Create or bolster mechanisms that support researcher-generated companies and researchers pursuing potentially licensable discoveries.
- Increase Research Support Fund levels to significantly improve universities' abilities to carry out research commercialization functions.

CIHR Reforms

UBC, as a member of the U15 Group of Research Universities, was a signatory to a January 2016 letter to CIHR articulating concerns over recent reforms to its funding streams and adjudication processes.

Rather than include detailed input on CIHR programs in this submission, UBC and members of its research community will continue to provide input through the processes initiated in spring and summer 2016 and the work of the recently announced CIHR International Peer Review Expert Panel. We encourage the science review panel to work closely with the CIHR panel as well as researchers and administrators across the country engaged in that work.

Modernizing and Supporting the Canada Foundation for Innovation:

Research Infrastructure, Digital Infrastructure, and Big Science

Universities across Canada have benefited enormously from state-of-the-art research infrastructure funded by CFI. CFI-funded facilities and equipment enable cutting edge Canadian research to take place. Without CFI, Granting Council-funded research programs would not be feasible. Yet, CFI lacks consistent government funding, hampering long-term planning of major research projects and institutional infrastructure. To adequately support Canadian research endeavours, CFI must be provided with stable, predictable, multi-year funding.

CFI is well positioned to help solve the disarray in Canada's approach to digital research infrastructure (DRI). Canada needs a comprehensive plan for DRI that unites computational power, research data

management and expertise for harnessing computing and data capabilities under one entity. Further investment in DRI is required to keep Canada abreast of the wide range of digital research domains. As Canada's primary adjudicator and supplier of research infrastructure funding and as the entity responsible for systems of infrastructure investment, CFI is the most suitable entity under which the current array of disorganized DRI entities could be united.

Likewise, with significant experience in administering project-funding decisions, CFI is best positioned to be the lead agency to recommend and administer Canada's participation in big science initiatives. Canada must be adequately represented in international discussions regarding major scientific projects for which we have significant expertise and other resources to offer; it is important for our global brand, our economic competitiveness, diplomatic relationships, and the advancement of scientific knowledge. As its first order of business, CFI should chart a course for Canadian involvement in future big science endeavours that considers national interests, peer review mechanisms, how Canada can contribute globally, how we can leverage big science programs to bolster specific areas, and how to treat emerging capabilities in the context of major global projects.

Recommendations:

- Establish ongoing, predictable funding for CFI to support necessary research facilities and equipment at levels that are in step with Granting Council and other research funding bodies' programs
- Provide CFI with the mandate and resources to develop and implement a comprehensive plan for Canada's digital research infrastructure and unite the current fractious array of DRI entities under CFI.
- Provide CFI with the mandate and resources to vet via peer review, to recommend to government, and to administer big science initiatives in Canada and Canada's participation in major international scientific endeavours.

Enabling International Collaboration

High-quality research is not an isolated endeavour. Our ability to address the most pressing challenges requires researchers to work together across disciplines and borders and beyond academia. Globally significant research is increasingly conducted through international collaboration. As well, this international research is an untapped and under recognized extension of Canada's engagement with the world. Canada and Canadian researchers are disadvantaged by a dearth of funding for international collaboration as well as by policies that restrict the use of funding in these collaborations.

Institutions are often asked to redirect scarce discretionary resources to match funding required for meaningful participation in international collaborations, resulting in under-resourced and underdeveloped partnerships and a weakened international reputation for Canada and its institutions.

Recommendations:

- Increase flexibility in Granting Council policies as they relate to funding for international partnerships to introduce greater flexibility in cross-border research collaborations.
- Create a Granting Council fund to support cross-border research endeavours, including researcher mobility and ancillary research activities (i.e. conferences and workshops).

Graduate Student and Post-doctoral Fellow Funding Programs:

Supporting emerging researchers and the development of highly qualified personnel

Graduate students become highly qualified personnel that drive the knowledge economy. Adequately supporting their success is one of the wisest investments a government can make in the future of the research ecosystem and the competitiveness of the country's workforce.

Funding Levels and Eligibility

Within the last decade, the Government of Canada introduced the Vanier Canada Graduate Scholarships and Banting Postdoctoral Fellowship programs. While their overarching goal is laudable, to attract top-tier emerging researchers, these programs have not, on the whole, produced sufficient results to justify the extraordinary individual funding levels above other graduate and post-doctoral funding programs.

The ability to attract graduate students from around the world is key to the success of Canadian research faculty. The federal government and provinces have also made a policy priority of attracting and retaining international students – they bring great value to Canada and its institutions while here as students, and are ideal candidates as permanent economic immigrants. There are, however, few opportunities for international graduate students to access funding for graduate studies in Canada.

Recommendations:

- Eliminate the Vanier and Banting Programs and fold the funding into regular doctoral and post-doctoral funding programs; this would support a larger number of graduate researchers at levels that are still internationally competitive.
- Ensure tax treatment of post-doctoral fellows, including Canadians pursuing post-doctoral fellowships abroad, results in net funding levels that are globally competitive.
- Further open graduate student funding streams to international students.

Application and adjudication processes for post-doctoral fellowships

A common theme in UBC's consultations with its research community was that the timing of post-doctoral fellowship application intake and adjudication does not align well with the variable completion dates of PhD students and the start dates for post-doctoral positions, resulting in faculty unable to recruit post-doctoral fellows and denying recent PhD graduates the chance to attain post-doctoral funding or positions. Additionally, in some fields, a one-time application policy is driving promising young researchers away from Canada's academic institutions.

Recommendations:

- Establish more frequent, or rolling, intake and adjudication for post-doctoral fellowships funding programs.
- Eliminate policies that allow applicants only once chance to apply for a post-doctoral fellowship.

Preparing graduate students for diverse career options

Canada's graduate student funding landscape is generally structured to prepare graduate students to continue academic career paths. However, a small and declining proportion of graduate students today

go on to become academics. While the current model of research project-based graduate funding prepares students with invaluable and useful research, critical thinking and technical skills, funding mechanisms could be created or modified to allow for a greater focus on preparing students for non-academic careers. In addition, graduate students who plan on remaining in academia would still be well served by exposure to students and program content focused on preparing individuals and their research products for the market.

Work-integrated learning, such as research internships partially funded by Mitacs, and dedicated programs of training, such as those funded under NSERC CREATE, are strong examples of new approaches to preparing graduate students to become highly qualified personnel. Such programs prepare trainees for diverse career options by adding training in entrepreneurship, knowledge translation and commercialization, business planning and strategy, and IP strategy, and by directly exposing them to industry partners.

Recommendations:

- Create new incentives for the private sector to develop work-integrated learning opportunities for both undergraduate and graduate students. This could take the form of an employer tax credit or voucher system.
- Support, under the Granting Councils, specialized graduate training and development programs focused on preparing students for non-academic career paths in their fields. The NSERC CREATE program can be a model for this. However, funding streams must ensure the long term sustainability of funded programs.
- Substantially increase funding for indirect costs of research to ramp up universities' abilities to support graduate student ventures.

Supporting Indigenous Students

Along with our partners in the post-secondary sector, UBC is committed to the success and advancement of Canada's Aboriginal Peoples. Engagement with Aboriginal communities is a key pillar of UBC's strategic plan, and encompasses establishing and maintaining meaningful relationships with Indigenous governments, supporting research that addresses issues identified by Indigenous communities, incorporating understandings of Indigenous cultures and histories into curriculum and operations, and supporting the success of Indigenous students and faculty.

Canada's research funding system can better support Indigenous students' access to undergraduate, graduate and postgraduate studies.

UBC also endorses Universities Canada's recommendation to enhance support through the federal granting councils to enable more Indigenous students to pursue graduate and post-graduate studies.

Recommendations:

- Continue to implement Budget 2016 commitments to vastly improve Indigenous peoples' access to high-quality education, from primary and secondary schools through to college education or advanced degrees.
- Enhance Granting Council to better enable Indigenous students' access to graduate and postgraduate studies.