UNIVERSITY OF ALBERTA
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DALHOUSIE UNIVERSITY
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MCGILL UNIVERSITY
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U15 Fundamental Science Review Submission – Institutions and Administrators

September 2016

U15

Group of Canadian Research Universities
Regroupement des universités de recherche du Canada

1. From the perspective of research, are Canadian universities keeping pace internationally? If not, what changes or new programs are needed to close the gap?

To ensure that Canada's researchers maintain their leading roles in global science, and our research infrastructure keeps pace with researchers' needs, it is crucial that our research funding ecosystem evolves. We must capitalize on the collaborative, interdisciplinary, international nature of today's – and tomorrow's – ground-breaking science.

Specific program improvements could further support Canadian researchers in the new research landscape and create a university research environment that keeps pace internationally. These improvements would foster a stronger system that enables:

- High-risk, long-term research that is competitively funded and facilitates the fundamental pursuit of knowledge, while remaining cognizant of the fact that it may take longer than a granting cycle to generate publishable, world-class work. This transformative research will establish Canada as a world-leader in specific fields and will attract international attention.

- Funding adjudications that take place outside of the traditional granting cycle, on an *ad hoc* basis. These additional adjudications will facilitate and improve Canadian participation in exceptional opportunities in international collaborations on research and infrastructure projects.

- Grant programs that are harmonized across disciplines. Establishing discipline-specific programs should occur only where harmonized programs do not meet specific needs.

- Support for the operations and maintenance of core facilities, as well as for small equipment and upgrades.

- Higher education R&D that is funded at a globally competitive level. Such funding levels would restore our place among OECD countries, given that Canadian funding levels dropped to seventh place in 2014 from third place in 2006.

Increasingly, "keeping pace internationally" means participating in, or driving, major international collaborations. Our funding system should facilitate these international, interdisciplinary partnerships through:

- A flexible international research fund, reflecting the fact that collaborating on international research projects requires the capacity to leverage domestic funding quickly, on unpredictable timeframes;

- Increased portability of grants, to allow Canadian researchers to conduct research abroad;

- Broad Tri-Council coordination of international outreach, because The U15 has heard from international partners that it is confusing to have siloed, *ad hoc* meetings with Tri-Council agencies that do not explain their shared objectives;

- World-class research infrastructure that acts as a beacon for international researchers; and

- Fostering excellence programs such as the Canada First Research Excellence Fund.

Canada accrues many benefits from being a global research leader, including ensuring that we are integrated into global knowledge flows, training and fostering excellence in teaching, identifying and fostering important partnerships, engaging in science diplomacy and improving our international reputation. Canada can further advance its leading role in research by continuing to attract top international talent through science diplomacy by:

- Hosting exchanges to encourage researcher-to-researcher connections;

- Leveraging Global Affairs Canada to attract international students to Canada; and

- Leveraging science diplomacy to encourage visits from high-profile researchers and research partnerships with researchers, institutions and nations, particularly from those countries with whom Canada seeks to improve ties.

2. Is the federal funding ecosystem meeting the needs of researchers in your institution(s)? As the needs change, is the ecosystem able to adapt and accommodate?

A fundamental research funding ecosystem is most effective when it is simple, flexible and strategic. To remain leading scholars, our university-based researchers must have:

- Competitive funding for research that recognizes the need for increased success rates to support research excellence;

- Sustainable funding structures that seamlessly cover the full cost of research, including the transition to application;

- Adaptable funding structures that recognize the evolving nature of research, science and knowledge creation environments;

- Incentives to attract top students;

- The capacity to foster and maintain research partnerships across sectors, disciplines and borders;

- A pipeline for hiring top emerging researchers; and

- Strong academic programs that world-class faculty deliver.

Building on the principles of strategic, simplified and flexible funding, there are also specific program-level gaps Canada can address by:

- Funding the full cost of research;
- Establishing the capacity to fund international research collaborations efficiently, particularly when opportunities arise outside of the granting cycle;
- Recognizing the interdisciplinary nature of the research environment and ensuring that interdisciplinary research is appropriately adjudicated and funded;
- Creating funding capacity to foster success in emerging fields and for new scholars;
- Establishing a comprehensive application process to reduce administrative burden and application fatigue; and
- Ensuring support for high-risk, long-term research that may not fit into current program schemes or funding cycles.

Although capital investments in research infrastructure are well-supported via the CFI and corresponding provincial funding, the available funds for operations and maintenance are not keeping pace and, indeed, that gap has widened over time.

3. Does the federal science funding community (e.g. the granting councils, the CFI and other agencies or organizations distributing federal funds for research) consult institutions to ensure that their programs are aligned to the needs of administrators? If so, how? If not, should it and how should it?

The federal granting councils, CFI and other funding agencies have differing approaches to consultation and, as expected, the research community and university administrators have varied experiences with these consultations. As the federal science funding community adjusts its programs, referring to these key principles will ensure the granting agencies and organizations align their funding programs with administrators' needs:

- Consultations must be robust and funding agencies must address the research community's concerns directly;
- Consultations should be part of the development process but should also provide ongoing feedback mechanisms to allow administrators, institutions and researchers the opportunity to continue to evaluate and respond after programmatic changes have been made;
- Any transitions should be phased in gradually, to mitigate the impact of changes on ongoing research projects;
- Bridging funding may be required to ensure continuity of projects or to support students and postdoctoral fellows; and

- Consultation processes and feedback mechanisms must be responsive to challenges and opportunities as defined by the research community, because there has often been significant fallout if the research community perceives the consultations as symbolic rather than robust.

4. Comment on the coordination between the programs being provided by the granting councils and other funding organizations, provinces, and/or amongst themselves. Are there areas for improvement?

Aligning the granting councils presents a strategic opportunity for our research funding system. Although there have been previous efforts to coordinate among the various agencies and programs at the federal and provincial levels, this coordination could be improved. As research becomes more interdisciplinary, better coordination becomes necessary to fund the best research and to identify gaps in funding. The granting councils and other funding agencies could enhance their coordination by:

- Re-examining matching requirements for funding and, in cases where matching funds are required, help to establish the pathways to success;
- Reviewing current programs to better align with new programs, eliminate duplication and improve the ease of the application processes;
- Establishing new mechanisms for increased flexibility in adjudication procedures;
- Establishing a comprehensive application that outlines all anticipated research costs, helping to achieve a balance in research funding, while ensuring that the full cost of research is funded;
- Aligning granting cycles across the agencies; and
- Providing funding for the length of a project, to avoid reapplication and delays.

5. Could the application processes for funding be improved? If so, what would you suggest? Are there issues with the matching programs associated with various funding programs? If so, how could this be improved?

Our research funding ecosystem must be sufficiently flexible to reflect the changing nature of research. There are aspects of the grant application process that could be improved by:

- Establishing a comprehensive application outlining all anticipated research costs. Such an application would achieve a balance in research funding, while ensuring that the full cost of research is funded and reducing the administrative burden and reviewer fatigue;
- Improving coordination among provinces and other partners regarding requirements for matching funds;

- Consulting with the research community on program design, to capitalize on members' expertise and experience;

- Providing funding for the length of a project, to avoid reapplication and delays;

- Providing funding for the full cost of research, which includes indirect costs, so that applicants are not required to submit multiple proposals to different granting bodies that are mutually dependent. Multiple proposals can delay start times and increase administrative burden;

- Assessing whether programs requiring matching funds from non-federal sources actually increases overall funding for research. Matching programs have become increasingly common and they should be reviewed to ensure that they serve the intended objective;

- Creating easier, more streamlined applications to diminish applicant fatigue; and

- Developing more user-friendly electronic forms and web interfaces. Researchers and administrators often note that they feel the application forms complicate the process unnecessarily.

6. Is there a need for the federal government to improve the balance across funding elements (e.g. investments in principal researchers, funding of research staff and other direct costs of research, funding of infrastructure and equipment operations and maintenance, and reimbursement of indirect costs)? If so, how can this balance be achieved? What is the appropriate federal role in supporting infrastructure operating costs? Do CFI and granting councils programs work in a complementary fashion?

In order to ensure a balance in research funding, funding should be targeted to support **people**, **research** and **infrastructure**, and the associated indirect costs of research. The U15 has identified some potential ways to achieve a balance in research funding:

- Creating a comprehensive application process that is sufficiently flexible to reflect the fact that cost breakdown can vary substantially from project to project. A comprehensive application outlining all anticipated research costs would help to achieve a balance in research funding, while ensuring that the full cost of research is funded; and

- Ensuring research excellence is the standard for evaluating all projects and proposals will leverage our world-class research as a beacon for researchers and as a driving force for fundamental research in the country.

An effective research funding ecosystem will necessarily support infrastructure along with people and research. Federal support for research is more likely to be balanced, efficient and comprehensive if it includes:

- A reasonable threshold for materiality. This threshold would reduce unnecessary audits and researcher hours directed to unnecessary administrative work identifying and costing immaterial research resources, thus reducing the administrative burden; and

- Block grants to fully cover indirect costs. The Research Support Fund supports indirect costs based on a funding formula that allocates funds to institutions at funding levels as low as 18 percent for Canada's largest research performers. CFI's Infrastructure Operating Fund supports maintenance and operations, with up to 30 percent of CFI funding allocated to this fund. Institutions can allocate the funding as needed, per the guidelines. These funds are institutional grants, rather than directed to the researcher. This flexibility could serve as a model that could reduce administrative burden and improve efficacy for other funding bodies.

7. What should the balance be across funding risky, novel, or emerging research areas and research with important established lines of inquiry? Do current programs and review processes achieve the right balance?

Universities are well-suited to undertake long-term, risky scientific endeavours that build on our current and emerging research strengths. Doing so advances national objectives, addresses future challenges, maintains and improves our standing in the international research community and leads to some of the most profound disruptive discoveries. Our funding process must achieve a balance in research funding by:

- Supporting established fields of research that are recognized as world-class;

- Supporting the full cost of fundamental research, while remaining cognizant of the fact that it may take longer than a single granting cycle to generate publishable, world-class work;

- Allowing for high risk research within current or dedicated programs; and

- Making risky decisions to fund potentially transformative research at the earliest stages, providing support as the research advances and creating the capacity to scale up when transformative research findings yield significant results.

8. What should the balance be across funding of research to meet broad government priorities and having research priorities determined primarily by the ideas of the research community? Do current programs and review processes achieve the right balance?

Although The U15 recognizes that the government should set the broad and overarching priorities for the research community, it should maintain a strong emphasis on investigator-driven research ideas. Fundamental research lies at the core of advances in innovation, and is the foundation of any innovation ecosystem. Building on the Haldane Principle, which holds that decisions regarding research funding are best made by research experts, rather

than politicians, The U15 suggests the following to achieve an appropriate balance in determining research priorities:

- A government-established target for funding based on international peer countries and commitment to a multi-year plan to achieve that target;
- An arms-length expert panel to provide advice to the government, ensuring that our programs continuously evolve to create the best conditions for research excellence. This panel should include international and domestic experts, and could be included in the Science, Technology and Innovation Council's (STIC) or Chief Science Officer's mandate, or be convened as a part of a new initiative;
- Sustained funding for investigator-driven research;
- Globally competitive funding for fundamental science, for "Big Science" and for scaling up research strengths;
- Federal grants that cover the full cost of research, including indirect costs; and
- A comprehensive application outlining all anticipated research costs can help to achieve a balance in research funding, while ensuring that the full cost of research is funded. A comprehensive application process could also serve to reduce the administrative burden and reviewer fatigue.

9. Do current federal programs encourage and support domestic collaboration? Is there sufficient flexibility in federal funding programs for participation in international collaborations? Are there particular research areas where more emphasis on international collaboration is needed?

The current system of federal programs encourages and supports domestic collaboration. All world-class research is international and requires international collaborations at the institutional level. However, there are gaps within the system that could be addressed.

Specifically, Canada's national platforms are critical to advancing research excellence and collaboration, but the required matching funding often poses a challenge.

The U15 suggests the following program changes to ensure that our granting programs are sufficiently flexible to allow researchers to leverage important international opportunities and drive world-class research projects:

- A flexible international research fund, reflecting the fact that collaborating on international research projects requires a capacity to leverage domestic funding on unpredictable timeframes;
- A funding process that recognizes the interdisciplinary nature of the research environment and ensures that interdisciplinary research is appropriately adjudicated and funded, to help foster research collaborations;

- Increased portability of grants to allow Canadian researchers to research abroad, including travel and accommodation funds;

- A fund to allow Canadian projects, particularly infrastructure projects, to be undertaken abroad, similar to the CFI's International Access projects; and

- Broad coordination of international outreach by the Tri-Council, because The U15 has heard from international partners that it is confusing to have siloed, *ad hoc* meetings with Tri-Council agencies that do not explain their shared objectives.

10. Are current federal programs supporting the needs of multidisciplinary research programs? If not, how can the situation be improved? Does the funding ecosystem (funding councils and other agencies) work collaboratively and effectively across disciplines?

The current funding ecosystem could further encourage and support interdisciplinary research. Increased coordination can promote domestic and international collaborations that bring together a range of disciplines to tackle major research questions. Better harmonization and coordination among the funding agencies would allow for easier identification of gaps and opportunities in the current research landscape and prevent innovative interdisciplinary research from missing opportunities for funding. Federal funding programs can and must be expanded to support collaboration, both domestically and internationally. The federal funding ecosystem can improve this capacity by:

- Developing appropriate adjudication and funding for interdisciplinary research and support for the interdisciplinary nature of the research environment to create the necessary conditions for research excellence;

- Establishing harmonized grants programs across disciplines, making room for discipline-specific programs only where specific needs go unmet by harmonized programs to foster the interdisciplinary environment that will encourage broad, ambitious research;

- Funding graduate students and postdoctoral fellows supervised by interdisciplinary teams;

- Reducing requirements for Networks of Centres of Excellence (NCEs) to receive funding from external sources. NCEs have the potential to foster multi-disciplinary research, but the need for matching funding and the requirements for commercialization and sustainability detract from the advancement of multidisciplinary research programs; and

- Providing sufficient funding to the core NCE program to allow for RFPs to be released regularly.

11. Does your institution participate in major science initiatives or "Big Science," including large international collaborations and facilities? Why or why not? If your institution does participate, how is your participation funded? Are there challenges in identifying or securing funding sources?

The U15 represents Canada's research-intensive universities, and our institutions participate in a wide range of "Big Science" projects at a range of levels. NCEs and the CFREF program have greatly enhanced Canada's competitiveness internationally. Our institutions note that it would be helpful to see the federal government make a concerted effort to increase opportunities in large international consortia. A streamlined process, coordinated with the provinces, for entering into Big Science projects is critical. There are ongoing challenges in participating in Big Science endeavours, including:

- Jurisdictional issues arising from federal and provincial buy-in;
- Substantial cost, including sustained funding for operations, and recognition of the added financial responsibilities for the host institution and province;
- Lack of clarity with regard to leadership roles at national platforms; and
- Limited funding for travel of scientists and research trainees to use such infrastructure.

12. What is the best way to fund areas of strategic interest such as emerging, transformative or potentially disruptive technologies, and/or areas of broader societal interest? Are granting councils well placed to fund/support these areas or are separate mechanisms required?

The Tri-Council and CFI should remain the major funding agencies in Canada. They are extremely valuable to the research community and well-positioned to support research across all disciplines and levels. They can be even more valuable with increased coordination, simplification of procedures and further emphasis on interdisciplinary research. Niche agencies such as Genome Canada can serve a complementary role to the Tri-Council and CFI, but increasing the number of specialized agencies risks creating a siloed funding landscape and increasing the administrative burden on the research community.

However, emerging and transformative technologies must be closely reviewed and assessed within the context of the research landscape. Emerging technologies quickly become foundational to the research enterprise. These technologies become platforms when they cut across a wide array of disciplines and invest in research, and include areas such as:

- Nanotechnology;
- Quantum computing;

- Genomics; and
- Information technology.

Granting agencies are well-placed to fund these initiatives but there must be a recognition and understanding of the full cost of operations. These initiatives often become financially burdensome on the hosting institutions due to a lack of clear mechanisms for funding, such as addressing user fees. A more robust financial framework would help both the users and the hosting institutions to ensure that such initiatives are accessible and well-maintained at a low cost.

In cases where technologies could potentially spin out to dedicated, federally funded organizations, an arms-length expert panel should evaluate the platform's capacity to advance broad strategic interest and societal application. This expert panel must:

- Establish clear guidelines for mainlining funding, including sustained operation and maintenance funding;
- Provide advice as to when the platform's funding envelope should be rolled into standard mechanisms; and
- Provide guidance regarding how and if programs should be harmonized with other granting councils.

13. Identify the unique barriers that the following groups face in obtaining support for investigator-led research. Do current programs address these barriers? What else could be done to address these barriers?

a. students, trainees, and early career researchers

b. women

c. aboriginals and other underrepresented groups

A diversity of perspectives and approaches enhances research excellence. Likewise, Canada's research ecosystem is strengthened by having a wide range of research and researchers who explore big questions in fundamental science. The factors hindering members of these groups from entering the academy vary. It is imperative that our funding system foster a research and education environment where researchers from diverse backgrounds thrive.

a) Students, trainees, and early career researcher:

The U15 has identified some barriers hindering early- and mid-career researchers from entering into the academy. These include:

- Dynamics in the hiring pipeline at Canadian universities that delay hiring of early-career researchers:

    - The end of mandatory retirement, coupled with the economic climate, has led to fewer retirements and, as a result, fewer new academic hires; and
    - Increased tendency toward sessional appointments, which limits the capacity of young researchers to undertake the research they have been trained to do.
- Mid-career funding decline, leading to:
    - Termination of long-term projects;
    - An inability to fund graduate students or post-docs (tomorrow's researchers); and
    - The closure of labs.

b) Women, Aboriginal peoples and other underrepresented groups:

Canada's academic system has faced chronic challenges in ensuring adequate representation of certain groups, notably women, Indigenous scholars, visible minorities and persons with disabilities. This lack of representation means that a diversity of opinions and experiences are not reflected within the academy, which in turn limits research and training.

Some of the barriers hindering certain groups include:

- Lack of mentorship programs to encourage those historically excluded from university research to pursue academic endeavours;
- A small pool of researchers who are highly sought as reviewers and project participants and, thus, are overburdened; and
- Emphasis and funding priority accorded to areas where researchers from diverse backgrounds are underrepresented, and to theoretical frameworks that do not reflect diversity of experience (including but not limited to traditional knowledge, feminist theory, diasporic theory and critical race theory).

The following opportunities could improve pathways to research for those scholars with diverse backgrounds:

- Encourage scientific curiosity from an early age, particularly among groups under-represented in the academy;
- Establish mentorship programs for tomorrow's researchers, particularly those from under-represented groups;
- Ensure appropriate supports exist for our scientific researchers over the course of their entire career, including bridging funding should changes be made to the current funding structure;
- Ensure that the important role of traditional knowledge is recognized and integrated into the funding process;

- Acknowledge that diverse perspectives improve the capacity for scientific study and enhance research processes and outcomes.

14. Are there international programs, structures, models, or best practices that Canada should consider adopting? If so, please explain why these should be considered.

There are international practices and examples that seek to address a range of program gaps in our research infrastructure that could inform a review of Canada's research ecosystem.

Some international funding bodies have prioritized coordination of funding:

- **Germany**'s Max Planck Society, Fraunhofer Institute, Leibniz Association and Helmholtz Association have well-integrated coordination across many research areas and fields, differentiated by technological readiness rather than discipline; and

- In the **UK**, Sir Paul Nurse's Report "Ensuring a successful UK research endeavour" recommends increased coordination of various parts of the research landscape, as well as simplified operational policies. The government has indicated that it will implement Nurse's recommendations.

Although Canada has made significant investments to advance research excellence, including creating the Canada First Research Excellence Fund, international funding programs have also focused on fostering domestic strengths on the world stage. In order to compete internationally, federal funding agencies must continue to advance research excellence and avoid complacency. Some international programs include:

- **Germany**'s Excellence Initiative is a federal program through the DFG to fund graduate schools, clusters of excellence and institutional strategies. Funding for universities of excellence is available for institutional strategies to universities with a graduate school and a cluster of excellence.

- The **Danish** National Research Foundation funds Centres of Excellence, with the objective of promoting world-class research in universities. The centres strengthen institutions' strategic efforts to prioritize research and create a distinct research profile, much like the Canada First Research Excellence Fund. This also serves to simplify the funding system and reduce the administrative burden.

- **France**'s Investments for the Future Program focuses on international recognition of education, research and innovation clusters, with results-oriented practices. The program's explicit objective is to prepare France for the challenges of tomorrow through investments in clusters that include higher education and training, research, industry and SMEs, sustainable development and digitization. These clusters consist of universities, governmental organizations, industry and national institutes, all recognized for their excellence in key, complementary fields.

Other international funding bodies have developed assessment processes to fund Big Science:

- Several international funders (including the National Science Foundation in the United States, the Commonwealth Scientific and Industrial Research Organisation in Australia and the Research Council in the UK) have engineered full-cost funding systems for Big Science. They fund large-scale facilities typically assessed through comprehensive funding proposals that include:
    - the initial capital costs for construction;
    - the costs for commissioning;
    - the operating and maintenance costs;
    - the plan for capital upgrades; and
    - decommissioning plans.

Other funding bodies have also developed systems to ensure that the full cost of research, including indirect costs, is funded:

- In the United States, federal granting agencies reimburse indirect costs at a pre-negotiated rate that varies by institution. The funding formula is highly complex but typically ranges from 50 percent to 60 percent.

- Australia provides block grants for operating costs based on a time allocation survey of researchers. Funding for indirect costs under this program varies from 30 percent to 90 percent.

Some nations have used block grants to allow research institutes to identify their own priorities and funding break-downs:

- Australia has instituted research block grants, through which universities receive a substantial grant to administer within broad guidelines, in order to reduce the administrative burden and shift the onus of responsibility of delegating the funds to the institutions.

- The UK has implemented the Research Excellence Framework (REF), a system for assessing British post-secondary education institutes. The system produces indicators of research excellence for benchmarking purposes, enabling it to distribute funding by reducing the administrative burden. The Russell Group in the UK supports the operational efficiency of these grants, but warns that the academic community must determine research priorities, in conjunction with key stakeholders and user groups, and worries that these block grants could undermine the peer review process.

15. What should the vision be for Canadian science? If we imagine an even more successful future for Canadian science, what does success look like and how should it be measured?

A strong foundation for Canadian science will have many benefits for Canadian society. Science is a core Canadian value, and a successful future for Canadian science will position Canada as a high-performing research nation where universities work in partnership with other sectors to drive innovation and build a robust knowledge economy and society.

Some key benefits for Canada in achieving success with regard to science are:

- Canada will earn a reputation as a "hub" of international research;
- Increased recruitment and retention of top Canadian and international research graduate students, post-docs, professors and researchers;
- Comparative advantage for Canada in the global knowledge economy;
- Proliferation of international think tanks hosted in Canada;
- Increased numbers of significant research alliances with international partner institutions;
- Growth of the creative class;
- Increased numbers of highly cited faculty and highly cited papers;
- Development of evidence-based policy;
- Competitive numbers of Canadian Nobel laureates and Nobel laureates at Canadian institutions; and
- Better understanding of and participation in research by the general public.

16. Are there any other issues or questions that you would like to raise and address?

The U15 suggests that the federal government create a standing arms-length expert panel to advise the government to ensure that our programs continuously evolve to create the best conditions for research excellence. This process will include regular, rigorous assessments of our funding programs, including Canada Research Chairs and Canada Excellence Research Chairs, to ensure that they meet objectives and advance research excellence.

This panel should include international and domestic experts, and could be included in the Science, Technology and Innovation Council's (STIC) mandate, the Chief Science Officer's mandate, or be convened as a part of a new initiative.