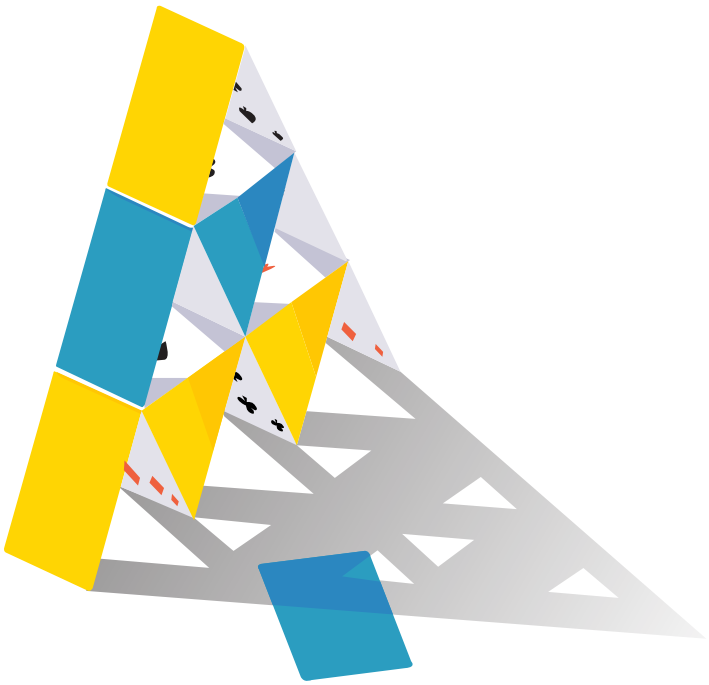
Impact Brief
October 2018

A Delicate Balance

Federal-Provincial/Territorial Coordination in Research and Innovation Funding



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Summary

Canada's research and innovation system crosses federal-provincial/territorial (FPT) borders. Provincial/territorial and federal agencies together fund over 30% of research and development (R&D) activities in higher education across the country (Statistics Canada, 2017). However, FPT coordination in this area has been largely a "reactive" and "ad hoc activity without a clear organizational structure or mechanism to support it" (Tamtik, 2016).

The dizzying mix of programs for research and innovation at both levels has also contributed to the coordination challenge, which has resulted in a patchwork of programs and co-matching requirements. Researchers and innovators are left to navigate a complex system of supports, seeking opportunities to help shoulder the direct and indirect costs of R&D.

The creation of the Canada Research Coordinating Committee (CRCC) to harmonize activities across the main federal agencies provides an opportunity for mechanisms for coordination with the provinces and territories to be considered. The purpose of this paper is to serve as a starting point in the conversation on FPT coordination.

First, we look at some basic concepts in policy coordination and then delve deeper into coordination on research and innovation funding. By clarifying areas of stress as well as opportunities for improvement, we hope to raise awareness of the "vertical coordination gap" that has been endemic in Canada.

As we move forward with the discussion on FPT coordination, some questions warrant further consideration:

- How do our federal and provincial/territorial policies for research and innovation currently reinforce/negate each other?
- How much effort should we invest in coordination?
- To what extent have stakeholders begun to address the coordination issue?
- How can the federal research councils work with their provincial/territorial counterparts to avoid policy duplication and inconsistencies in support programs?
- What could be some short- and long-term coordination targets? What do we define as success?

The path forward must consider how current barriers to coordination could be overcome. This includes setting attainable short-term targets such as more awareness, better data, clear responsibility for coordination at both government levels, and clear mechanisms for data exchange and consultation. More effective linkages across the system would help cover gaps in services and supports currently encountered by Canadian scientists and help build broad research capacity needed to sustain innovation.

Introduction

Coordination: "the need to ensure that the various organizations – public and private – charged with delivering public policy work together and do not produce either redundancies or gaps in services."

Peters (1998),

Dubbed the "Holy Grail" of public administration, coordination has always been a considerable challenge for public policy (Peters, 2015). Policy coordination has become even more urgent in recent decades. Increasing complexity of and demand on public services along with calls to reverse the fragmentation that has marked public sector development have partially driven this trend. In addition, our ability to address "cross-cutting" problems, like climate change, women's rights, and health, will depend on more effective connections between stakeholders from a wide range of organizations, government levels, and policy domains (Candel and Biesbroek, 2016; Peters, 2018).

All policy targets are partly coordination problems. For instance, comprehensive social programs for low-income groups mobilize financial assistance, education, training, housing, employment services, along with access to health. Urban development must weigh, among others, the needs for transportation, housing, green space, water resources, and public input (Candel and Biesbroek, 2016). The 2015 Paris Agreement on environmental and climate change policy is case in point just how challenging it is to achieve consensus and action on specific problems within countries, but especially when those problems cross international borders.

Definitions and Tools

Coordination can be defined simply as "the need to ensure that the various organizations – public and private – charged with delivering public policy work together and do not produce either redundancies or gaps in services" (Peters, 1998, p. 5). This definition implies a sense of coherence in activities that would "provide service to the 'whole client' instead of "segment[ing] (often artificially)" their needs (Peters, 2015, p. 5).

Depending on the nature of the problem at hand, policy makers and practitioners can choose from a menu of tools to boost coordination. The creation of centralized agencies or legislations are commonly used mechanisms. "Softer" tools entail:

- cabinet committees or the budget process as venues to create consensus,
- intergovernmental committees setting common plans and strategies,
- priority setting across departments and organizations,
- creating funding programs to incentivize collaboration,
- undertaking consultations or policy evaluation to consider new perspectives,
- co-funding of projects,
- creating networks of program staff to share information, and
- employing personnel tasked mainly with coordination (Candel and Biesbroek, 2016; Peters, 2015; Peters, 2018).

This list is by no means comprehensive, and no single tool will suffice. Coordination can come from the top down or from the bottom up (Peters, 1998). It can begin by agreeing on a high-level strategy or by tweaking a program to align eligibility requirements for applicants.

However, a more concerted strategy for coordination deploys tools at both policy and implementation levels to improve data/information exchange, encourage consultation, and foster common strategies across the whole system. Some of the key questions should be: "What does the client see?" This increases the likelihood that duplications or gaps in the system will be reduced. The combination of tools should strive toward the goals outlined in Exhibit 1.

Exhibit 1. Coordination Goals

- Avoiding or minimizing duplication and overlap
- Avoiding program inconsistencies
- Minimizing bureaucratic conflict
- Ensuring coherence and cohesion
- Agreeing on priorities
- Improving the efficiency in the way funding is allocated
- Promoting a comprehensive, "whole-of-government" perspective on the policy issue

Adapted from Braun (2008)

Levels of Coordination

Any "cross-cutting" policy issue (i.e. health, research, innovation) can be viewed on a spectrum from weakly to highly coordinated. To gauge the extent to which the problem is actually coordinated, we can assess it using the following eight elements:

- *Policy framing.* How is the problem defined, and how widely is it recognized across the system?
- *Stakeholder involvement.* Who is involved in managing the problem?
- *Interactions.* How frequent are the interactions?
- *Range of policies in which the issue is addressed.* Where are the concerns about the problem adopted?
- *Coherence of policies.* Do the goals of various policies on the issue reinforce each other?
- *Deployment of instruments.* To what extent have stakeholders deployed or adapted their instruments to address the issue?
- *Consistency in the instrument mix.* To what extent do the instruments reinforce each other?
- *Existence of system-level coordinating instruments.* Have instruments been deployed to coordinate efforts across the system?

The elements are also depicted visually in Exhibit 2, which shows how the elements change when the governance of a particular problem moves from *no or weak coordination* on the periphery to a state of *high coordination or even integration* at the centre.

What this breakdown makes clear is that coordination begins with how a policy issue is defined and positioned in the system (i.e. important or unimportant).

In uncoordinated systems, the issue at hand is typically not broadly seen as critical. It remains under the jurisdiction of one stakeholder, with no interactions and consistency of policy or programs with other organizations.

When an issue is highly coordinated, the problem is not only recognized widely as important, but it has also been meaningfully translated into action: all relevant stakeholders see their activities as part of a greater whole. They interact frequently to exchange data and information, formulating mutual strategies to deal with the issue. The problem thus becomes integrated within all relevant policies, with synergies between instruments and investments to meet policy targets. These efforts are supplemented by high-level coordinating instruments that track, evaluate, and drive the efforts of the whole.

Coordination in Research and Innovation

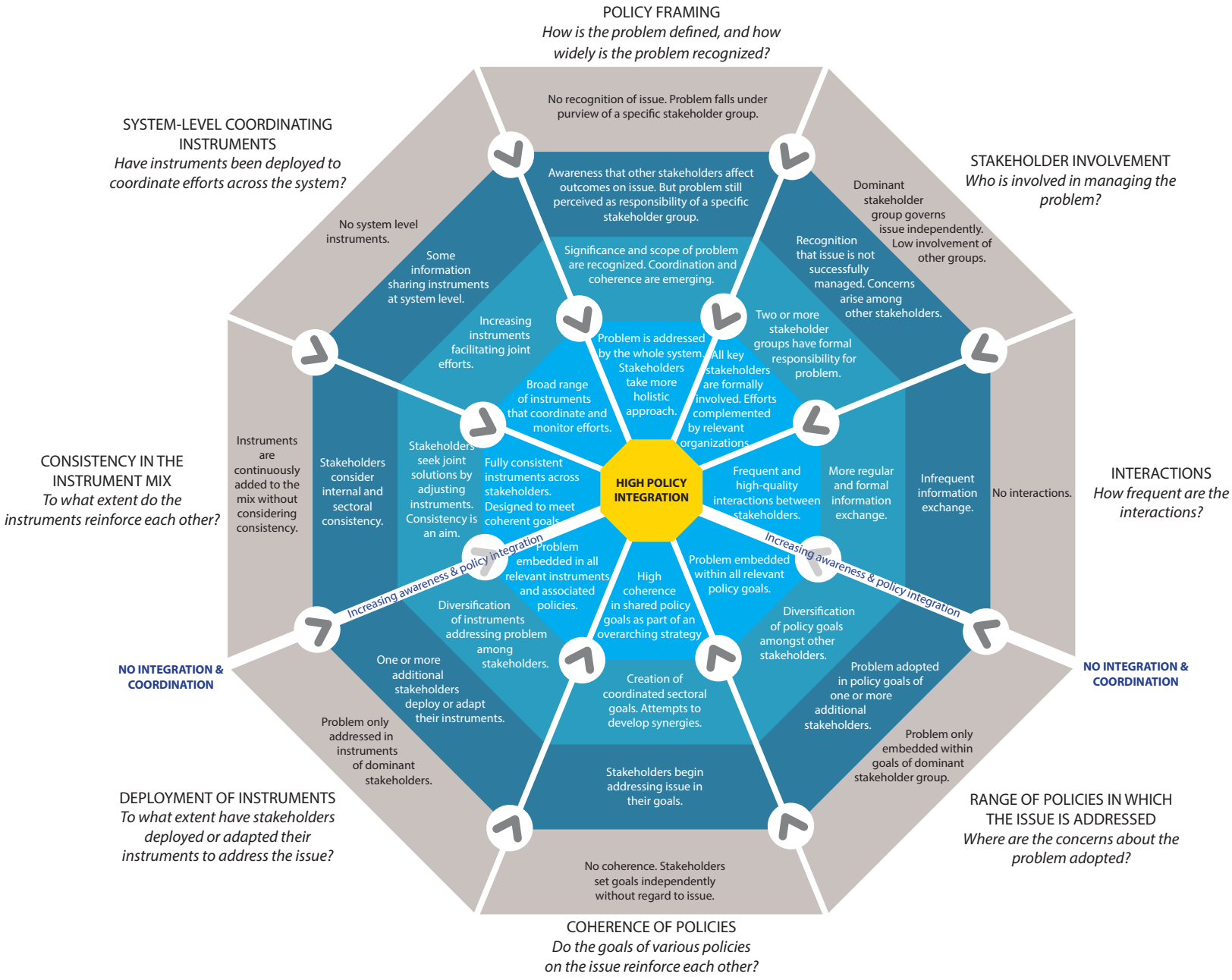
Equipped with a basic notion of policy coordination, we can now look at Canada's research and innovation system through the same lens. Certainly, coordination has become pivotal in this domain and has been emphasized in recent narratives in Canadian research policy. The Fundamental Science Review (2017) made it clear that the renewal of the Canadian science system will depend on a more holistic approach to how we support research and related talent and infrastructure. Therefore, *coordination* and *coherence* have become actual policy goals.

In January 2018, the federal government created the Canada Research Coordinating Committee (CRCC) made up of the heads of the research councils, the Canada Foundation for Innovation (CFI), the National Research Council (NRC), Canada's Chief Science Advisor, and the Deputy Ministers of Health Canada and Innovation, Science and Economic Development Canada. This Committee is tasked with harmonizing activities across the main federal agencies to position Canada as "a bold, world-leading and highly coordinated system of federal support for science—a system that contributes to the social and economic well-being of Canadians". The CRCC just completed its first round of national consultations, seeking input on the Tri-Agency research fund, equity and diversity in research, and the state of supports for early-career investigators.

If we also take into account innovation—especially innovations driven by discoveries in higher education—then the number of potential supports and stakeholders involved increases dramatically. As the results of research move to market, other types of funds and partners must be considered, from advisory networks to venture capital organizations.

In light of the creation of the CRCC to harmonize activities "horizontally" across the main federal agencies, mechanisms for coordination with the provinces and territories must also be examined. Since the 1980s, the provincial and territorial governments and organizations have played a progressively larger role in both research and innovation and have developed programs to fund higher education R&D and related commercialization. But systematic, intergovernmental cooperation in this area has been relatively weak, and the provincial/territorial role has been largely overlooked in recent discussions on coordination. The remainder of this document will clarify areas of stress as well as raise questions about potential opportunities for federal-provincial/territorial (FPT) policy coordination in R&D.

Elements of Policy Integration
Exhibit 2



Source: Authors' visual depiction of the framework proposed by Candel and Biesbroek (2016).

Divided Responsibility for Research in Canada

University research is funded by both the federal and provincial/territorial governments. Together they inject well over $8B per year into higher education research and development (R&D) in Canada, representing 31% of total funding (Statistics Canada, 2017). These investments in science are expected to foster breakthroughs that will lead to innovative products, processes, and services. But despite the overlapping FPT role in science, coordination has been relatively poor and inconsistent.

Provincial/territorial governments have overall constitutional responsibility for the regulation of postsecondary education, but they do not have sole responsibility for science and research. In fact, the provinces and territories invest a relatively small fraction of funds, with federal agencies providing significantly more of the baseline research funding to sustain the science system. An estimated 23% of all R&D funds come from the federal government in the form of operating and infrastructure grants, scholarships, fellowships, and supports for indirect costs of research (accounting for $6.1B out of total $26.5B spent on university and college R&D in 2015/16).

Funding for Higher Education R&D, in Current Millions of Dollars (2015/16)

Exhibit 3

Geography	Federal funding ($)	% of total funding in the province	Provincial funding ($)	% of total funding in province	Total funding for higher ed R&D from all sources
Prince Edward Island	19.8	25%	2.4	3%	79.4
New Brunswick	60.3	17%	15.6	4%	365.2
Newfoundland and Labrador	69.2	14%	19.0	4%	477.9
Saskatchewan	110.9	17%	49.7	8%	653.8
Manitoba	145.0	18%	46.8	6%	800.2
Nova Scotia	215.8	26%	21.8	3%	830.8
Alberta	547.0	19%	496.0	17%	2,849.4
British Columbia	819.2	27%	152.7	5%	3,007.4
Quebec	1,589.6	24%	724.6	11%	6,729.7
Ontario	2,480.0	23%	664.4	6%	10,705.0
Canada	6,056.6	23%	2,192.8	8%	26,499.0

Source: Statistics Canada. Table 27-10-0025-01. Provincial estimates of research and development expenditures in the higher education sector, by funding sector and type of science (x 1,000,000).

Barriers to Effective Coordination

While coordination is often mentioned as an area in need of strengthening, outcomes in practice are still far from ideal.

Why has effective coordination been such an elusive policy goal in Canada?

Policy researchers have noted a number of challenges, which begin with the largely independent development of provincial/territorial and federal systems for research and innovation funding. In addition, the inherent complexity of policy making in federal systems, along with operationalizing policy coordination and managing the needs and viewpoints from diverse stakeholders are amongst the obstacles that must be overcome to making a meaningful change in this area. Exhibit 4 outlines some of the key issues noted in interviews with industry, university, college and federal and provincial government representatives in a recent study by Tamtik (2016).

Barriers to Effective Coordination

Exhibit 4

Factors related to	Description
Federal system	• Independent development of federal and provincial systems for higher education and little history of systematic collaboration (i.e. data sharing, priority setting) • No legal recourse to incentivize coordination • Lack of vertical communication • Disconnect between provincial and federal economic and S&T priorities • Historically, reactive (rather than proactive) approach to coordination
Administration of policy coordination	• No mechanisms for managing stakeholders that make up Canada's R&D ecosystem • Limited resources available for coordination • Limited knowledge to administer complex system of innovation policy and diversity in stakeholder expectation • Geographic distances limit knowledge spillovers and communication
Stakeholder groups	• Limited resources for relationship/trust building and coherence on goals • Outcomes and purpose of coordination process viewed differently by various stakeholder groups • Coordination limited to individual initiatives and specific tasks

Source: Analysis reproduced from Tamtik (2016).

The dizzying mix of programs for research and innovation at both federal and provincial/territorial levels has also contributed to the coordination challenge. Like other regions around the world, Canada has seen the multiplication of a "wide variety of R&D policy instruments…over time in an ad hoc manner (e.g., reflecting political or economic circumstances at the time), interacting with each other as well as with the intended actors in a complex and often unpredictable manner, and giving rise to legacy problems" (Martin, 2016, p. 159).

With funding instruments increasingly used for promoting a wide range of scientific, economic and social goals, the blend of schemes has become very complicated for researchers and innovators on the ground (Jongleod and Lepori, 2015). Programs must make trade-offs between nurturing fundamental science and fostering innovation, offering competing signals to the clients they are intended to benefit. This has resulted in patchwork of programs and co-matching requirements at different levels of governments targeting the same communities with incentives that have conceptual and structural similarities. Researchers navigate a complex system of funding streams, seeking opportunities to help shoulder the direct and indirect costs of their research programs, which are covered through the piecing together of funds from multiple sources.

With a proliferation of agencies and voices involved in the conduct of research and research policy, coordination must not only cross FPT but also organizational boundaries, making the process even more daunting for those involved. To date, improvements and attempts at coordination are typically confined to specific initiatives and programs, making policy coordination largely a "reactive" and "ad hoc activity without a clear organizational structure or mechanism to support it" (Tamtik, 2016, p. 420).

Impacts of Poor Coordination

The lack of coordination between the provincial/territorial and federal governments and their agencies has resulted in issues that are duplicated at both levels of government, including how to balance the allocation of money between fundamental science and innovation, and how to support both established and early-career scientists (Council of Canadian Academies [CCA], 2018).

The impact on the ground is best evidenced by the types of issues encountered by scientists and innovators navigating these systems who see increasing fragmentation and resource allocation challenges (Neilsson and Moodysson, 2015).

Fragmentation results from mounting program complexity, in which supports and services may be available but without forming any synergies. From the perspective of the "client", the costs to learn and move through the system are very high. But without connections between programs, uneven allocations of money and supports across institutions, researchers and disciplines are likely, leading to gaps in services, and potentially lost opportunities.

The rest of this section provides two examples of such fragmentation and resource allocation issues. Using data from Ontario, the first case offers a brief analysis of how the lack of coordination affects fundamental science funding. In the second case, we look at the coordination gap in the health technology innovation system (which was covered in more detail in a recent Impact Brief by C. Plant, 2018).

Although this analysis is done through the lens of the largest province and in the context of basic science funding and health technology commercialization, similar studies should be performed for other provinces and territories to shed light on gaps in resources. This would offer a useful starting point for an informed discussion on coordination across Canada.

Example: State of Fundamental Research Funding in Ontario

The Ontario Government has overall constitutional responsibility for the coordination and regulation of postsecondary education, and it plays a role in funding research and innovation.

Provincial investments

Ontario has developed its own funding programs that operate largely independently of the federal system. The Province committed $1.84B for research between 2004 and 2015, mainly through the Ontario Research Fund (ORF) and the Early Researcher Awards (Exhibit 5).

Ontario Commitments by Research Program (2004-15)
Exhibit 5

Source: Amounts in 2015 dollars. Calculation based on Ontario research funding summaries, Government of Ontario. "Other" includes past programs (International Strategic Opportunities Program, Premier's Discovery awards, Postdoctoral Fellowship Program).

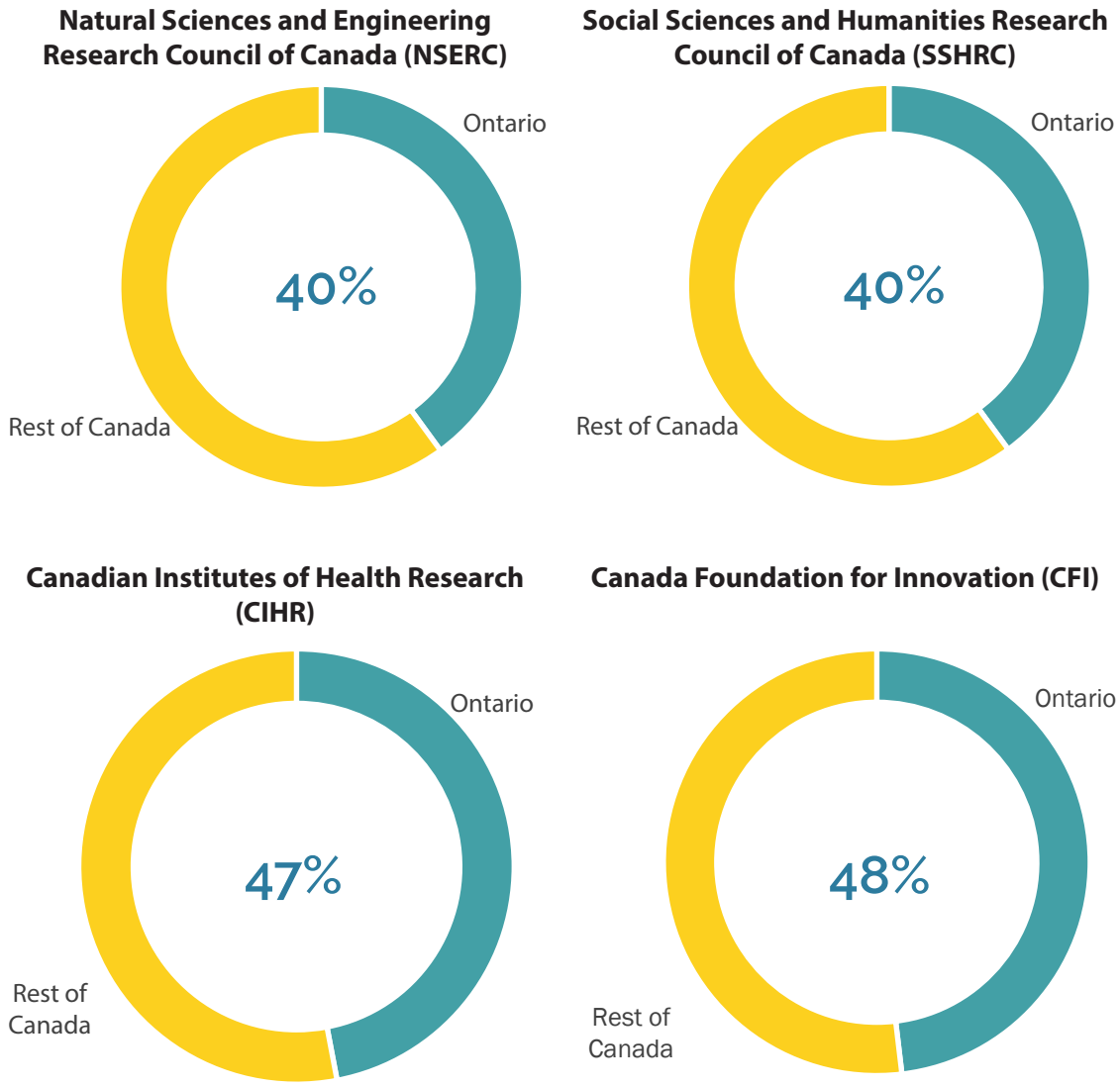
Established in 2004, the ORF is a peer-reviewed granting program divided into the Research Excellence (ORF-RE) and the Research Infrastructure (ORF-RI) streams (Government of Ontario, 2008). ORF-RE shoulders operating costs of large, strategic projects and emphasizes research excellence coupled with commercialization potential, economic/social benefits, and strong industry involvement (Government of Ontario, 2017a; Office of the Auditor General of Ontario, 2009).

The ORF-RI is divided into the Large Infrastructure, Small Infrastructure, and the College-Industry Innovation programs, which collectively fund facilities and equipment for research and technology development (Government of Ontario, 2017b). The Early Researcher Award (ERA) offers up to $140K for early-career scientists to build the capacity of their research teams.

Federal investments

Ontario receives the largest portion of funds from federal agencies for basic science (Exhibit 6): 47% of the funds from the Canadian Institutes of Health Research (CIHR), 40% from the Social Sciences and Humanities Research Council of Canada (SSHRC), 40% from the Natural Sciences and Engineering Research Council of Canada (NSERC), and 48% from the Canada Foundation for Innovation (CFI). The money is allocated competitively to help scientists cover research costs. Key programs for fundamental research are included in Exhibit 7.

Portion of Federal Agencies' Funding Provided to Ontario Universities for Basic Research and Associated Talent and Infrastructure
Exhibit 6



Source: NSERC, CIHR, SSHRC, CFI Funding Databases. Breakdowns based on 2016-17 data.
Includes NSERC Discovery Suite, Research Tools & instruments, awards for students and postdoctoral fellows (total in Canada $457M), SSHRC Insight suite, doctoral awards and postdoctoral fellowships (total $124M), CIHR Foundation Grants, Project Grants and CIHR fellowships (total $229M), CFI (total $423M).

Key Federal Support Programs for Basic Research and Related Talent and Infrastructure
Exhibit 7

Natural Sciences and Engineering Research Council of Canada (NSERC)
Discovery Grants
Discovery Development Grants
Discovery Accelerator Grants
Discovery Accelerator Supplements
Discovery Frontiers
Undergraduate Student Research Awards
Postgraduate Scholarships – Master's & Doctoral
Postdoctoral Fellowships
Collaborative Research and Training Experience (CREATE)
Social Sciences and Humanities Research Council of Canada (SSHRC)
Insight Grants
Insight Development Grants
Doctoral Awards
Postdoctoral Fellowships
Canadian Institutes of Health Research (CIHR)
Foundation Grants
Project Grants
CIHR Fellowships
Canada Foundation for Innovation (CFI)
John R. Evans Leaders Fund
Innovation Fund
Major Science Initiatives

Note: These programs were included in calculations in Exhibit 6. Selection was based on programs covered in Canada's Fundamental Science Review (FSR), 2017. FSR also included tri-council programs and contribution agreements with various federal arm's-length agencies, which were not included in our calculation.

Despite the potential for synergies, there is no "strong tradition" of federal-provincial collaboration on research in Ontario (Tamtik, 2016). In fact, in the entire portfolio of basic research supports, only infrastructure projects have been actively co-funded between the CFI and the ORF-RI program.

However, as early as 2009, a Value-for-Money audit pointed out weaknesses in this arrangement, including (Office of the Auditor General of Ontario, 2009):

- overreliance on CFI to make decisions and monitor projects, without sufficient provincial review, and
- not ensuring that funded projects benefit Ontario's strategic priorities.

By 2011, the Province introduced the *Ontario First Strategy* mandating that funding decisions create "strategic benefits to Ontario" as well as drafting agreements that clarified roles in the "sharing of monitoring, audit, and site-visit reports" (Office of the Auditor General of Ontario, 2011).

With the exception of CFI, the connection between Ontario and federal agencies on basic research remains highly fragmented (Tamtik, 2018). Based on our analysis, at least $500M of federal and provincial funds for fundamental research go uncoordinated every year. This highlights both the challenge and the opportunity.

Impacts in Ontario

Fragmentation
The proliferation of funding schemes at the federal and provincial levels has increased complexity without forming a well-functioning system and clear linkages. An estimated 12,828 research-active university scientists in Ontario navigate this dual system and seek piecemeal funds to shoulder the costs of their science.[1] This results in significant waste and inefficiencies such as excessive time to learn all potential funding opportunities and to apply for grants with significant delays between application and notice of decision. For unsuccessful faculty, this presents a significant waste of effort.

Resource allocation challenges
Any solution to the coordination gap must begin with understanding how resources are currently allocated in the Province. Ideally, needs not met by provincial programming would be met by federal programs, and vice versa. But this is not the case.

The challenges at the federal level are well known. Mixed success rates in granting competitions and declining funding for unfettered basic science leave many researchers without sufficient funds (Advisory Panel for the Review of Federal Support for Fundamental Science, 2017).

At the provincial level, a number of programs were phased out in 2012. The annual financial commitments through the remaining streams have fluctuated widely (see differences in amounts in Exhibit 8) (updated from Matyskiel, 2013). In some years, no funding calls were even issued, making the provincial programs highly unreliable and unpredictable sources of funds.

Provincial funds that are actually disbursed are allocated unevenly across institutions, disciplines, researchers, and types of projects. For example, the University of Toronto, the University Health Network, and other Toronto hospitals secured 40% of all major commitments for science in Ontario. A small group of universities each received in excess of $100M (Exhibit 9) (updated from Matyskiel, 2013).

1 Fraction of research-active faculty estimated from Council of Ontario Universities report, Faculty at Work. The Composition and Activities of Ontario Universities' Academic Workforce, January 2018.

"Without coordination, there are gaps in who and what gets funded. Currently, only 52% of all research-active faculty across Ontario are supported by federal and provincial basic science programs."

Ontario's major funds also have overwhelmingly emphasized natural sciences and engineering (NSE) (Exhibit 10). Projects in select NSE disciplines, including information technology, biomedical engineering, and genetics, each garnered close to or over $100M. Overall, the Government committed 30 times more funds to NSE than to the Social Sciences, Humanities and Arts (SSHA). This is reflected in specific programs: e.g. SSHA disciplines account for only 0.2% of all funds in the ORF-RE stream.

At the researcher-level, the top 10% recipients attracted nearly three-quarters of all committed funds (Exhibit 11). This means that less than 1% of all full-time university faculty in Ontario handled more than 50% of all major grants committed by the Province. [2]

The awarding has also skewed the balance in favour of larger-scale NSE projects. Ontario committed, on average, more than $4M per project through the ORF-RE program and more than $483K per project through the ORF-RI stream. [3]

Without coordination, there are gaps in who and what gets funded. Currently, only 52% of all research-active faculty across Ontario are supported by any basic science programs, provincial or federal.[4]

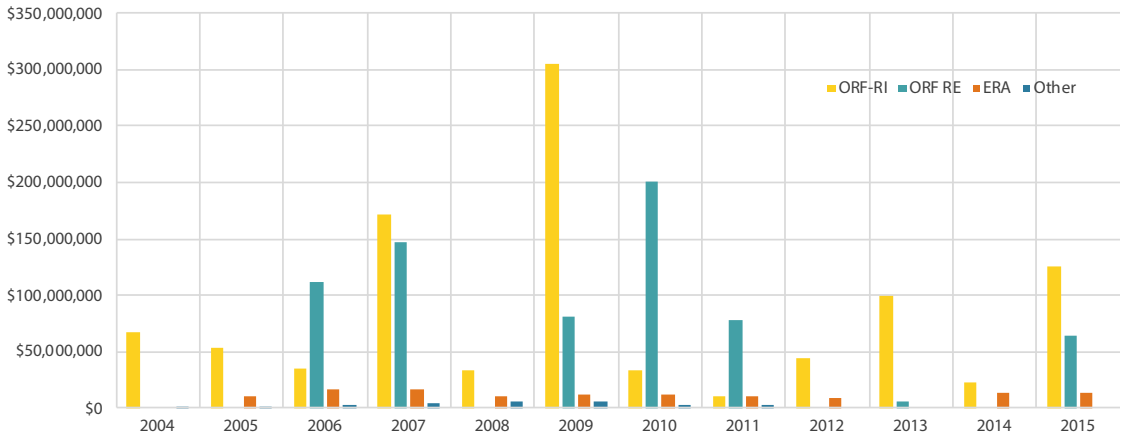
The concentration of funds in specific institutions, researchers, disciplines and even project types has the potential in the long-term to create a system of "winners and losers", compromising the development of talent and institutional capacity, stifling innovation and compromising system health.

2 The number of full-time faculty (all ranks) grew from 13,526 in 2004-05 to 15,316 in 2014-15. Based on data from the Council of Ontario Universities (2017). Information about Ontario universities' faculty.'Table 1. Full-time faculty in Ontario by Rank and Gender'. <http://cou.on.ca/numbers/multi-year-data/faculty/> accessed 16 February 2018.

3 Analysis based on Ontario research funding summaries

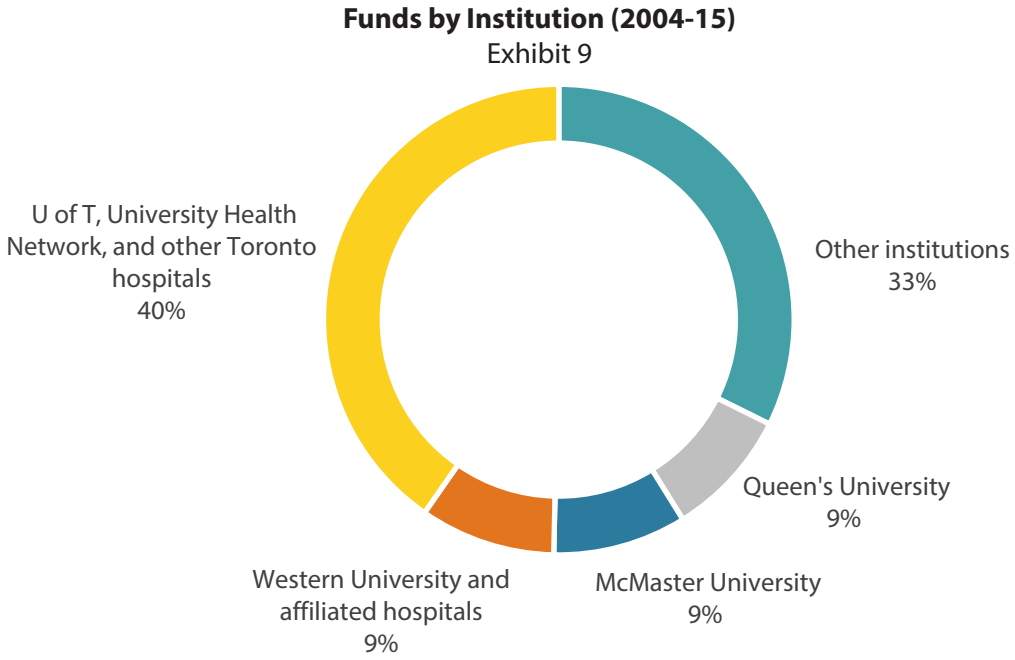
4 Percentage of funded faculty based on calculation using Ontario research funding summaries from Government of Ontario and NSERC, SSHRC, CIHR, CFI funding summaries for basic science programs.

Annual Commitments by Program
Exhibit 8



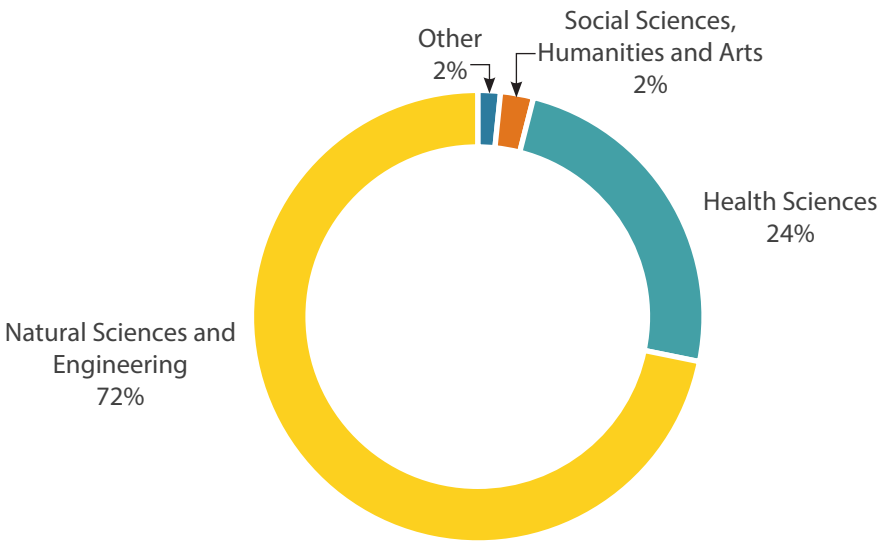
Source: Amounts in 2015 dollars. Calculation based on Ontario research funding summaries, Government of Ontario. Adapted from John Matyskiel (2013). 'A look at Ontario's research funding' MaRS Data Catalyst <https://www.marsdd.com/systems-change/data-catalyst/news/ontario-research-funding/>

Funds by Institution (2004-15)
Exhibit 9



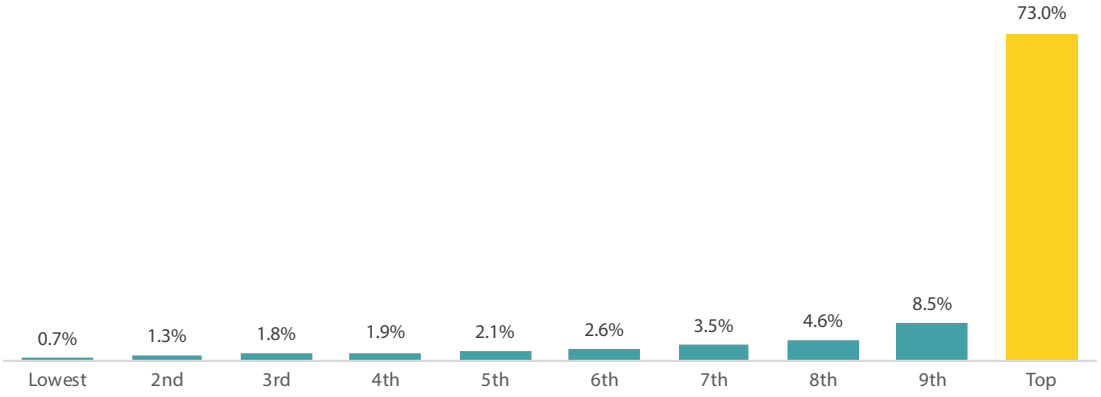
Source: Amounts in 2015 dollars. Calculation based on Ontario research funding recipients, Government of Ontario. Adapted from John Matyskiel (2013). 'A look at Ontario's research funding' MaRS Data Catalyst <https://www.marsdd.com/systems-change/data-catalyst/news/ontario-research-funding/>

Funds by Research Domain (2004-15)
Exhibit 10



Source: Amounts in 2015 dollars. Calculation based on Ontario research funding recipients, Government of Ontario.

Distribution of Commitments by Recipient Decile (2004-15)
Exhibit 11



Source: Calculation based on Ontario research funding recipients, Government of Ontario. Total funding of $1.84B includes ORF-RI, ORF-RE, and ERA. Total number of faculty listed as recipients is 2,349.

Example: Commercialization of Health Technologies

Program misalignments and gaps go beyond basic science funding. If we look further along the R&D spectrum, we are likely to see similar challenges. In fact, a recent Impact Brief on the health technology innovation system highlighted Canada's relatively weak performance on metrics such as the number of health tech companies and investments in young as well as more established businesses (Plant, 2018).

Weak commercialization, investment, and business growth have been a persistent challenge and part of our national innovation story for many years. But what the recent report highlighted in particular is the *complexity and the lack of coordination* across the system. Discoveries commercialized via the "public track"—i.e. those moving from university labs and often supported by a mix of public and private funds all the way to the healthcare system—are susceptible to encounter fragmentation and complexity.

This becomes especially clear when we take the point of view of a scientist commercializing a hospital or university discovery through a startup in Ontario. Depending on needs, the entrepreneur may access a range of organizations for services, from university incubators for advice and the Ontario Centres of Excellence (OCE) for funding to MaRS for market intelligence and the Business Development Bank of Canada (BDC) for financing.

The innovation support system is thus split between federal and provincial agencies offering multiple points of entry to services but without significant linkages. Although there is some recognition of the problem, the system remains highly fragmented with "funding and assistance gaps". For example, while many programs help shoulder some basic R&D costs, certain expenditures critical to commercializing a technology and scaling a young business (e.g. prototyping and marketing) are rarely considered eligible.

The analysis also suggests that more effective coordination will demand not only change across agencies but also within organizations playing an active role in our innovation ecosystem. As Plant points out, the health system also incorporates hospitals as the main purchasers of health-related innovations. But the primary objective of our hospitals is quality health care rather than commercialization and purchase of innovation. This is complicated further by the fact that a significant portion of health research is supported by the federal government, while health generally remains under provincial jurisdiction.

Please refer to the report entitled *Land of Stranded Pilots* (Plant, 2018) for a more detailed discussion on the lack of coordination in Canada's health technology innovation system.

Policy Options

In light of the shared responsibility and similar themes at the federal and provincial/territorial levels, there are opportunities for coordination. The 2016 Fundamental Science Review recognized that research supports are "an area where close cooperation and shared planning would make sense, but that is not what the Panel found" (p. 67). A recent Council of Canadian Academies (CCA) report (2017) on provincial and territorial science policy highlighted this coordination gap as "both a risk and opportunity" (p. 6). Although the expert committee cautions against poor strategy and policy formulation, there are significant benefits to be derived from a closer connection between provincial/territorial and federal programs—if successfully translated into practice.

Any recommendations going forward must consider how current barriers to coordination could be overcome. Although we will certainly not be able to address all shortcomings inherent in the structure of our federal system, we could begin with more attainable, short-term goals while laying the foundation for more ambitious coordination targets.

Let us look at potential short-term opportunities in relation to select barriers mentioned earlier.

Barrier:
Lack of mechanisms/vertical communication and limited resources for relationship building and common goal setting.

Opportunity:
The integration of scientific activities across Europe offers instructive examples of possible tools for communication and relationship building in Canada. Some European countries have used *centralization* as a means to achieve better coordination. Examples of the "superministry" approach, which involves ministerial mergers and internal coordination of all R&D activity within a single ministry, can be found in Denmark (Koch, 2008), and more recently outside of Europe (e.g. China). While there are advantages and disadvantages to centralization, Canada's regional diversity, strong jurisdictional division on higher education, and sensitivity to infringement over activities does not make this a likely path.

"Softer" approaches that do not require major organizational restructuring are perhaps a better alternative. Examples of tools used to promote better information exchange, alignment, and integration in Germany, Sweden, and Switzerland are listed in Exhibit 12.

Amongst venues for information exchange, Canada currently has the Council of Ministers of Education, Canada (CMEC) and the Canadian Intergovernmental Conference Secretariat (CICS). CMEC is an interprovincial body where provincial and territorial ministers of education work together on higher education and K-12 issues. But in its current form, CMEC is not well suited to FPT coordination on science and research for three reasons. First, CMEC tends to focus on education issues, and particularly K-12 policy. Second, research is not represented in this venue because it does not fall under the Ministry of Education in most Canadian regions. Third, the federal government and its agencies have not been granted membership to the CMEC (Jengblut and Rexe, 2017).

Funded by both levels of government, CICS offers administrative support for conferences of first ministers, ministers and deputy ministers. Although not exclusively concerned with research and innovation, it has organized meetings for FPT ministers for innovation and economic development, which have led to some high-level talks on talent and innovation strategy.

However, with agencies closest to the research system, the CRCC could be an opportunity to foster closer linkages between the federal and provincial/territorial agencies and could, in fact, be nurtured as a mechanism for ongoing coordination.

But, regardless of the venue chosen, an intergovernmental forum should:

- foster a common understanding on policy issues that affect research supports,
- provide a site for proactive consultation on major programs that could impact matching requirements at both levels,
- call task forces on specific topics that could impact FPT research budgets, and
- formalize interactions and strengthen the mechanisms for information exchange and consultation.

Such an "inter-jurisdictional coordinating body" and "learning-centered approach" could be a practical and achievable pathway for Canada (Tamtik, 2016). The need for such a forum was recognized quite early in studies on Canadian science and technology:

> *[T]he absence of an official intergovernmental body dealing with science and technology policy has provoked some to argue that there is a need for such a body to act as a focal point for federal-provincial discussion on science and technology* (Le Roy and Dufour, 1983, p. 72).

The provincial/territorial representation in this forum should include chief scientists (or equivalent), directors of research and innovation branches, and civil servants and staff overseeing provincial/territorial programs. The process could begin with assigning clear responsibility for coordination at both levels, setting coordination targets/common definitions, and creating instruments for monitoring these targets. Above all, this type of forum should allow for input from researchers and innovators at all career stages and from a wide range of disciplines and types of institutions.

Examples of Strategies Used to Promote Coordination in Research and Innovation
Exhibit 12

Country	Coordination tools
Germany	Large initiatives, strategies and roadmaps (e.g. Excellence Initiative) that require co-funding and co-signing on projects Alignment through shared strategic intelligence (e.g. common evaluation and monitoring activities and standards) Science and Technology Council, an advisory body with federal/state representatives and scientists to offer analysis on policy issues straddling jurisdictions
Switzerland	Legislation and common governing body mandating clear responsibility for basic and applied research (e.g. Switzerland Federal Research Act that mandates all stakeholders to be involved in the planning of four-year strategies) Inter-ministerial coordination committees Embedding of observers in stakeholder organizations
Sweden	"Micro-networks" to reduce program mismatches "Foresight guilds" as thematic meetings and seminars to discuss future projects Umbrella organizations as neutral convenors and observers of challenges/opportunities
European Union	"Open Method of Coordination" as a "soft-law" mechanism Progresses from agreement on policy goals between member countries to creating instruments for evaluation and benchmarking, to actual evaluation and regular "show and tell" meetings between member states to report on progress to date

Source: Science and Public Policy (2008); Neilsson and Moodysson (2015); Peters (2015).

Barrier:
Limited knowledge and resources to coordinate and manage a complex research and innovation system and wide range of stakeholders.

Opportunity:
Better coordination will demand a change in how we think about programs at the top and deliver services to the clients "at the bottom". When it comes to coordination, "[t]he first lesson is that mere structural manipulations [at the top] cannot produce changes in behaviour" (Peters, 1998, p. 47).

To raise awareness and assist with building capacity in government to deal with issues of coordination, secondment or placement initiatives could be used to move program experts and staff between provincial/territorial and federal agencies. Such swaps have already been extensively used in the public sector. Select employees could serve at the host institution from few weeks to months-long stints depending on project type. A starting point may include the placement of provincial/territorial research staff with the CRCC Secretariat, or a similar forum, to create shared monitoring and evaluation tools for FPT initiatives.

Another area could be the swapping of employees between programs that are currently co-funded to learn how their provincial/territorial and federal counterparts review, evaluate, fund, deliver, and monitor projects. Other options may cover exchanging employees between provincial/territorial and federal programs with similar scope, duration and budget. Such placements would provide a good opportunity for learning throughout the funding lifecycle and for building capacity in regions whose research systems are still maturing. Such initiatives would enable mutual learning and data exchange at the program level.

Barrier:
Proliferation of programs and services at the federal and provincial/territorial levels.

Opportunity:
More conscious and effective linkages in the system would reduce fragmentation and resource allocation challenges described in previous sections. The Fundamental Science Review made it clear that from the point of view of researchers, the program mix is an area in urgent need of attention.

As provinces and territories seek to boost their own investments in research and innovation, their mandate should allow for coordination of these investments with federal agencies, including NSERC, CIHR, SSHRC, and CFI. While many regions across Canada already leverage significantly, continued coordination is particularly important for smaller provinces and territories whose federal investments significantly outweigh local funds for research.

In making recommendations on program linkages, strategies should account for existing funding gaps (as described earlier for Ontario). That means that good data is key. Without it, it is impossible to actually ascertain the state of FPT coordination.

Equipped with better data, FPT linkages could consider both strategic and administrative aspects of programs that would lend themselves well to alignment, for example:

- allowing federal contributions as eligible matching in funding programs,
- setting targets for increasing the number of researchers with some funding,
- taking into account funding life cycles and minimizing gaps between calls for proposals,
- connecting scientific areas that are actively funded by both levels but are currently not linked, or
- considering areas that are still not adequately supported by both levels.

Currently, financial leveraging or co-matching is frequently used to manage relationship between different programs in Canada. However, co-financing should not be seen as the only tool for coordinating. Exhibit 13 highlights a number of potential relationships between supports that could be considered in the formulation of a strategy. A "user-centered" design that considers the journey of the scientist or innovator through the R&D support system would be particularly useful in this regard.

Potential Relationships Between Programs

Exhibit 13

Relationship	Description
Similarity	creating synergies between programs with similar characteristics (e.g. funding a research program rather than random independent projects)
Complementarity	task division can reduce waste (e.g. adjusting the scope or focus of different activities to help avoid duplication)
Acquaintance	mutual awareness of other activities helps exploit possible synergies (e.g. referring clients to other programs matching their needs)
Collaboration	active sharing of resources can boost efficiency of activities (e.g. data, funding, knowledge)
Synchronicity	purposeful timing of activities (e.g. output of one activity is the input to another)
Proximity	geographical proximity makes contact, mutual learning and spillovers more likely (i.e. co-locating activities, facilities, staff)

Source: Reproduced from Hessels (2013).

Discussion Questions

As we move forward with the discussion on FPT coordination, we pose here a few questions that warrant consideration—including some elements mentioned in the introduction to this paper:

- How do our federal and provincial/territorial policies and programs for research and innovation currently reinforce/negate each other?
- How widely is FPT coordination recognized as an issue? To what extent have stakeholders begun to address it?
- How much effort should we invest in coordination?
- Who should take responsibility for dealing with the issue, at both the provincial/territorial and federal levels?
- Where do we begin FPT coordination?
- What could be some short- and long-term coordination targets? What do we define as success?
- What existing venues or mechanisms could be used for information exchange?
- How can the federal research councils work with their provincial/territorial counterparts to avoid policy duplication and inconsistencies in support programs?
- The funding data from Ontario hints at resource allocation issues and gaps in coverage. In view of those issues, should we be setting targets to help increase the fraction of scientists funded through federal and provincial/territorial agencies?
- How can past examples of FPT initiatives inform the present?
- What are potential models for future intergovernmental coordination?
- What data is needed to inform ongoing coordination?

Conclusions: Implications for Policy Makers and Funders

The consultation points outlined here offer a starting point to the discussion on FPT coordination on R&D. The current focus on harmonization between major funding agencies at the federal level makes a conversation on coordination mechanisms with the provinces and territories particularly timely.

We recommend leveraging existing science advisory structures to build the mechanisms that can sustain coordination. More effective linkages would cover gaps in services currently encountered by scientists and innovators and help build the capacity needed to sustain both science and innovation. At a minimum, the targets should consist of more awareness, better data, clear responsibility for coordination at both government levels, and clear mechanisms for data exchange and consultation.

However, balance must be struck between too little and too much coordination. The system must allow for a certain amount of flexibility and diversity across regions, research disciplines, and types of activities. Critical to better coordination will be to look at the system from the perspective of scientists and innovators navigating the increasingly complex mix of supports.

We also need to keep in mind that research and innovation, although linked, must receive slightly different treatments. We have not yet touched on supports for industrial R&D, venture capital, and related challenges.

We invite others to send us their feedback, thoughts, and suggestions on the issue of coordination. These collective contributions and thoughts, along with some other areas that must considered, will be covered in an upcoming Impact Brief.

References

Advisory Panel for the Review of Federal Support for Fundamental Science (2017) *Canada's Fundamental Science Review.* <http://www.sciencereview.ca/eic/site/059.nsf/vwapj/ScienceReview_April2017-rv.pdf/$file/ScienceReview_April2017-rv.pdf> accessed 26 May 2017.

Braun, D. (2008) 'Organising the Political Coordination of Knowledge and Innovation Policies', *Science and Public Policy*, 35/4: 227-39.

Candel, J. J. L., and Biesbroek, R. (2016) 'Toward a Processual Understanding of Policy Integration', *Policy Sciences*, 49:2011-31.

Council of Canadian Academies (2017) *Science Policy: Considerations for Subnational Governments.* Ottawa, ON: A Workshop Steering Committee Report, Council of Canadian Academies.

Government of Ontario (2008) *Seizing Global Opportunities: Ontario's Innovation Agenda*.

Government of Ontario (2017a) *Ontario Research Fund: Research Excellence* <https://www.ontario.ca/page/ontario-research-fund-research-excellence> accessed 29 January 2018.

Government of Ontario (2017b) *Ontario Research Fund: Research Infrastructure*. <https://www.ontario.ca/page/ontario-research-fund-research-infrastructure> accessed 1 February 2018.

Hessels, L. K. (2013) 'Coordination in the Science System: Theoretical Framework and a Case Study of an Intermediary Organization', *Minerva*, 51: 317-39.

Jengblut, J., and Rexe, D. (2017) 'Higher Education Policy in Canada and Germany: Assessing Multi-Level and Multi-Actor Coordination Bodies for Policy-Making in Federal Systems', *Policy and Society*, 36/1: 49-66.

John Matyskiel (2013) 'A look at Ontario's research funding', MaRS Data Catalyst <https://www.marsdd.com/systems-change/data-catalyst/news/ontario-research-funding/>
Koch, C. (2008), 'The Superministry Approach: Integrated Governance of Science, Technology and Innovation with Contracted Autonomy', *Science and Public Policy*, 35/4: 253-64.

Le Roy, D. J., and Dufour, P. (1983) 'Partners in Industrial Strategy. The Special Role of the Provincial Research Organizations', Background Study No. 51, prepared for the Science Council of Canada.

Martin, B. R. (2016) 'R&D Policy Instruments – A Critical Review of What We Do and Don't Know', *Industry and Innovation*, 23/2: 157-76.

Neilsson, M., and Moodysson, J. (2015) 'Regional Innovation Policy and Coordination: Illustrations from Southern Sweden', *Science and Public Policy*, 42/2: 147-61.

Office of the Auditor General of Ontario (2009) *Annual Report*. '2009 Annual Report. Chapter 3. Section 3.10. Ontario Research Fund', pp. 238-53.

Office of the Auditor General of Ontario (2011) *2011 Annual Report*. 'Chapter 4. Section 4.10 Ontario Research Fund. Follow-up on VFM Section 3.10, 2009 Annual Report', pp. 376-83.

Peters, B. G. (1998) 'Managing Horizontal Government. The Politics of Coordination', Research Paper No. 21, prepared for the Canadian Centre for Management Development.

Peters, B. G. (2015) Pursuing Horizontal Management. The Politics of Public Sector Coordination. Lawrence, KS: University Press of Kansas.

Peters, B. G. (2018) 'The Challenge of Policy Coordination', *Policy Design and Practice*, 1/1: 1-11.

Plant, C. (2018) *The Land of Stranded Pilots. Challenges Facing the Health Technology Innovation System in Canada*. Toronto, ON: Impact Centre.

Tamtik, M. (2016) 'Policy Coordination Challenges in Governments' Innovation Policy—The Case of Ontario, Canada', *Science and Public Policy*, 44/3: 417-27.

Tamtik, M. (2018) 'Movers and Shakers of Canadian Innovation policy – Recognizing the Influence of University Vice-Presidents as Policy Advocates', *Tertiary Education and Management*, DOI: 10.1080/13583883.2018.1445772

Tosun, J., and Lang, A. (2017) 'Policy Integration: Mapping the Different Concepts', *Policy Studies*, 38/6: 553-70.

Science and Public Policy, Volume 35, Issue 4, May 2008, pp. 227-98

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