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Discussion Paper

The Promise of Convergence Research: The Readiness of Canada's National Research Facilities and Academic Partners to Support Policy Responses to Grand Challenges

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The Promise of Convergence Research: The Readiness of Canada's National Research Facilities and Academic Partners to Support Policy Responses to Grand Challenges[1]

Convergence Research

"Convergence" is often used interchangeably with terms that capture concepts of research spanning multiple disciplines such as interdisciplinary, transdisciplinary, or multidisciplinary. While sharing much in common with those latter terms, convergence is most often used to suggest a type of research collaboration focused on addressing a particular challenge. More specifically, convergence research has been positioned nationally as research *"aimed at a specific and compelling problem requiring the deep integration of disciplines, knowledge, theories, methods, data and communities. Merging ideas, approaches and technologies from widely diverse fields of knowledge at a high level of integration is a crucial strategy for solving complex problems and addressing complex intellectual questions"*[2].

Convergence research therefore goes beyond familiar notions of collaboration in emphasizing the need to address global challenges that require diverse perspectives, strategies, and approaches.[3] By bringing together different knowledge and expertise, it is aimed at finding solutions for problems too complex to be addressed by a single knowledge domain or discipline.[4] Although less fully articulated, convergence research can also mean the value of drawing on knowledge systems outside of what might be considered "traditional science" – e.g. diverse ways of knowing across sectors, and from a variety of stakeholders, or communities, including Indigenous knowledge keepers and industry professionals. Convergence may also be

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[1] This discussion paper has been prepared to stimulate reflection, dialogue and exchange in association with a conference panel entitled "The Promise of Convergence Research: The Readiness of Canada's National Facilities and Academic Partners to Support Policy Responses to Grand Challenges," scheduled as part of the Canada Science Policy Conference 2020. As such, this discussion paper is not intended to reflect the views of any specific member of the conference panel, nor CSPC. Comments or questions regarding this paper may be directed to the authors at leader@edwards.usask.ca and/or peggy.schmeiser@usask.ca. The authors also recognize the contribution of the Sylvia Fedoruk Canadian Centre for Nuclear Innovation for their support of a current research project entitled "Advancing Convergence and Collaborative Research through Major Research Facilities" that has helped inform this work.

[2] Canada Foundation for Innovation (2018, p. 5)

[3] National Research Council (NRC) (2014). This definition of convergence research to solve large scale problems across disciplines is echoed by the American National Science Foundation (NSF) (2020). The NSF (2020, para. 2-3) identified two primary characteristics of convergence which relate to a need to address a specific challenge or opportunity "*whether it arises from deep scientific questions or pressing societal needs"* and acknowledging how *"as experts from different disciplines pursue common research challenges, their knowledge, theories, methods, data, research communities and languages become increasingly intermingled or integrated."*

[4] There is evidence to suggest that diverse teams with different perspectives on problem solving will generate innovative solutions to complex problems more readily than teams with similar approaches as well as with increased creativity. See: Hong and Page (2004); Horwitz and Horwitz (2007); Stahl, Maznevski, Voigt, and Jonsen (2010).

understood in the context of research institutions as a coming together in order to maximize shared resources such as infrastructure, research facilities, technologies, and partnerships to tackle large-scale challenges.

The Potential Role and Capacity of National Research Facilities

In Canada, national research facilities (NRFs) present a broad platform of scientific infrastructure and research capacity. Canada itself operates and maintains a vast array of scientific infrastructure designed to support innovative and cutting-edge research. Many of the country's NRFs are well aligned with the objectives of the Major Science Initiatives (MSI) fund of the Canada Foundation for Innovation (CFI) whose primary role is to "enable Canadian researchers to undertake research and technology development that leads to social, health, economic, or environmental benefits to Canadians"[5]. Such national research facilities are intended and well-positioned to support experts who are focused on addressing scientific problems through the use of particular infrastructure or tools.

Given their role and mandate, NRFs have a key role to play in convergence initiatives. However, the role and capacity of national scientific infrastructure to drive and lead convergence research is less than clear. Current funding models are typically designed for infrastructure and operations of scientific facilities rather than for funding research projects where collaboration is often essential. And yet, NRFs have clearly been the site of major convergence projects and initiatives, building on their ability to attract researchers from hugely divergent fields and disciplines, either by intention or happenstance. NRFs in Canada continue to play a vital role in solving grand challenges such as those linked to infectious disease, climate change, energy, food, and health among others at global and local levels. Recent examples include the Mechanical Ventilator Milano project through which Italian, Canadian and American teams including physicists, engineers, and companies with contributions from TRIUMF, SNOLAB, Canadian Nuclear Laboratories and the McDonald Institute have come together to address a vital need amidst COVID-19.[6] Elsewhere, Ocean Networks Canada has been working with Indigenous community partners using instrument-based monitoring, Indigenous knowledge, and local observations aimed at understanding the multiple impacts of changing ocean conditions.[7] Through a variety of policy and funding frameworks, Canada's NRFs contribute to areas of national priority.

National funding bodies are increasingly recognizing the importance of bringing diverse knowledge and expertise together through enhanced funding for research initiatives that build on the importance of collaboration and convergence. Canada's tri-agencies – the Social Sciences and Humanities Research Council, Canadian Institutes of Health Research and Natural Sciences and Engineering Research Council - are developing plans and strategies to

[5] Canada Foundation for Innovation (CFI) (2019, p. 2).

[6] See: https://www.queensu.ca/gazette/stories/ventilators-co-designed-canadian-team-led-queen-s-nobel-laureate-ready-go

[7] See: https://www.oceannetworks.ca/sites/default/files/images/u2179/ONC_AR1819_web.pdf

ensure greater public collaboration in support of interdisciplinary research. As part of this effort, the Canada Research Coordinating Committee launched a national consultation over the summer of 2018 to "reinvigorate Canada's support for science and to position Canada as a global leader in research excellence"[8]. Meanwhile, the New Frontiers in Research Fund (NFRF) was announced by the Tri-agency Institutional Programs Secretariat (TIPS) in 2018, including an investment of $275 million over the next five years ($65 million per year ongoing) to support research that is international, interdisciplinary, fast-breaking and high-risk[9]. Described as representing "a fundamental shift in how Canada invests in research and supports collaboration among non-traditional partners", the NFRF could foreseeably enable biomedical engineers to work "alongside social scientists to develop groundbreaking solutions for Canadian patients"[10].

Current Gaps and Challenges

Although the concept of collaboration that drives convergence research is generally understood and supported, the mechanisms and models to enable and cultivate cultures of convergence are not well-established. While Bowman and Arnold (2019) acknowledge that funding is only one element enabling this style of collaboration, facilitating and achieving convergence in research requires overcoming challenges relating to leadership, structures, resources, relationships and culture. In many cases there are gaps in identified long-term priorities and established structures to support convergence. A variety of potential measures linked to funding and training could support a greater coming together of divergent, yet potentially complementary, fields of inquiry. Having a productive mix of collaborative culture and practice are equally essential.

While people who are passionate about curiosity-driven research and people who tackle goal-driven challenges can both drive and contribute to convergence research, organizational and disciplinary boundaries can create barriers for collaboration. Structures that support productive competition while enabling productive collaboration, that are nimble enough to be repurposed and repositioned to address urgent challenges, and that incentivize true collaboration that builds on the unique strengths of diverse fields, are urgently needed. Clearer understandings and greater awareness about what convergence success looks like and what it can enable could foster increased collaboration in efforts to address problems at local and global levels. However, collaboration and the integration of expertise cannot be forced. Rather, structures are needed that foster its development and enable organic cross-fertilization of knowledge where most appropriate and beneficial.

[8] Social Sciences and Humanities Research Council (SSHRC) (2019, para. 1)
[9] SSHRC (2018)
[10] SSHRC (2018, para. 4)

Future Potential Considerations for Convergence Research

With its strong base of research capability and the resources embedded in its vast array of scientific infrastructure, Canada is well positioned to be a leader in addressing the world's grand challenges. Yet questions remain about the role, readiness and potential of our nation's major science facilities and their academic partners to undertake the sort of large-scale collaboration and convergence necessary to support effective and comprehensive policy solutions and decision-making in response to complex problems.

Many potential issues require deeper consideration, including:

- Government policies and funding frameworks for supporting NRFs;
- Roles and mandates of specific NRFs and research personnel;
- Governance models for NRFs including leadership structures and board membership;
- Funding criteria for research projects and collaboration;
- Academic incentives for collaboration across disciplinary boundaries including with respect to tenure and promotion;
- Training and education of current and future researchers;
- Means and obstacles for researchers from diverse fields to interact and collaborate;
- Elaboration of what convergence success looks like, along with ways to measure it;
- Opportunities and barriers for deeper engagement among all stakeholders including government, industry and community leaders, along with research communities.

Our objective in this paper is to trigger a far-ranging discussion among representatives from across government, industry, not-for-profit, and research sectors to help deliver on the promise of convergence research in providing new strategies for addressing complex problems of global significance.

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