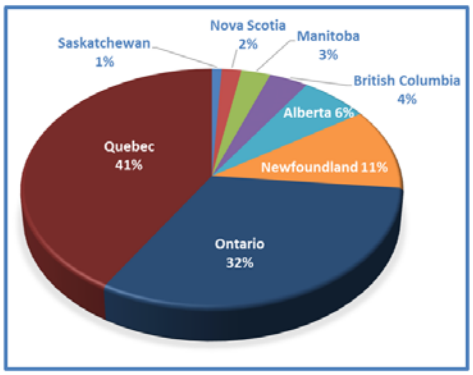
CANADIAN NETWORK OF SCIENTIFIC PLATFORMS (CNSP)
RÉSEAU CANADIEN DES PLATEFORMES SCIENTIFIQUES (RCPS)

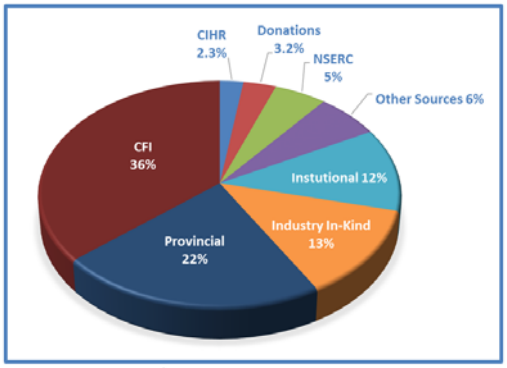
CNSP/RCPS Position Paper on the Current State of Scientific Infrastructure Platforms in Canada

CNSP/RCPS: The CNSP/RCPS is a newly created network of scientists and administrators with responsibility for and vested interests in the sustainability of scientific infrastructure platforms across Canada. The definition the CNSP/RCPS has adopted for scientific platforms can be found in *Appendix I*. The network was created in August of 2016, has **33 member institutions** from 8 provinces representing **109 scientific platforms**, and represents diverse research areas including light and electronic microscopy, tissue banks, microfabrication, MRI, mass spectrometry and NMR *(complete list-Appendix II)*. One of the main mandates of the network is to **"Raise awareness, promote utility of shared scientific platforms and affect how these resources are funded in Canada** through engagement 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." The full mission statement of the network is found in *Appendix III*.



Percentage of Survey Respondents by Province.

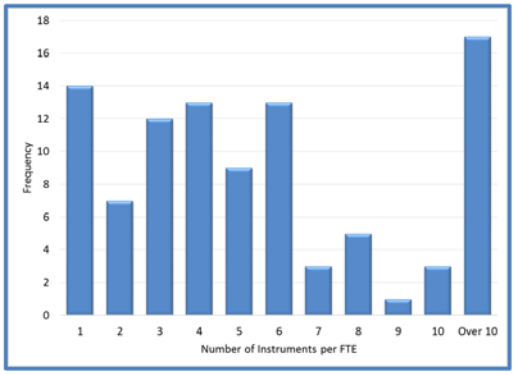
The network recently initiated a detailed survey to collect information from administrators, scientific platform managers and directors at leading institutions who oversee shared scientific infrastructure across their respective institutions. Thirty-three institutions from 8 of the 10 provinces participated in the survey *(complete list-Appendix IV).* Here we summarize some of the key findings from the survey data, the major challenges the community faces, and make several recommendations to the Canadian Scientific Review Board.



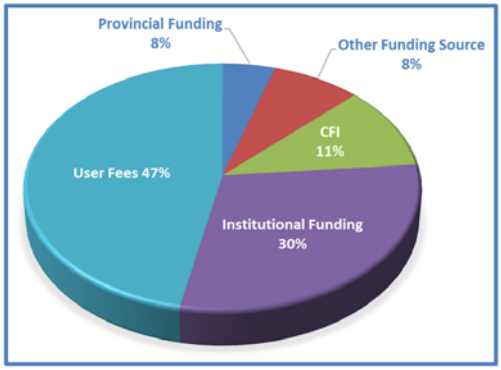
Percentage of Funding for Infrastructure by source.

Survey Respondents and Infrastructure Funding: The survey was answered by managers or directors of **109 scientific platforms (SP)** that were established 12 years ago on average. Newly created facilities as well as facilities that have been serving the scientific community for several decades are also represented. On average, the facilities serve over 100 researchers from 43 laboratories and 7 institutions. Although it is a rough estimate, due to possible overlap between users using several scientific platforms, this represents approximately **10,000 researchers**, **4000 research laboratories** and **500 institutions.** On average, each SP consists of ~$6M worth of infrastructure. The funding for the initial purchase of the infrastructure comes from several sources including the Canadian Foundation for Innovation (CFI, 36%), federal funding agencies (e.g. CIHR, NSERC), provincial funding agencies (22%), institutional funding (12%) and industry support (13%). This tremendous investment of scientific research funding totaling ~$520M relies on long term funding for infrastructure operation and maintenance and salaries of highly trained technical staff.

Infrastructure Numbers and Technical Staff: The nature of the equipment covers a range where a SP could have 100 or more basic systems that require little maintenance and training, or have 3 high end systems that required highly qualified personnel (HQP) to run the infrastructure full-time. Overall, the survey represented SPs with a total of ~1,400 instruments and on average each platform operates 14 instruments. One of the bottlenecks of many platforms is an insufficient number of HQP (or full time equivalents, FTEs) to keep pace with the demand for training and instrument use. In fact, the data shows that over half of the instruments require significant training (36%) or full time support from the staff (21%). On average, each FTE platform staff member has 6.4 instruments under their care and 21% of these staff oversee 10 or more instruments. Usage of the infrastructure to its full potential depends directly on these highly trained technical staff that are responsible for the operation, maintenance, training and usage of the equipment.

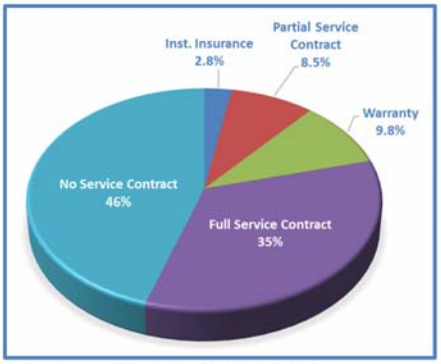


Histogram of the number of full-time equivalent (FTE) staff members per instrument in the scientific platform.



SP percentage of annual revenue based on the source.

Revenue and Expenses for Infrastructure Operations and Maintenance: The long term sustainability of the operation and maintenance of the infrastructure is of vital importance in order to achieve an exceptional return on the immense investments. It is the responsibility of many stakeholders to ensure the proper operation and maintenance. The stakeholders include the funding agencies who provide the infrastructure, institutions who own it and the companies who manufacture and service it. Almost half of the revenue for the operation of SPs comes mainly from user fees charged to researchers for access to the infrastructure. This revenue comes from operating grants from federal and provincial granting agencies and also from foundations. The remainder of the operational costs come from institutional funding (30%) and CFI institutional operating funds (IOF). Note that these percentages are estimates as some of the institutional funding may in fact be CFI-IOF allocations directly to the institution. However, this revenue is insufficient as is evident from the fact that the survey results show that **nearly half of all of the state-of-the-art scientific infrastructure is not covered under a warranty or service contract.** Research projects depend on the equipment being at peak functional operation and are in jeopardy if equipment fails and the means to have it repaired rapidly are not available. Only 15% of survey respondents stated that the infrastructure in their SP is used to capacity (40 hrs/wk, 50 wks/year). Equipment is not used to its capacity for many reasons. There is often a lack of awareness of the infrastructure that is available, there is a lack of operating funds for researchers to pay the instrument fees, a lack of institutional funds to pay salaries or a lack of HQP time for training and/or technical support and a lack of funding to repair or update the infrastructure.



Type of infrastructure maintenance plan.

Highly Qualified Personnel (HQP): The investments that have been made in the infrastructure are only valuable if they are supported by highly trained personnel or HQP. One of the major challenges of SPs is to recruit, train and retain HQP. The training SP staff receive takes a significant amount of time and is highly specialized making it very difficult to recruit HQP with the appropriate experience, or quickly replace HQP who move on to other career goals. Most SP funding is dependent on three sources that are highly sporadic: 1) the success of researchers in applying for peer reviewed operating grants in a highly competitive funding environment; 2) institutional funding (if there is any); and 3) the success of highly competitive CFI grants that include IOF funding that can be used to pay HQP salaries. This results in difficulty with retention because HQP typically have short term contracts and little job security. For example, only 25% of respondents were in positions where the institution had a clearly defined career track for SP staff. The staff are highly qualified and often leave for more secure positions in industry or at more well-funded institutions. This leaves SPs with infrastructure that cannot be efficiently used until new HQP are recruited and trained. This is by and far the most challenging aspect of the maintenance and operation of the infrastructure.

Challenges and Potential Solutions for the Sustainability of Scientific Platforms

Challenges: Essentially 100% of survey respondents replied that **the biggest challenge to face is inadequate funding** resulting in the inability to sustain operations. More funding is needed to upgrade aging infrastructure, to pay for maintenance and repairs and to pay for HQP salaries. The current SP model relies on user fees for at least 50% of the annual revenue. However, it is a constant challenge to balance fees so that they are low enough for research laboratories to afford paying them from limited operating grant revenue, and high enough to recover SP operating expenses. Funding for new infrastructure is highly competitive while older equipment usually requires more HQP time and costly repairs. As stated above, secure funding for HQP salaries is required to sustain the expertise of the SP. Another challenge SP managers and directors face is limited staffing (6 or more instrument per FTE). As a result, there is limited or no time to develop novel cutting-edge procedures and protocols. This is required to keep pace with world class institutions in Canada and internationally. Administrative support is also lacking as is evident in that 85% of survey respondents still use time consuming manual invoicing to collect SP fees. Finally, there are challenges associated with duplication of resources and competition between SPs offering similar services within institutions, who may also be in competition for inadequate institution funds for maintenance and operation.

Potential Solutions

Institutions:

a. **Stable Positions for HQP.** Highly qualified staff working in SPs are integral to the research mission of the institution. It is imperative that these scientists are in stable institutionally funded positions so they can be retained by SPs and infrastructure can be maintained and used to its full potential. These staff need a clear career track and opportunities for continued training and professional development. If HQP salaries were covered by the institution, most SPs could recover infrastructure

operating and maintenance costs from user fees. **Indirect funding given to institutions from the tri-agency councils should be earmarked for this purpose.**

b. **Centralization of SPs and Administrative Support.** Centralized oversight of SP infrastructure will reduce competition between platforms, eliminate duplication of services, pool expertise and improve efficiency of platform operation and maintenance. Administrative support to the facilities will remove administrative burden and allow the HQP to focus on science. A dynamic database of SPs and the available infrastructure will allow for the dissemination of this information across the institution and to external parties. Most SPs have an annual operating budget of $250k-$1M, so scientifically trained managers should be give opportunities for training and professional development in management. **Centralization of SPs and administrative support from the institution should be required in infrastructure sustainability plans when applying for equipment funding.**

c. **Funding and infrastructure earmarked for SPs.** A percentage of new investigator start-up funding should be earmarked for SPs as appropriate.

d. **New Researcher Integration with SPs.** Researchers applying for CFI-JELF funding should be required to explore housing new infrastructure within SPs as appropriate. This will ensure the infrastructure is well maintained, and researchers will not have to deal with maintenance and service issues so they can focus on their research programs; and infrastructure will be readily accessible to others if the principle laboratory is not using it. This will ensure that SP infrastructure remains state-of-the-art.

e. **Industry Partnerships:** Institutions should work with key infrastructure suppliers to build partnerships and reduce the cost of service contracts. This could be done on the provincial and national level as well. This should be done in the same way as with large companies that supply services.

Provincial Funding Agencies:

a. **Regional Technology Networks:** Provincial funding agencies should provide funding for technology networks. This would involve the development of networks of SPs with similar or complementary technologies. This would include the development of an interactive regional database of SP and infrastructure so researchers and potential industry partners would be aware of the resources available in their region. These networks could band together, partner with industry and develop affordable plans for regional service contract agreements. These networks would promote technologies, reduce duplication, share expertise and focus on quality science.

b. **Project Grants to use SPs:** Competitions should be launched for researchers to access the SPs within the network for short or mid-long term projects. Short term grants would be $5-10k and mid-long term projects would be $10k-25k. The grants would cover travel, lodging for the researcher and technical support and infrastructure fees for the SP.

Federal Funding Agencies-CIHR, NSERC, Genome Canada, Brain Canada, MITACS:

a. **Direct operational funding to SPs.** These agencies are in effect already funding the operation of core facilities because the majority of user fees come from operating grants from these agencies. The CIHR resource grants should be reinstated. NSERC RTI grants should include an IOF portion for warranty, service and staff salaries. The NSERC MRS should be opened up to include institutional SPs. Brain Canada is already funding SPs but the requirement for 50% matching funds is difficult to achieve for basic research laboratories. These initiatives would **remove the need to tax each researcher** for user fees and **ensure all researchers have access to state-of-the-art infrastructure** and would **minimize the administrative burden of billing** on the HQP in the SPs.

b. **Fellowships and Internships.** The staff in SPs need access to professional development opportunities. Funding for fellowships and internships should be open to technical staff working in SPs. For example, a SP could develop a new protocol for a specific technology with an industry partner and a MITACS internship could cover the salary of the HQP from the SP.

c. **National Technology Networks:** National technology networks could work in a very similar way to regional networks. A wonderful example of a successful national network is France BioImaging, france-bioimaging.org.

Federal Funding Agencies-CFI:

a. **IOF Funding:** The IOF support that comes with the infrastructure is simply not enough to cover the operational costs of the equipment for 5 years. The percentage of funding allocated to IOF should be increased. Separate competitions should be held for IOF support past the 5 years of CFI funding if the equipment is still useful. IOF funding should cover new equipment purchases if repairs cannot be made.

b. **Equipment Upgrades:** During CFI competitions upgrades should be promoted before the purchase of new infrastructure. Competitions could be held specifically for infrastructure upgrades. Technology networks would provide a clear knowledge of existing infrastructure in the institution, province or nationally would ensure targeted funding and minimized redundancy.

Corporations:

a. **Partnerships:** Develop partnerships with SPs to develop state-of-the-art procedures, protocols, reagents for state-of-the-art infrastructure use.

b. **Group Service Contracts:** Work with SPs, institutions, regional and national networks to build a sustainability plan for the service, maintenance and upgrade of scientific infrastructure.

Appendix I: Scientific Platform (Research Core Facility)

- 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**, which 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 and operated 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 an integral part of SPs and are thus welcome to join the CNSP.

The definition was conceived by the Canadian Cytometry and Microscopy Association (CCMA) and is based on documentation from the National Institutes of Health (NIH) and a number of core facility institution guidelines.

Appendix II: Technologies Represented in this CNSP/RCPS Position Paper

		3D Prototyping	Amino Acid Analysis	Animal Facility (3)
Animal Physiology	Aquatic Containment	Bioinformatics (3	Biophotonics (3)	Biophysical and Structural Biochemistry
Biosafety Level 3	Brain Imaging	Cardiovascular Phenotyping	Chemical Synthesis	Chromatography
Computation	CRISPR	Cyclotron	Data Management	Deep-sea Equipment
DNA Sequencing (5)	Drug Screening	EKG	Electron Microscopy (11)	Elemental Analysis
Flow Cytometry (21)	Genomics (2)	Geophysics	High Throughput Automation (2)	High Throughput Screening (2)
Histology (2)	Human cardiovascular Ultrasound	Human Exercise	Human PFT	Image Processing and Analysis
In-vivo Imaging	In-vivo Screens	In-vivo Testing (2)	iPSC (3)	Light Microscopy (31)
Lipidomics	Mass Cytometry (3)	Mass Spectrometry (15)	Materials Characterization (2)	Metabolomics (3)
Micro-computed Tomography	MicroCT Scanning (2)	Microinjection (2)	Micro-nanofabrication and Characterization	Molecular Biology (3)
Molecular Imaging	Molecular Pathology	MRI (4)	Multiphoton Microscopy (2)	NMR Spectrometry (7)
Optical Spectroscopy	Peptide Sequencing	Peptide Synthesizer (2)	PET/SPECT Scanning (3)	Protein Characterization (3)
Protein Engineering	Proteomics (7)	Robotics	Single Cell Analysis	Slide Scanning
Surface Plasmon Resonance (3)	Surgery/phenotyping	Tissue Bank (6)	Transgenics (4)	Translational Cancer Research
Ultrasound (2)	Viral Vector (2)	X-ray Crystallography (3)	XRF Spectrometer	Zebrafish

Appendix III: Mission Statement of the CNSP/RCPS

1. **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.
2. **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.
3. 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.
4. 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.
5. 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.
6. **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 IV: Represented Institutions

CHU de Québec/Laval University
CHU Sainte-Justine
Concordia University
CR-CHUM
Dalhousie University
Douglas Hospital Research Center
Hospital for Sick Children
INRS-Institut Armand-Frappier
IRCM
IRIC | Université de Montreal
IUSMQ
Lady Davis Institute
Lawson Health Research Institute
University of Manitoba and Health Sciences Centre
McGill University
McMaster University
Memorial University
Queen's University
Research Institute in Oncology and Hematology
RI-MUHC
Sunnybrook Research Institute
University of Alberta
University of British Columbia
University of Calgary
University of Guelph
University of Montreal
University of Ottawa
University of Saskatchewan
University of Toronto
University of Victoria
University of Western Ontario
University of Windsor
Wilfrid Laurier University

This paper was written by **Claire M. Brown** with extensive input from the CNSP/RCPS
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