Conversation on the future of research and research infrastructure in Canada: Role of the Canada Foundation for Innovation: A discussion paper
CNSP Discussion Paper Response

Claire M. Brown, President, CNSP, Director, Advanced BioImaging Facility (ABIF), McGill University

Claire Brown synthesized many comments into this document. The text and ideas are from many members of the CNSP community listed here. Aspects of this discussion paper also stem from feedback and discussions at CNSP Scientific Platforms Meetings held in Montreal, QC, May 9, 2017 and in Edmonton, AB, June 18-20, 2018. These meetings were attended by ~200 researchers from across Canada.

Contributions from:

Pedro M. Aguiar, Coordonnateur, Laboratoire de RMN, Université de Montréal
Rebecca Barnes, Program Leader, Canadian Tissue Repository Network (CTRNet)
John Copeland, Director, CBIA Microscopy Core, University of Ottawa
Isabelle Cossette, Director, Centre for Interdisciplinary Research in Music Media and Technology, McGill University
Karen Colwill, Staff Scientist, Network Biology Collaborative Centre Manager, Lunenfeld-Tanenbaum Research Institute
Serge Dernovici, CFI project coordinator, Core Facility Director, Institute of Parasitology, McGill University, The Centre for Interdisciplinary Research in Music Media and Technology (CIRMMT), McGill University
Miki Fujita, Research manager, BioImaging Facility (BIF)**,** University of British Columbia
Melina Jaramillo Garcia, Coordinator, Molecular and Cellular Microscopy Platform (MCMP), Douglas Hospital Research Centre
François Jean, Western Canada Representative, CNSP, Associate Professor, University of British Columbia
Karen L. Kavanagh, Dept. of Physics, Simon Fraser University
Laurence Lejeune, Vice-President, CNSP
Guillaume Lesage, Treasurer, CNSP, Grants Officer-Strategic Initiatives, McGill University
Sabine Mai, Director, Genomic Centre for Cancer Research and Diagnosis, University of Manitoba
Brent Myron, Eastern Canada Representative, CNSP, Manager of Operations, CREAIT, CFI, and CRC Services (CCCS), Memorial University
Derek Oliver, Secretary, CNSP, Director, Manitoba Institute for Materials, University of Manitoba
Marie-Eve Paquet, Central Canada Representative, CNSP, Coordonnatrice de la plateforme d'outils moléculaires, Centre de recherche CERVO**,** Université Laval
Mario Methot, Coordinator, Neurophotonics Center & Biophotonics and Neurophysics Training Programs, Université Laval
Sato Sachiko, Director of Bioimaging platform, CHUL-CHU de Québec Research Centre
Tara Sprules, Quebec/Eastern Canada High Field NMR Facility (QANUC), McGill University
Peter A. Stokes, Director, CFI Projects, CMC Microsystems
Michaela Strüder-Kypke, Advanced Light Microscopy, Advanced Analysis Centre, University of Guelph
Amélie Tétu, Consultante, Professionnelle de recherche, Unité de recherche clinique et épidémiologique (URCE) du CIUSSS-Estrie, CRCHUS
Barbara Triggs-Raine, Scientific Director for Central Animal Core Facilities, University of Manitoba
Patrice Vaillancourt, Manager, Operations and Platforms, Research Institute of the McGill University Health Centre.

Discussion Paper Summary

The CFI has provided tremendous infrastructure resources to the Canadian research community over the last 20 years. The Canadian Network of Scientific Platforms//Réseau canadien des plateformes scientifiques (CNSP/RCPS) (http://cnsp-rcps.ca/) termed CNSP for the remainder of this paper, acknowledges that these investments have created a rich landscape of research infrastructure platforms also termed core facilities or scientific platforms (SPs). The CNSP specifically uses the term scientific platform (SP) instead of core facility as many researchers include all core institutional services under the term core facility. SPs focus only on scientific infrastructure facilities and do not include other centralized services (e.g. dish washing, laundry, autoclaving). The term SP will be used to represent core facilities throughout this document. A detailed definition of a SP is provided in **Appendix I**. The CNSP mission statement in **Appendix II** is very well aligned with the goals of the CFI and aims to promote the maintenance and sustainability of research infrastructure and SPs and the use of that infrastructure to its full potential by academic, government and corporate researchers.

The three main challenges from the SP platform point of view are summarized here. More detailed responses in relation to the discussion questions are provided below.

1) **Recruitment, retention and recognition of platform scientists.** Platform scientists are world class researchers on pare with principal investigators and top scientists in industry. They need to be treated accordingly. Funding is needed to support competitive salaries, opportunities for professional development and career progression. Without highly qualified platform scientists, infrastructure and services cannot be offered to the scientific community at a globally competitive level.

2) **Acquisition, maintenance and replacement of routine and high-level infrastructure.** Separate infrastructure funding calls that platform directors and managers can directly apply for. This funding should not be tied to a single research program but to the overall success of the SP, often at the convergence of different disciplines. SPs should be evaluated with metrics such as publications, user base, quality of platform scientists, sustainability of the SP, institutional commitment, sustainability plan and need for the infrastructure. Funding calls should include replacement of routine heavily used infrastructure as well as high-end unique infrastructure. Platform scientists should be involved in developing these calls and in the review process. Work could be done nationally with corporate partners to establish national pricing for service, maintenance and upgrades.

3) **Awareness and promotion of SP infrastructure and expertise.** Further investment in the CFI Navigator and development as a highly-interactive database of infrastructure, services and expertise. Funding for national networks such as the CNSP to be involved in national, regional and institutional awareness campaigns, development of national policies, processes and best practices, improved standards, reproducibility, enhanced access, tailored responses to research needs and reduced duplication of infrastructure. Mobility funding directly to researchers to access SPs.

The CNSP is perfectly positioned to advise the CFI on the creation of new funding initiatives and policies to support SPs. The network is already well established, continues to grow, is engaged with the community and has the mandate to speak on behalf of its members. The CNSP would like to be actively engaged with the CFI in the process and be part of the solution. We will work together towards the future of sustainable, world class SPs with well supported and recognized platform scientists putting Canada at the forefront of modern technology and applications for innovative research.

Convergence

1. Do your intended research objectives lend themselves to convergence research?

SPs are inherently multi-disciplined and inter-disciplinary and can play a central role in convergence research projects. SPs are the place where people meet and share experience. Importantly, SP managers and platform scientists are at the core of institutional networks, interact with diverse groups and can efficiently direct researchers towards potential collaboration with other researchers and other SPs to strengthen research findings. ***A common institutional mandate for SP managers and platform scientists is to stimulate and sustain new convergence projects.*** *This highlights the* ***importance of an overarching organizations like the CNSP*** *for sharing of knowledge and exchanging experience across institutions, geographies and technologies.*

2. Would you say that you are carrying out convergence research at this time?

The CNSP currently represents 134 platforms across Canada. *Each platform is serving hundreds of researchers in their institutions so the CNSP is playing an integral role in hundreds of convergence research projects. Some examples include The Canadian Neurophotonics Platform which brings together the expertise of physicists, biologists, engineers, chemists, mathematicians, and neuroscientists to address fundamental questions in neuroscience at Université Laval. The nanoFab facility at University of Alberta (https://www.nanofab.ualberta.ca/) was established in 1999 and serves a large base of researchers from diverse areas and works closely with biotechnology companies.*

3. What would be the main characteristics of a fund designed to support convergence research?

Direct funding to the CNSP *to disseminate new technology developments, develop and advocate best practices, harmonize different technological approaches, communicate success stories to different stakeholders (different technologies, different geographies, private sector presence) and researchers from different backgrounds would facilitate convergence research.*

One of the main advantages of convergence research is that members of the team coming from different backgrounds will approach a research question from different perspectives. This often leads to innovative and unique solutions made possible from a diverse team. However, this can also bring along with it a challenge in getting to a point where researchers from different backgrounds are speaking the same language and understanding the scientific question in the same way. Platform scientists working at the interface between areas of research and experienced in working with diverse groups are ideally suited to facilitate interactions on convergence research team. To facilitate this there is a need for funding for recruitment and retention of highly qualified platform scientists at the mid- to late-career stage with extensive interdisciplinary expertise (inherent in most SP technologies and applications).

4. To what extent should convergence be used as a criterion for making funding decisions?

With the increased capabilities and diversity of technology development and application convergence research is going to continue to become more mainstream. It is important that it is of central concern when making funding decisions. A priority for direct funding for SP operations and platform scientists will facilitate convergence science. SP are uniquely positioned to enable convergence because they bring together a diverse group of researchers with diverse research questions that can be addressed with specific infrastructures and expertise. There is an efficiency in funding many of these projects as a group rather than as individual isolated programs. At smaller institutions, the critical mass required to achieve world-leading convergence is challenging. Paradoxically, particularly at smaller institutions a pathway to convergence may be found through investment in SPs which seed interdisciplinary collaboration and, in turn, develop a critical "converging" mass. Outside of the biggest 5-12 institutions, this longer-term view is critical to developing new initiatives. ***SP infrastructure funding is justifiable and needed to ensure that there is diversity of "convergent" research themes within the national portfolio.***

5. How can space act as a catalyst for convergence research?

SPs that act as institutional resources and not dedicated to a single-researcher, department or faculty will inherently act as a catalyst for convergence research. This can be achieved by creating space that is dedicated to SPs and managed on an institutional level. To be successful, independent funding directed to SPs and not individual principal investigators will be necessary. This funding then benefits the entire research community and not just individual research programs.

6. What is required to enable convergence research beyond academic institutional boundaries and to create and enhance partnerships with business and all sectors?

SP are perfectly positioned at the interface between academics and businesses and can act as a catalyst bringing together the two groups. For example, infrastructure companies can engage SP to co-develop standards, standard operating procedures (SOPs), new procedures and protocols, new services and disseminate these developments directly to the research community of SP users. ***Direct financial support for the CNSP to play a central role in building corporate-academic partnerships would bridge this gap.*** *The CNSP symposium in 2018 was supported by an NSERC connect grant and brought together SPs, corporate users of SPs and corporations building R&D relationships with SPs. Highly qualified staff hired by the CNSP could be dedicated to identifying and building academic-corporate partnerships. Funding for the CNSP to participate in corporate, infrastructure, technology workshops, courses and symposia would allow for the discovery and development of new partnerships. This could build into SP-corporate partnerships that would increase R&D activities based in Canada.*

The CNSP also has plans to develop basic business skills development courses for platform scientists and managers. Training in management, leadership, marketing, accounting and finance will

allow SPs to optimize research dollars, run top SP operations and build corporate partnerships. University business schools could build on intra- and inter-institutional convergence by being involved in developing these training opportunities through executive MBA program expertise. Corporate partners could also be engaged in these training initiatives.

Some more flexibility in IP management that is shared by many institutions, and more flexibility with non-cash-in-kind contributions from small start-up businesses could remove insurmountable barriers for these agile and engaged potential research partners.

7. How can research infrastructure, through regional facilities, institutional core facilities or individual laboratories better facilitate convergence research?

Investments in highly qualified platform scientists *are essential to build and retain the knowledge base needed to operate research infrastructure to its full capacity.* ***Centralized expertise with multiple expert staff*** *in SPs will ensure a breadth and depth of knowledge and a collaborative team work environment that will benefit the individuals involved and the entire scientific community. There is a need to identify facilities that are* ***structured and operated sustainably*** *with demonstrated breadth of impact that can catalyze convergence research and provide operating funds to do so.*

Most SPs cannot sustain themselves from grant-funded individuals and most importantly beyond the 5-year CFI-IOF funding window and be financially self-sufficient. ***Promoting the formation of centralized institutional SPs with clear institutional sustainability plans and supporting them is essential.*** *Recognition of platform scientists as world class experts who are supporting hundreds of research programs and providing stable funding for them is important for sustaining SPs. Stable SP funding will allow platform scientists to focus on development of new applications in non-classical research areas that can facilitate multi-application convergence and allow pricing to remain competitive and accessible to smaller teams, young investigators and start-up companies with limited R&D funds. Overall, this will ensure convergent research through the broad accessibility of proven and reliable technologies, and unique and state-of-the-art infrastructure to the broader research community and use of infrastructure investments to their full potential.*

8. Apart from providing research infrastructure and space, what additional role can the CFI play to better support convergence research?

There is a need to provide resources to promote existing infrastructure and expertise across the country. SPs need to be promoted within individual institutions, regionally and nationally. Further investments in the Navigator web portal are needed so researchers and businesses can drill down and not only find SPs but also individual pieces of infrastructure, details about that infrastructure and most importantly ***expert platform scientists*** *for applications in specific research areas. For example, multiple institutions may have high level infrastructure in a given area but only one group may have expertise in applying that technology to a specific research area. Personnel in specific research areas will be required to promote the Navigator, research infrastructure and make connections between academics*

and business, this will require staff with broad expertise (e.g. engineering, materials science, aerospace, cell biology, clinical research). The CNSP could play a central role in providing that expertise, finding key connections between academics and corporations and aid in the overall promotion of infrastructure and expertise available regionally and nationally. ***Direct funding of the CNSP would allow the network to provide the human resources necessary to make these unique connections that will enable convergence science and optimize use of research infrastructure and expertise.***

International Collaboration

1. What are some examples of important international collaborations that further your institution's strategic priorities?

The CNSP is a relatively young organization and already represents 134 SPs from 40 institutions. Those SPs are actively engaged in international collaboration. More directly, the CNSP is actively engaged with Global BioImaging, the Association of Biomolecular Resource Facilities (ABRF), EuroBioImaging, Core Technologies for Life Sciences (CTLS) and Microscopy Australia. Future plans are to engage with additional technology networks across the physical, life and health sciences such as the Canadian National Proteomics Network (CNPN). Networking internationally through the CNSP will enable rapid uptake and input in new technologies, international standards, recommendations, SOPs, procedures and protocols and will ***keep Canada at the forefront of SP technologies and expertise****. In turn, the CNSP membership is world leading in many areas and can share that expertise internationally. For example. Claire Brown (McGill University, Advanced BioImaging Facility) participated in the Global BioImaging Exchange of Experience III meeting in Sydney Australia and shared her expertise in standards for light microscopy, international training initiatives and had input in an international recommendation for research data management. In addition, the Canadian Neurophotonics Platform and Neurophotonics Center (Université Laval) has a strong association with Boston University, in the development of new technologies and training the next generation of scientists at their Annual International Frontiers in Neurophotonics Summer School.*

2. While our data show that CFI funds have been used to support international collaboration, is the CFI sufficiently contributing to the internationalization of research?

CNSP members, member SPs and institutions are engaged with international partners and projects. ***Further investment in awareness and promotion of infrastructure and expertise****, funding for international training programs and courses and funding for international exchange of SP platform scientists, job shadowing at SPs and mobility funding to access SP infrastructure and expertise would all enable further international collaboration.*

3. Should the CFI be a stronger enabler of international collaboration around infrastructure? If so, how?

Yes. SPs, infrastructure and expertise of platform scientists need to be leveraged to strength and build international collaboration. Direct support for the CNSP would allow the network to promote SPs and expert platform scientists nationally and internationally and to offer international training programs. Funding directly to SPs to promote their infrastructure and expertise and international travel of platform scientists could also contribute and build international collaboration. The CNSP is already working on international training programs including a Quantitative Super-resolution Course at the Neuro in Montreal in May 2019, courses for SP management, leadership and finance and job shadowing

programs where platform scientists can travel and learn from SPs across Canada and globally and in exchange Canadian platform scientists can travel to international partner's SPs. The pilot job shadowing project will involve two United States platform scientists coming to Canada in 2019.

4. What are the key barriers and obstacles faced by Canadian institutions and researchers in successfully engaging in international collaborations? Do you have examples of recent missed opportunities for international collaborations, and if so, what were the barriers to participation?

Mobilization funding opportunities for SPs, managers, directors and platform scientists to travel to international meetings, job shadowing opportunities, technical training and management/business training do not currently exist. Professional development and networking are essential for platform scientists to learn from the global community and build their capacity as research scientists and managers to become leaders in their field. In turn, funding to facilitate international partners to travel to Canadian run SPs, courses and workshops would give hundreds of platform scientists the opportunity to learn from the international community and share our knowledge and expertise. For example, Europe offers many opportunities for imaging scientists to learn quantitative image processing and analysis and the application of machine learning and artificial intelligence to microscopy data (NEUBIAS Training School). Canadian SPs cannot take advantage of these opportunities as revenue from infrastructure usage fees is needed for salary support and maintenance and service of infrastructure. Funding to send Canadian platform scientists to such training events does not exist. Funding opportunities for SP staff to cover travel, accommodations and registration costs would have a tremendous impact. Training opportunities for individual students or post-doctoral fellows do not scale quickly; the training experience may be disseminated to trainees in their immediate laboratory environment and then later to their research teams if they become independent investigators. On the contrary, ***SP scientists can return to their home institutions and immediately disseminate training experience to hundreds of trainees*** *(e.g. students, postdoctoral fellows) using their respective SPs. They can also further develop that training experience by developing or incorporating it into more* ***broadly applicable training courses*** *of their own. This type of* ***"train the trainers"*** *initiative is very effective for rapid dissemination of information and expertise.*

5. What would be the main characteristics of a fund, or funds, designed to support international collaboration (consider scope, size, etc.)?

One key way to promote international collaboration would be through mobilization grants. Grants for scientific platform scientists to travel internationally for professional development opportunities would have a tremendous impact on international collaboration. For example, management courses available internationally would provide platform scientists required training for running facilities, technology courses and schools would provide novel expertise, exchange of experience events to learn from the world's best and all these activities would provide networking opportunities with leaders in the field. In turn, mobilization grants to bring international participants to Canada SP lead training

events, job shadowing and CNSP events would allow us to learn from our international partners. This funding could be distributed directly to institutional SPs with a proven track record, sustainable operation, clearly developed expertise that needs to be built on, expertise in dissemination, course development and implementation, and outreach to an engaged scientific user base. Funding could also be distributed to institutions based on previous CFI success rates and distributed institutionally to avoid excess administrative work. A second type of funding could be mobilization grants for international researchers to travel to Canada to access unique infrastructure and expertise. The funding could be used for travel expenses and user fees for infrastructure use and technical expertise. This would be a way to directly support costly, unique infrastructure and the SPs with the required scientific platform experts for specific technology applications. This would showcase Canadian investments and talent in specific technology areas and applications. For example, international researchers could take advantage of the incredible infrastructure and expertise at FINDER (https://www.finder.ubc.ca/) at the University of British Columbia for infectious disease research.

6. Do you know of other funding opportunities or mechanisms in Canada or abroad with which CFI could partner (within the limits of our mandate) to increase the likelihood of success for international projects?

Direct funding to the CNSP *and other infrastructure networks to partner and participate in international infrastructure network activities such as ABRF, CTLS, EuroBioImaging and Global BioImaging. Funding for travel to exchange of experience meeting, conferences, workshops, training courses and to host these types of events for our partners in Canada.*

Currently it is very difficult to find ***direct funding opportunities for platform scientists****. Assistance could be found in two directions. One would be to open existing funding opportunities available for trainees (e.g. graduate students, postdoctoral fellows) to SP scientists. For example, if Mitacs funding were open to salaries and professional development for platform scientists then companies, institutions and/or the CFI could provide matching funds. Mitacs already has an extensive international network but funding is not open to platform scientists. In turn, programs could be created for graduate students and postdoctoral fellows to perform their training partly or completely within SPs. For example, Janelia research center has a postdoctoral fellowship program to learn optical imaging and core facility management. Those types of postdoctoral training opportunities could be eligible for Mitacs funding and could be* ***targeted for international scientists****.*

The CFI could partner with local, provincial, federal and international funding agencies matching mobility, salary, professional development funding and direct it towards platform scientists. *Professional development in key technology areas (e.g. clinical research, project management, micromachining) would ensure researchers accessing the SP would have access to well-trained experts to guarantee they obtain high quality data. IOF funding could be leveraged to enable international collaborative funding by partnering with groups such as certain opportunities within the European Commission's "Research and Innovation Staff Exchange", "The Innovative Training Networks", and/or "Co-funding of regional, national and international programs" such as funding*

opportunities under their Marie Skłodowska-Curie Actions. Links with international or multi-national corporations could be promoted through a partnership between CFI and the many industrial programs offered by NSERC that could be targeted to ***SP-corporate projects****.*

Support for Smaller Universities, Colleges, Cégeps

1. What are the challenges faced by researchers at a small institution with respect to accessing leading-edge research infrastructures to conduct research?

   Due to the geographical isolation of many of Canada's smaller institutions, researchers often must travel to access key infrastructure and expertise and pay external SP user fees. It is challenging to fund these collaborative initiatives from research grants. In turn, researchers may have to spend significant amounts on travel to access unique, yet remote, infrastructure and expertise at smaller institutions.

2. How can CFI better address the specific needs and challenges of smaller institutions as they relate to research infrastructure?

   Mobility grants to cover travel costs and SP fees to enable researchers at smaller institutions to travel and access necessary infrastructure and expertise and in turn, to allow outside researchers to travel to and use SP infrastructure and expertise at smaller institutions. SPs at smaller institutions could also partner with similar SPs at larger institutions and share expertise, SOPs, best practices, procedures and protocols. Job shadowing or mentorship programs could be very helpful here. CFI applications that build on successful and sustainable SPs and promote collaboration with smaller institutions could be prioritized.

3. From a smaller institution's perspective, what are the advantages and/or challenges stemming from collaborative, multi-institutional projects? How can smaller institutions best contribute to these endeavours?

   It is often more straightforward to initiate and maintain centralized oversight and management of SPs at smaller institutions. The small size also can facilitate international collaboration because the necessity for external collaboration makes it a key priority. These factors can enable smaller institutions to do innovative work with CFI infrastructure.

4. Should the CFI do more to facilitate inter-institutional collaboration with smaller institutions?

   No, smaller institutions already invest extensively in inter-institutional collaborations and have the people and mechanisms in place to facilitate it. There is a need for funding for these initiatives but no need for direct CFI involvement.

5. Do the current CFI funding architecture and merit-review processes appropriately support the research infrastructure needs of smaller universities, colleges and cégeps? Do you have suggestions on how these might be changed to better support smaller institutions?

In the current funding schemes there is a lot of focus on the benefits to Canada. The broad reach of SPs to a larger research community ensures diverse benefits to Canada from multiple projects. However, realistically it is difficult to produce and measure direct benefits to Canada in the short 4-5-year timeframe of a CFI infrastructure program grant. A stronger focus on innovation (including implementation and dissemination of the technologies), strength of the SP team of expert scientists and the sustainability of the SP beyond the 5-year CFI grant period should be made.

Core Facilities and Regional Platforms (Scientific Platforms)

1. From your perspective, tell us about your experience with core facilities, both at the institutional and regional levels.

The current CNSP membership represents 134 SPs representing a wide variety of technologies from 40 Canadian institutions in 8 provinces. *It is a network of SP technical staff, managers, directors and administrative staff from Canadian academic and government institutions. The membership also consists of corporate partners. The CNSP represents institutional and regional SPs. Considering the role of the CNSP in Canada, the network is well positioned to have a clear view of the main challenges facing SPs, such as the recruitment and retention of platform scientists. Technologies span from engineering (e.g. nanofabrication), to chemistry (e.g. NMR), to life sciences (e.g. cell imaging and analysis network) and health sciences (e.g. FINDER, infectious diseases). The CNSP sees SPs playing a central role in the current and future landscape of world class research in Canada. Technology is moving at an ever-increasing pace and in order to harness its full potential and make the best use of infrastructure dollars technologies must be placed in* ***centralized SPs with a team of expert platform scientists****.*

2. Is the development and support of core facilities an institutional priority? If so, what steps is your institution taking to develop and support core facilities? What are the major challenges to establish and effectively operate core facilities?

Development and operation of SPs should be an institutional priority. ***SPs are the ideal way to maximize infrastructure use, minimize infrastructure redundancy and serve hundreds of research programs****. The establishment and development of SPs at institutions should be driven by a strategic vision and aligned with institution research priorities. Centralized well supported SPs make financial sense and are a strategic tool to recruit and retain top scientists and support innovation. However, the reality is that there is enormous variability between institutions represented by the CNSP. Some institutions have full time dedicated high-level administrative staff overseeing, managing, building and developing SPs. Other institutions have no oversight, little support and no coordination leaving each research laboratory or small local facility isolated.*

The biggest challenge for operating SPs is the lack of sustainable long-term funding for infrastructure and platform scientists (i.e. managers, directors, technical experts). User fees are not sufficient to cover the cost of infrastructure maintenance and staff salaries (see specific example in ***Appendix III****). Stable long-term funding is required to develop a strategic plan for the purchase, maintenance and replacement of technologies over the long-term and for the recruitment and retention of platform scientists. Technology is developing at a rapid pace. Novel technologies need to be acquired and implemented rapidly to stay globally competitive and heavily used relatively routine equipment needs to be replaced. In addition, platform scientists are highly trained, highly sought-after researchers most often at the PhD level. Funding sources for platform scientist salaries are not stable so retention is difficult. Salaries in Canada are not internationally competitive, so recruitment is also*

challenging. Clear well-developed and appealing career paths need to be offered to platform scientists along with exciting professional development opportunities.

More specifically, the CFI-IOF contributions cannot be extended beyond the 5-year grant timeframe even if the infrastructure has a useful lifetime of 10-years. Thus, there is no capacity to sustain platform scientists even though the infrastructure is operational, and the expertise has been built over the 5-year grant term. This is especially true for smaller SPs that may only have 1-2 instruments. New infrastructure can be obtained with CFI-JELF funding but only if the appropriate new principle investigator can be recruited during this timeframe. It is also important to have multiple platform scientists to ensure sustainability and efficient operation when one staff member is absent.

Another challenge is the lack of awareness by the local, regional and national community of the infrastructure and expertise available. Researchers may even be aware of the infrastructure that is available but may not understand how it can facilitate their research program and what research questions can be answered. Visibility and marketing of SPs falls in between centralized (e.g. CFI databases) and local institutional marketing policies and programs. SP managers and platform scientists are asked to resolve these requirements without any training or dedicated resources.

3. How can CFI better address the needs of researchers in connection with the development of institutional core facilities and regional platforms?

Promote and prioritize funding for centralized facilities in single or multiple technology areas. This will enable the SP to have multiple platforms scientists that can be cross-trained and support one another. Each platform scientist can develop specific expertise but also have a general working knowledge of multiple pieces of infrastructure. This will provide a positive work environment for platform scientists and better service for researchers. There is an economy of scale in that the investment in the salary for one platform scientist can contribute to in-depth one-on-one training and support for more than 100 researchers using the SP. Teams of SP staff can also develop training programs and courses to keep the research community at the cutting edge, build user communities and scale training initiatives efficiently.

Provide direct funding to SPs to remove direct ties to large investigator led research programs. This could be done with a program similar to the MSI competitions but at a scale commiserate with the size of institutional, regional and national SPs. This funding could directly support salaries and operational expenses but also R&D lead by the SP director for the development of technologies, technology applications and procedures and protocols. This research work would directly support the entire research community who has access to the SP.

Incentivizing and supporting institutions with long term sustainability plans and those that take a central approach to fully certify SP to international standards levels such as ISO 9001. This will ensure quality and enable use of infrastructure by industries such as pharmaceutical companies and manufacturing companies (especially in the aerospace and medical sectors). This approach was recently implemented by Monash University (More Information).

The CFI should partner with the CNSP on several initiatives. *1) Further develop CFI navigator as detailed in question 8 of the Convergence section of this document. Have dedicated staff to promote the network and make connections. 2) Direct funding to the CNSP for annual meetings to bring stakeholders together, invite international experts, identify challenges and explore solutions as a community. 3) Develop national guidelines for institutional operation of SPs. 4) The CFI should adopt the CNSP definition of a scientific platform (**Appendix I**). 5) Promote the **benefit of SPs to early-career investigators** who can get their research programs up and running rapidly upon arrival at an institution with well-funded, well-managed and well-staffed SPs. This can have an enormous benefit in terms of young investigators and trainees in their laboratories.*

Prioritize infrastructure grants were equipment will be placed in a well-managed, well-staffed SP with clear institutional support and an institutional sustainability plan. ***A SP-specific funding initiative*** *(other than JELF or IOF) to acquire, replace or update instrumentation managed by a SP, and for which there is a demonstrated base of users. Such a program could be modeled on the United States National Institutes of Health Shared Instrument Grants and High-end Instrument grants. Provide IOF funding beyond the 5-year grant period. Provide funding opportunities to extend maintenance contracts on existing CFI-funded and well-used instrumentation. Ensure that IOF funding for the infrastructure is sufficient for the needs of operation. Sometimes the 30% IOF is well matched with the need for platform scientists, but certain infrastructure requires a much higher level of platform support and this amount is insufficient. The IOF request could be justified as part of the budget and sustainability plan rather than a fixed amount based on the infrastructure cost.*

Open CFI funding to SPs that are not based on infrastructure but services and resources. For example, Biobanks, viral vector cores, primary cell banks. The CFI definition should be expanded to include these types of services as research infrastructure (see the EU definition of research infrastructures). These facilities fall through the cracks, are rarely funded by provincial or federal granting agencies and are often not considered research infrastructure so are not eligible for indirect support funding from institutions. Currently these services are essential to thousands of research laboratories, but institutions struggle funding platform scientist salaries, cost of storage of biological resources and distribution of materials to researchers. Funding is needed to encourage national frameworks to support networks such as a national network of all biobanks to streamline resources, standardize good practices and avoid redundancies.

Some funding for first 1-2 years for research activities to get new SPs running or help new investigators get preliminary data while applying for more significant operating funds. Perhaps institutional startup funding targeted for SP use could be matched by CFI funds.

4. Is the development and support of core facilities an important area for CFI to provide additional support? To what extent should CFI prioritize support of core facilities?

Investing in SPs should be a high priority for CFI. Relatively small investments will maximize previous investments, favour the extension of usage and lifetime of existing infrastructure, secure the

knowledge base of existing highly trained platform scientists, ensure a high level of quality and standardization across SPs, create an awareness of available infrastructure across Canada and demonstrate that Canada is a world leader in scientific discovery. Providing resources to SPs that have been set up in sustainable fashion will reward best-practice institutional behaviours and enable those SPs to maintain currency in terms of world-leading technology/resources. This will enhance the competitiveness of researchers across multiple disciplines, enhance the training resources that the SPs represent and create a world class environment for the training of the next generation of scientists.

5. What are the most effective ways the CFI could support core facilities (e.g., funding architecture, eligibility of projects and infrastructure, application processes and forms, assessment criteria) and improve their sustainability? What other policies, processes or practices could the CFI adopt to more effectively support research excellence through core facilities?

There are three key ways SPs should be supported. Many of these points have already been made in the context of other sections of this document but they will be summarized here.

***Challenge:* Recruitment, retention and recognition of platform scientists.**
Solutions: *Platform scientists are world class researchers on pare with principal investigators and top corporate scientists. They need to be treated accordingly. Funding is needed to support competitive salaries, opportunities for professional development and career progression. Without highly qualified platform scientists, infrastructure and services cannot be offered to the scientific community at a globally competitive level.*

***Challenge:* Acquisition, maintenance and replacement of routine and high-level infrastructure.**
Solutions: *Infrastructure funding calls that platform directors and managers can directly apply for. This funding should not be tied to a single research program but to the overall success of the SP. Metrics such as publications, user base, quality of platform scientists, sustainability of the SP and need for the infrastructure could be used to determine funding success. Funding calls should include replacement of routine heavily used infrastructure as well as high-end unique infrastructure required locally, regionally or nationally. Platform scientists should be involved in developing these calls and in the review process. There will be a need for a clear definition of a SP for these funding calls (**Appendix I**).*

***Challenge:* Awareness and promotion of SP infrastructure and expertise.**
Solutions*: Further investment in the CFI Navigator as the go to national database for infrastructure, services and scientific expertise. Funding for national networks such as the CNSP to be involved in national, regional and institutional awareness campaigns. CFI programmatic funding to networks with national policies, processes and best practices will effectively support improved standards, SOPs, reproducibility, enhanced access, tailored response to research needs and reduced duplication of infrastructure. Dedicated staff to connect SPs with researchers and corporate users or R&D partners is needed. Support for exchange of experience meetings, networking events, regional networks and*

technology networks. Funding for travel and SP fees for required technologies, services and expertise. Use of national networks and a national database like the Navigator could be used to work with corporate partners and come up with a regional and national strategies to negotiate more affordable infrastructure service agreements and infrastructure renewal. Such Canada wide pricing could stretch Canadian tax payer dollars further and be critical for the operation and sustainability of SPs. CFI and the Tri-Council agencies could enforce certain basic expectations from corporate partners to ensure SP sustainability. Schematics, manuals, extended warranties as required items. Software solutions running on modern, non-proprietary versions of operating systems for example.

6. Should the CFI take on a greater role to support the networking of core facilities across the country?

Yes. *As mentioned in Point 5 above there is a need for awareness of SPs and platform scientist expertise. The CNSP is already a well-established national network. A partnership with CFI could further develop the CNSP into a resource encompassing SPs from all geographic regions and fields of research. This could be accomplished by funding for: administration of the network, an annual meeting bringing together key stakeholders, dedicated staff to promote SPs, SP technologies, build new collaborative partnerships regionally, nationally, internationally with researchers, international networks and corporate partners, mobility grants for travel and user fees to use SP infrastructure, development of training programs in administration, management and basic business practices for SP managers and grants for international travel to meetings, courses and workshops. In partnership with the CNSP, the CFI should support the establishment of best practices among core facilities, development of SOPs, certification of facilities and the training of experts (technical competences and administrative skills).*

The CNSP could play a role in developing a national infrastructure road map including the local, regional and national infrastructure needs in key technology areas (e.g. MRI, NMR, microscopy, biobanks, X-ray, computational) as part of method to promote better resource sharing and efficient use and renewal of infrastructure at the national level. The establishment of regional and/or technology networks to promote the sharing of resources, best practices and expertise is a current goal of the CNSP.

7. What are the differences between establishing and operating regional core facilities in collaboration with other institutions or organizations and doing so within your institution? How do regional core facilities present different challenges to institutions?

The CNSP could facilitate the development and sustainability of regional SPs through its inherent nature as a national network. Regional SPs are more challenging to set up and more complex to operate, govern and coordinate due to agreement between multiple institutions. However, it is difficult for any one institution to have all the infrastructure, services and expertise required for the current multi-disciplinary and inter-disciplinary research landscape. Some institutional SPs are de facto regional facilities especially in remote areas. Both are essential. The CNSP and the CFI could play a role in the success of regional SPs developing best practices for setting up regional and national facilities including guidelines for multi-institutional oversight and governance.

Equity, Diversity and Inclusion

1. How can the CFI assist your institution in advancing the EDI objectives in your strategic research plan and meeting your EDI targets?

The CNSP conducted a membership survey in 2017 and determined that approximately half of core facility staff positions, including upper level management and directorship positions are occupied by women. This ratio of female scientists, especially in positions of leadership is much higher than in other areas. For example, principal investigators in most fields are typically 30% female at most. Improved funding to SPs will ensure stable, secure, rewarding research career tracks for female scientists without the need to create new programs. Direct funding would enable the CNSP to allocate resources to projects that enhance the visibility of their clearly diverse workforce.

Additional Comments and Ideas

1. *For the current infrastructure funding programs, it would be valuable to have separate grant reviews by platform scientists. The CFI could create a separate review committee(s) for large infrastructure grants that focuses on determining if the requested infrastructure is required and appropriate to address the research questions being asked. This committee would not evaluate the research program but the need and appropriateness of the infrastructure. This committee would require access to an up-to-date and in-depth database of all previously funded CFI infrastructure, so they could quickly review similar existing equipment funded by CFI and determine if additional infrastructure is required at the institutional or regional level. In many cases, travel grants and funding for user fees for researchers to travel to regional or national sites where the infrastructure and most importantly the expert platform scientists are would be more economically viable than duplication of infrastructure. This would ensure maximum use of existing flagship instruments and availability of the necessary scientific expertise.*

2. *Funding mechanisms to upgrade instruments if they are still within their useful lifespan. Option to lease infrastructure or lease-to-own might be more cost-effective particularly for new types of instruments that have not been extensively field-tested or for projects where the instruments are only required on a short time frame.*

Appendix I: Scientific Platform Definition

- Scientific platforms (SP) are **centralized and shared** laboratories that offer **specialized instrumentation and services** that are required by **multiple investigators**.

- SPs provide access to equipment with a fee-for-service component in the business model. The **business model** may consist of cost recovery of a diverse nature including any or all of the following: 1) direct institutional support; 2) external grant funding; 3) donations; 4) hourly user fee charged to operating grants; and 5) annual SP membership fee charged to operating grants.

- SPs provide individual researchers with **open access** to specialized instrumentation, technology, service and expertise including in-depth education and training initiatives that are generally too expensive, complex or specialized for investigators to reasonably provide and sustain in individual laboratories through operating grant funding and laboratory personnel.

- SPs are **discrete units** within the Institution and are directed by **dedicated expert research personnel** or faculty, have **dedicated equipment** and **dedicated space**. They are usually supported by the Institution to meet the collective needs of its research community.

- A number of SPs may share a centralized administrative and management structure. Such structures are integral part of SPs and are thus welcome to join the CNSP.

Appendix II: CNSP Mission Statement

The CNSP-RCPS is a pan-Canadian network of professional/staff working in any aspect of research scientific platforms (i.e. technology resources, core facilities) at the technical, managerial or administrative level. The aim of the network is to represent diverse technologies and institution types from regions across the country.

- **Raise awareness, promote utility of shared scientific platforms and affect how these resources are funded in Canada.** Engaging with granting and governmental agencies, institutions, researchers and scientists, instrument manufacturers, industry service providers, industry scientific platform users and industry leaders or any other relevant stakeholders.

- **Educate research personnel** working in scientific platforms by providing resources for leadership, administration and management of facility operations. Educate institutions on the importance of appropriate professional development for leaders of scientific platforms.

- Encourage and support scientific platforms in their goal to advance research and improve their service to facility users by **setting and promoting best operations & management practices.** Promote sharing of these practices between institutions and network members.

- Create opportunities for scientific platform leadership and staff to **network, exchange ideas** and move the field of shared resource management forward in an efficient manner.

- Promote a **cooperative culture in the research community** where scientific platforms and the researchers who work in them are an integral part of the scientific community and the effective advancement of research at top institutions across the country.

- **Promote interactions with industry** and **raise awareness** of **industry access** to academic scientific platforms. These interactions could include but are not limited to awareness of scientific platforms for industry usage, partnerships between industry and institutions to become developers and early adopters of new technologies and development of academic procedures, protocols, innovations and SOPs by industry leaders.

Appendix III: Detailed Cost Recovery Scenario.

From a cost-recovery perspective the economic challenges are stark. To use, as an example, a brand-new, fully-equipped scanning electron microscope (a workhorse tool for many disciplines). Supported user costs (i.e. technical staff supporting use for the instrument) of about $50/hr are typical for this across many facilities in Canada and the US. If such an instrument is used 8 hours/day, 5 days/week, 40 weeks/ year (allowing time for maintenance etc.), the income generated is $80,000. This is not quite enough to pay for a truly interdisciplinary technical support person, nor is it enough for a service contract. Yes, commercial rates are higher, but such users require not only expert technical support, but that technical support to be available without possible IP interest (i.e. not a trainee). But an effective lab also trains students to be users, such users are given concessional rate access because (as registered users) they don't need the support. In effect, a target of $50,000-$80,000 annual revenue from a single instrument is optimistic and doesn't cover either the technical support required nor the service contract. This representative of the economic gap that research infrastructure grapples with for long-term sustainability.