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Canada Foundation for Innovation

OMS Summary Report

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The Canada Foundation for Innovation (CFI) commissioned this Outcome Measurement Study (OMS) Summary report. Dennis Rank, Senior Associate KPMG LLP, and Janet Halliwell, J.E. Halliwell Associates Inc., were engaged to design a method for incorporating the data of individual OMS studies and wrote the report. Their expertise is well recognized and their contribution to this report was most valued. The findings presented in this report resulted from OMS visits held at nine Canadian research institutions in 2007-08. The CFI would like to thank the researchers and personnel from these institutions who participated in the OMS. We would also like to acknowledge the participation of 33 expert reviewers and three chairs, without whose support and commitment to the OMS exercise, this report would not have been possible. The CFI would also like to thank the numerous observers from the federal granting councils and the provinces who were also in attendance at many of the site visits.

Prepared October 30, 2008

The CFI

The CFI is an independent corporation created by the Government of Canada to fund research infrastructure. The CFI's mandate is to strengthen the capacity of Canadian universities, colleges, research hospitals, and non-profit research institutions to carry out world-class research and technology development that benefits Canadians. As of August 22, 2008, the CFI has committed almost $4.4 billion in support of 5,751 projects at 130 research institutions in 64 municipalities across Canada. The CFI normally funds up to 40 percent of a project's infrastructure costs, which are invested in partnership with eligible institutions and their funding partners from the public, private, and voluntary sectors.

The Summary Report

This report summarizes the impacts of the Canada Foundation for Innovation (CFI) over the period 1998–2008. It covers a sample of nine research themes, listed below, representing $128 million (13%)[1] of the CFI's investments at nine institutions.

Brock University	Oenology and viticulture [pilot]
McMaster University	Advanced Materials [pilot]
Hospital for Sick Children	Human genetics and genomics [pilot]
University of Calgary	Biomedical engineering
Dalhousie University	Information and communications technologies
University of Western Ontario	Musculoskeletal research
McGill University	Cognition and Brain Imaging
University of Manitoba	Immunology and Infectious Diseases
University of Victoria	Environment and Oceans

Impacts were documented using the Outcome Measurement Study (OMS), a unique evaluation tool that combines an on-site expert panel visit with quantitative and qualitative data collection to identify outcomes from a cluster of infrastructure projects in a theme.[2]

The OMS

The OMS was established as a tool in the CFI's suite of evaluation activities in 2006. It is designed to assess the degree to which CFI investment in research infrastructure is a critical contributing factor in the realization of five outcomes: strategic research planning, research capacity, highly qualified personnel (HQP), research productivity, and innovation. Each outcome is evaluated on the basis of several indicators (e.g. for the HQP outcome category,

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[1] This figure represents theme funding for developed projects only. Undeveloped projects (those, having had less than one year to procure infrastructure, were included only for the outcome category "strategic research planning." The total CFI amount committed to the themes including undeveloped projects is about $170 million (18% of the total CFI investment at the nine institutions).

[2] Representative examples from individual institutions are presented throughout this report for illustrative purposes. The examples do *not* constitute an exhaustive list of the significant outcomes for any institution or theme.

indicators include: number of research trainees; quality of training and trainees; and knowledge transfer through HQP). The OMS methodology involves an in-depth questionnaire submitted to institutions with a follow-up validation by a visiting expert panel[3] whose report is the key output of the exercise.

The OMS recognizes the CFI as one player in a large and complex system of research support. Observers from other key funding programs (notably provinces) are invited to the visits, and careful discussion of the relative contributions of different programs and other factors external to CFI ensures issues of attribution are addressed accurately and in context.

The OMS is one of the CFI's key tools for informing how well it is meeting the following national objectives documented in its Funding Agreement with Industry Canada, and the CFI Performance, Evaluation, Risk and Audit Framework (PERAF):

- To support economic growth and job creation, as well as health and environmental quality through innovation.
- To increase Canada's capacity to carry out important world-class scientific research and technology development.
- To expand research and job opportunities by providing support through research infrastructure for the development of highly qualified personnel.
- To promote productive networks and collaboration among Canadian post-secondary educational institutions, research hospitals and the private sector.

Overall impacts

The infrastructure provided by the CFI and other partners has had strong, and sometimes remarkable, impacts on all research themes investigated through the OMS. There were transformative impacts reported at Dalhousie, McGill, the Hospital for Sick Children, Victoria, and Brock. Pre-CFI, these institutions found they had: little or no research strength in the theme; a lack of integration in the research and/or its strategic planning; inadequate and outdated infrastructure; a lack of critical mass; a lack of ability to serve external users; or sometimes all of these. For these themes, there were dramatic increases across most or all of the indicators. The remaining four institutions experienced strong, but more incremental impacts. In one of these cases, the CFI-funded projects significantly expanded upon existing strengths, while in two others they were limited by a lack of formal cohesion in the theme.

Two additional phenomena were observed across many of the themes: a "facility" effect where there was a dramatic collective impact from integrated suites of infrastructure; and, a related "organization" effect in cases where deliberate planning of diverse activities around these facilities played a key role in achieving outcomes. Specific results under each of the five OMS outcome categories follow.

[3] Panel members have expertise in both the theme science and its potential applications.

Strategic research planning

A special characteristic of the CFI approach is that institutions must prepare a strategic research plan which is used by the CFI as background when reviewing applications for individual infrastructure awards. The CFI was the first major Canadian funding program to have such a requirement and to make funding decisions partially based on how an award could enhance the institution's strategic priorities. The CFI's programs were designed to encourage institutions to think strategically about how to maximize the impact and efficient use of their research infrastructure.

The CFI has had a dramatic effect on strategic research planning at most of the institutions studied in OMS. Brock, Dalhousie, Manitoba, McGill, Victoria, and Western credited the CFI directly with initiating or greatly improving their strategic research planning process, indicating that it was yielding both expected and unexpected benefits. For example, planning has facilitated a process of integrating human resources such as Canada Research Chairs and new faculty hires with the additional infrastructure capacity. Table 1 summarizes the institutions' complementary human resource investments, an indicator of commitment to the theme as a planning priority.

Table 1 – Complementary human resource investments in the themes

Type of Investment	Total amount/number	Context	Range
Number of CRCs allocated to themes	56	Estimated as 12% of total CRCs at the institutions[4]	0– 28% of total number of CRCs at institutions
Number of new faculty hires in themes (does not include internal transfers)	303	Estimated as 81% increase in theme faculty *vs.* pre-CFI[5]	4–68 new hires
CFI awards	$128 million	The CFI funding alone in the themes	$2 million–$52 million

All institutions mentioned the strong positive influence of other recent funding initiatives. In particular, the Canada Research Chairs program allowed institutions to create high-profile professorships. Provincial funds were also deemed essential to realizing the potential of CFI-funded projects. Many institutions had undertaken substantial interactions with the province regarding the nature of the theme projects. The strategic research plan requirement encouraged institutions to consult with other institutions on infrastructure requirements, funding, and operation. In general, the expert panels found the CFI had a strong indirect impact on planning at these other institutions as well as planning at municipal, provincial, and national levels.

[4] Weighted average.

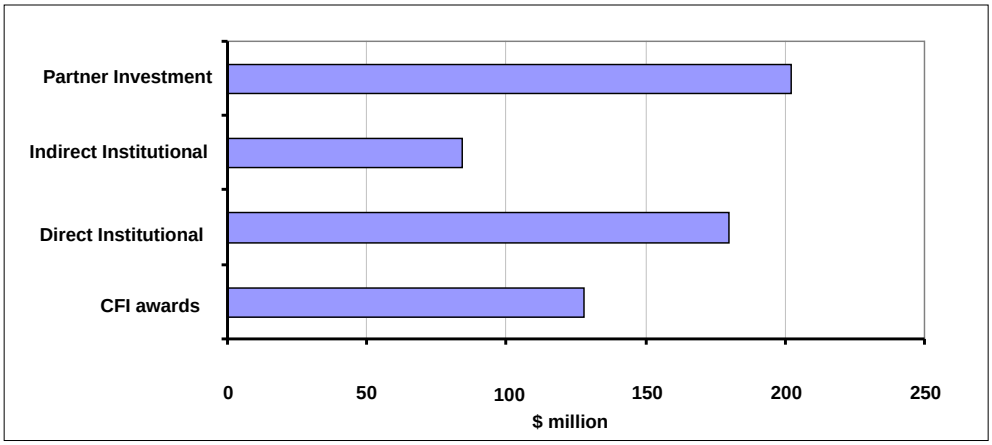
[5] Complete data (i.e. both pre- and post-CFI) only available from four OMS sites: Calgary, Dalhousie, Manitoba, and McMaster.

Overall, the CFI and its partners have allowed the institutions to "think big" in a way that was not possible before. Institutions that were particularly successful in terms of outcomes had deliberately and explicitly implemented plans including research, training, and knowledge and technology transfer activities around integrated facilities, demonstrating powerful "facility" and "organization" effects.

Research capacity

CFI awards had a tremendous impact on research capacity. Prior to the CFI and partner investments, the expert panels rated the level of infrastructure investment in the OMS themes to be, on average, low. Some institutions, such as Brock, had little to no infrastructure in the theme prior to its CFI awards. By 2007-2008 about half the theme infrastructure investments were rated by the panels as "high" and half as "very high." Internal investments made by the institutions include related infrastructure support (e.g. space, overhead), research support (e.g. from dean's budgets), or training support (e.g. new courses and curricula) (see Figure 1). The totals extend well beyond the requisite 60% partner funding implied by CFI's application guidelines and include some related investments, such as non-capital support, which is part of the cost of running large-scale facilities.

Figure 1 – Complementary investments in the themes[6]



The CFI has had a profound impact on the technical and operational infrastructure capabilities in most themes. Generally, the expert panels rated these capabilities as below average prior to the CFI-funded projects. After the new CFI-funded infrastructure was in place, the panel rated most facilities as "like the best in Canada", while the state-of-the-art infrastructure at McGill, Victoria, and the Hospital for Sick Children were rated on par with the best in the world. While other sites had some state-of-the-art capabilities, they were not quite at world-class levels due to their smaller size or lack of unique capabilities. Each

[6] "Direct" investments are those specifically in the theme area, and related to the CFI-funded projects studied in the OMS. "Indirect" investments were outside the narrowly-defined theme and CFI-funded projects within it, but highly related; e.g., to strengthen infrastructure in a multidisciplinary group using the thematic infrastructure.

portfolio of infrastructure within the themes had a component of more generic infrastructure serving important roles, the ratio varied among institutions. McMaster, for example, had some facilities at the "best Canadian" level, and others at the world-class level. Such variation is normal within research laboratories.

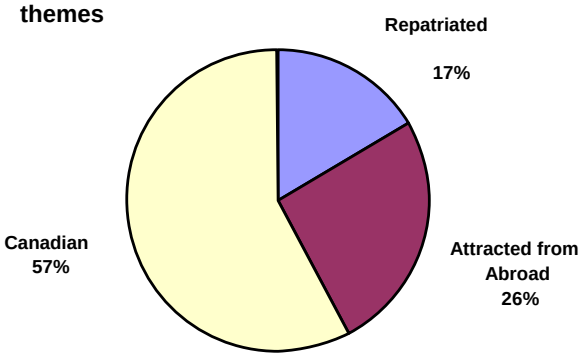
Better infrastructure should allow scientists to propose more innovative and usually more extensive and more expensive research. A key indicator of research capacity is thus the level of sponsored research funding. The expert panels rated the impact of the CFI-funded projects on this funding to be "high" to "very high," on average, at the nine OMS sites. The themes have attracted on average nearly seven times as much total annual sponsored research funding following the CFI investment. In addition, funding per principal user in the themes has approximately tripled since the CFI investments began, going from $149,000 pre-CFI to $453,000 post-CFI.[7]

Table 2 shows that, on average, the themes now include twice as many faculty members as before the CFI investments.

Table 2 – Number of project leaders and principal users in the themes

	Pre-CFI	Post-CFI	Factor post *vs.* pre	Range
Estimated total faculty members in theme[8]	312	706	2.1x	1.3x– 3.0x

Figure 2 – Attraction of Researchers in the themes



About 250 of the faculty members cited the availability of the infrastructure as a key factor that attracted them to work on research in the theme over the OMS sample period. Figure 2 shows the success in attracting foreign researchers to Canada and in repatriating Canadian researchers. Over 42% were from abroad, including repatriated Canadians. A number of key scientists also commented that the CFI-funded infrastructure had helped keep them in Canada.

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cross six of the nine themes[9] the CFI-funded facilities attracted approximately 500 visiting researchers who stayed one week or

[7] Weighted average. This appears to exceed national increases in combined funding from major federal funding agencies in the same period.

[8] The net change here is due to new hires, researchers leaving, or internal transfer.

[9] Data was not available for three visits.

longer — more than two-thirds the number of faculty members in these theme areas. While this figure demonstrates the state-of-the-art nature of much of the infrastructure as well as being an indicator of collaboration, the expert panels rated this on average as only "medium-high," noting that many of the facilities are still in the process of becoming fully operational and well-known.

Expert panels determined that the increased numbers of researchers in six of the nine themes were sufficient to be a critical mass; that is, they comprised a well-integrated group of researchers of suitable size and constitution (considering the diverse disciplinary and technical skills necessary) to be able to make significant advances in the field at a level of national to international competitiveness. As an example of rapid formation of critical mass, the number of faculty members in Victoria's environment and oceans theme grew from 19 to 51 between 1999 and 2008, a 170% increase, versus 25% growth university-wide. In addition, high numbers of federal and other non-faculty scientists worked in the theme.

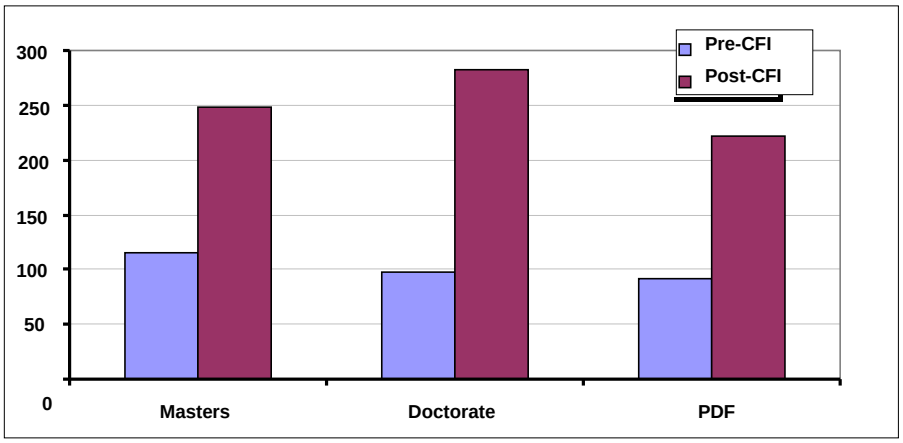
The nine OMS themes all show high degrees of multidisciplinarity: in the use of the infrastructure; in the affiliations of the principal users; and in the institutions' restructuring of traditional "silo" policies, practices and structures. Some themes also show a high degree of multi-sectoral work. Those themes that included integrated suites of equipment in facilities promoting multidisciplinarity and multi-sectoral research tended to show stronger outcomes, a "facility" effect. These impacts are actively fostered by the CFI's unique mandate, its resources, and its links to institutional strategic research plans.

Highly qualified personnel

The CFI has deliberately considered the training of highly qualified personnel (HQP) separately from "research capacity" in the OMS because of its particular importance as a predictor of future capacity for both research and innovation. Compared to the immediate pre-CFI years, approximately two and a half times more HQP in total were being trained per annum in the themes studied. This effect is, of course, strongly tied to the approximately doubled number of project leaders and principal users in the theme since the CFI began. A rough estimate of the impact per faculty member is that there were about 1.4 graduate students per faculty member in the theme pre-CFI versus about 1.6 post-CFI.[10] A minimum estimate is that nearly 2,200 HQP have already been trained on the CFI-funded infrastructure in the themes studied. Figure 3 shows the annual breakdown.

[10] Data for this calculation excludes institutions for which one of the four required data points was missing, Brock, McMaster, Hospital for Sick Children, and Western.

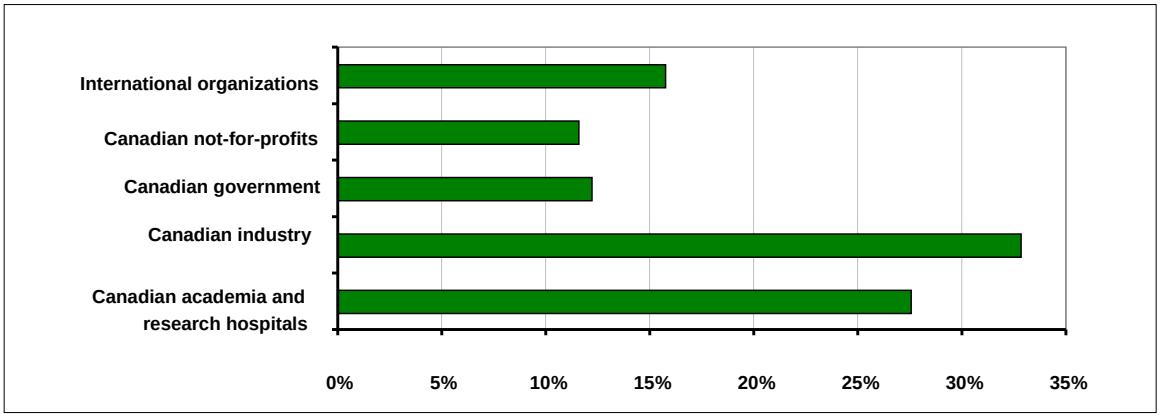
Figure 3 – Research Trainees per Year in the themes



The expert panels noted that the CFI-supported projects, in concert with the strategic research planning and the integrated nature of the facilities, have had a high impact on the quality of training available for graduate, and even undergraduate students. In addition, all the institutions have taken the opportunity afforded by CFI-supported projects to notably expand and improve the structure of their training programs. For example, Manitoba's Nairobi labs have facilitated an exchange training program allowing Kenyan and Canadian MSc and PhD students to use the CFI-funded infrastructure in both countries. Calgary has several seminar series specific to the theme, allowing students and researchers to exchange ideas and pilot new presentations. Victoria was in the process of implementing 10 new undergraduate and graduate programs in their theme. The Hospital for Sick Children works cooperatively with local colleges to identify and train future project managers and technicians required for theme projects. At McGill the quality of the training environment is evidenced by the competition for places; each position receives 20 to 40 applications and is filled by high-calibre students. There, 75% of graduate students and 50% of post-doctoral fellows are supported by external funding.

The expert panels saw the movement of HQP from academia into user organizations as a key mechanism for innovation. This was frequently assisted by mechanisms such as co-op programs, industrial scholarships and fellowships, or simply by having students work on applied problems with industry or government partners. Figure 4 shows minimum figures for post-graduate employment of students formerly associated with the CFI-funded projects (excluding the approximately 50% of HQP still in training).

Figure 4 – Career Destinations of Graduates who had trained in the themes



Research productivity

The expert panels found that the CFI-funded infrastructure has had a profound impact on the productivity and competitiveness of most of the themes. Following the CFI and partner investments, none of the themes is less than nationally competitive, and at least four of the themes as well as a significant portion of a fifth are internationally competitive. This is in the context of some of these themes essentially not existing in any strength prior to the CFI investment, or having facilities which had become outdated and uncompetitive over the years prior to the CFI.

Expert panels noted, on average, medium-to-high impacts of the CFI-funded infrastructure on the quantity of research produced in the themes. Data on publications per theme or per principal user were quite difficult for the institutions to provide, and are minimums considering that incomplete data were received. Nonetheless, the data in Table 3 show that six of the themes have produced nearly 3,000 publications since CFI awards began, and that productivity (as measured simply by volume per principal user, per annum) has increased, on average, by about 50%.

Table 3 – Research productivity in the themes

	Pre-CFI	**Post-CFI**	**Factor post *vs.* pre**	**Comments**
Total publications, all themes	No data	2,868*	n/a	Range: 92– 1,380
Publications per principal user, per annum	3.13**	4.56**	1.5x	Range: 1.2x–2.5x

* Total publications since CFI creation from six institutions.

** Four institutions provided pre-CFI data and five provided post-CFI data. However, ”Post-CFI” and “Factor post vs. pre” are only from the four providing both figures.

Although expert panels expressed occasional concerns about the level of productivity in themes or sub-themes, generally the levels were satisfactory when put in context. They noted that the attention required of project leaders for implementing major CFI-funded projects takes time away from research. Also, new hires (especially researchers early in their career and foreign and repatriated Canadians) require time to establish themselves at the new location. Finally, the ambitious, state-of-the-art nature of some of the CFI-funded projects represents a major shift in how research is being done.

The expert panels rated the impact of CFI-funded infrastructure on the quality of research conducted in the themes as being high, on average. As a typical example, McMaster researchers in the theme had been recognized by the American Physical Society, Killam Foundation, Rank Foundation, NSERC Synergy Awards, and several Premier's Research Excellence Awards for young faculty. Their research was also highlighted on the covers of *Physical Review Letters* and the *Journal for Polymer Science*, the top journal in this field. In relying on CFI-supported equipment, theme researchers at the Hospital for Sick Children had similarly recently been senior co-authors in publishing the chromosome 7 sequence, the gene copy number variation (CNV) work, and gene markers for some cancers. Having fundamentally changed understanding of genomics and medicine, the expert panel considered this research as meeting Nobel standards.

The Hospital for Sick Children's research is an example of how many of the themes have been transformed by infrastructure in terms of the increasingly ambitious nature of research topics that could be investigated and the methodologies used to investigate them. For the expert panels, the defining aspect of enhanced "research quality" was the nature of the research issues that the CFI-funded infrastructure catalyzed, and which would not otherwise have been possible. Evidence of the seminal nature of the questions and the research itself were the quality of the journals, research that had changed paradigms, and the public profile of the investigators.

Innovation

The OMS studies found that there were many activities specifically directed towards innovation and generation of significant practical socio-economic impacts within the themes. All of the themes showed a willingness to address the needs of external user organizations, and to interface in both formal and informal ways with them. At the Hospital for Sick Children, for example, strong leadership from the Centre for Applied Genomics adjusted the research strategy to better reflect external needs, while biotech fee-for-service revenues to biotech companies increased from $500,000 in 1999 to $3.5 million in 2006. At Victoria, contract research grew from 10 to 20 contracts in 2004 to more than 200 per year in 2008, with diverse collaborations ranging from Agriculture and Agri-Food Canada, to the Canadian Water Network, and the National Aboriginal Health Program.

External user organizations have contributed at least $47 million in cash and in-kind to the themes over the period studied – approximately 37% of the value of the CFI awards.[11] At

[11] External users are individuals or organizations outside the academic community (typically in industry or government) that use research results to develop practical applications. This category does not

Western, for example, this included $9 million through industrial contributions to the London Imaging Research group (not all of which was in the theme), $2 million in private sector contributions to the bone and joints group, and a recent $5 million private donation to the Fowler Kennedy Clinic. On average, however, the expert panels found that linkages to the external organizations were still moderate, as were the cash and in-kind contributions these organizations had made to the themes. The panels commented that relationships with end users could still be stronger, more formal, and more actively pursued, even considering the relatively early stage of some of the themes.

Some themes, for example at Brock, developed a strong industrial orientation, while others were already well-established prior to the CFI such as McMaster. Others, like Calgary, Manitoba, McGill, Hospital for Sick Children, and Western are associated with medical and health care issues, so the primary external users were often both in industry (e.g. pharmaceuticals) and among health care. systems (including policy makers and practitioners). In Victoria, there will likely be increasing usage by government researchers and policy makers, in addition to industry. Dalhousie acts as a platform for many different possible uses and users, including government (e.g. security), health care and industry.

A wide variety of mechanisms were employed by researchers in these themes to link to external users. Some of the mechanisms seen in the themes included:

- Movement of HQP from academia into user organizations (a key mechanism for knowledge translation), as well as cross-appointments or researchers seconded from the institution to user organizations or vice versa (e.g. Brock, McMaster, Hospital for Sick Children);
- Collaborations such as MOUs, contract research, industrial research consortia, intellectual property protection arrangements, collaborative arrangements with government research labs, working groups, task groups, and collaborative-planning (e.g. McGill, Manitoba, Victoria);
- Provision of fee-for-service testing, analytic services, imaging and modeling services, etc. (e.g. Hospital for Sick Children, Western, McMaster);
- Presentations of research projects and results such as conferences, “meet-and-greet” sessions with potential users, workshop series, student poster sessions (e.g. McMaster, Calgary, Western, Dalhousie) and active public outreach and education components (e.g. Hospital for Sick Children, McGill, Victoria);
- Information and materials flowing back and forth from academia to and from users, including setting up first points of contact for external users (e.g. Hospital for Sick Children, McMaster, Western).

Figure 5 summarizes indicators of formal technology transfer. Their relative importance and validity varies depending on the theme. These should be considered as minimums considering the difficulty institutions had in tracking some of these data.

Figure 5 – Formal technology transfer in the themes

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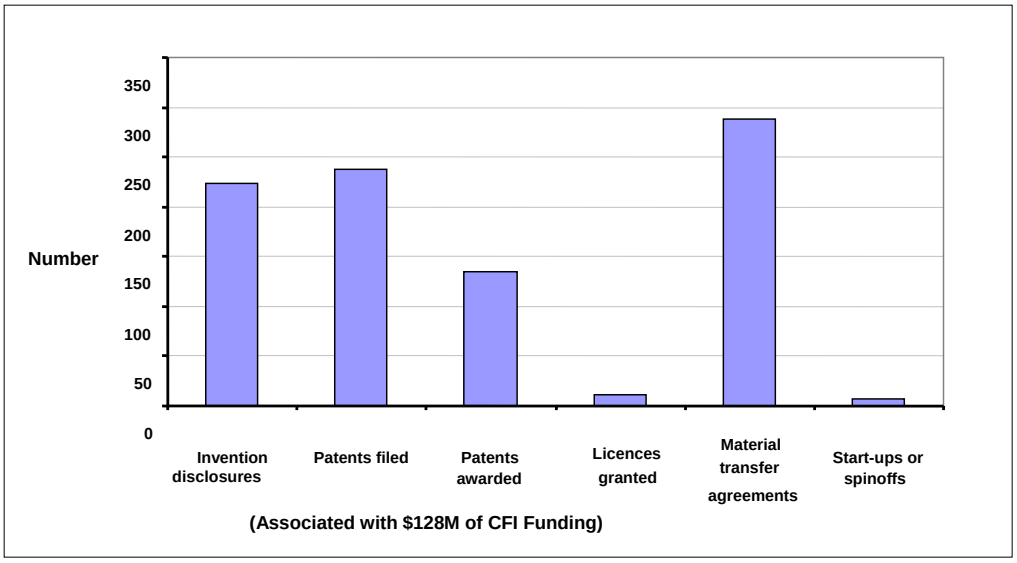
include tri-council or provincial funders. Due to the timeframe considered in the OMS, this amount goes beyond the amount formally recorded as partner funding by CFI’s application guidelines.



The expert panels were not always satisfied with the level of patenting and licensing, believing that many of the themes were not fully exploiting their potential in these areas. In some themes, the expert panels identified some weaknesses in the strategic planning for innovation, and in linkages to users. Nevertheless, many examples of practical socio-economic impacts were seen developing. A small sampling:

- **improved health care,** e.g. a new scoring system for acute strokes, the Alberta Stroke Program Early CT Score (ASPECTS) is used internationally for all acute stroke clinical trials to improve outcomes (Calgary); improved surgical treatment of brain tumours and epilepsy through pre-op MRI and intra-op ultrasound (McGill); gene markers for some cancers (Hospital for Sick Children); early diagnosis and treatment of osteoarthritis (Western); new drug development for HIV/AIDS (Manitoba); and a proposed AwareHome at Dalhousie to enable the elderly and those with disabilities to live at home longer.

- **better regulatory ability,** e.g. authentication techniques for ice wines (Brock); real-time monitoring of drinking water quality (Victoria);

- **new structural codes and standards,** e.g. guidelines and standards for repair and rehabilitation of structures (McMaster);

- **new and improved products and processes,** e.g. wine grape canopy management (Brock); steel, composite, and thermoplastic materials and production (McMaster); undersea technologies (Victoria); development of new medical imaging technologies through partnership with GE (Western);

- **better public policies,** e.g. guidelines for surgery in ligament injuries (Calgary); impacts of circumcision on reducing risk of AIDS (Manitoba); patient databases available to Canadian and international hospitals (Hospital for Sick Children); improved practices for community care and better health and exercise guidelines among the elderly (Western);

- **environmental benefits,** e.g. improved production of cement materials (McMaster); modeling of climate change, oceanic and forestry resource use (Victoria).

Challenges

Institutions discussed challenges they faced in being able to achieve strong results in the five major OMS outcome categories. There was a remarkable commonality across themes. Challenges are listed below in decreasing order of frequency. All institutions mentioned the first three points.

- The CFI awards, with associated funding from the institutions' partners, are the principal Canadian source for research infrastructure and thus institutions are vulnerable to any diminishment of these resources.

- The infrastructure requires substantial ongoing resources, including funds to cover a wide variety of indirect costs such as overhead and human resources in order to be operated effectively, particularly after the CFI's Infrastructure Operating Fund is no longer applicable.

- New investments in infrastructure and renewal of core facilities must be made on a regular basis to keep the infrastructure and research environment state-of-the-art.

- There should be better alignment of CFI with other funding sources, including both federal and provincial, for co-funding for infrastructure. Also, sufficient research funding for the direct operating costs of research projects must be available. In some fields, the success rate for grant proposals submitted to the tri-councils is low, leading to concern that the resources of the overall research funding system have not kept pace with infrastructure investments.

- Without state-of-the-art, upgraded and well-maintained infrastructure that has sufficient research grant funding, it will be difficult to attract or retain top quality faculty members and maintain critical mass. In some themes the loss of even one or two key personnel would have major negative consequences.

- Strategic research plans are a key tool to maximize the impacts of the infrastructure, and institutions recognize the need for more attention to these plans to ensure appropriate co-funding, and coordination with recruitment, training, multidisciplinary and cross-disciplinary efforts, and innovation activities.

- Creation of practical applications is challenging considering the unpredictable nature of research, commercialization difficulties (such as low receptor capacity in some contexts), the difficulty of supporting early product development stages, the patchwork of IP policies across Canadian institutions, and challenges to integrate research findings into public or health care policy.

Conclusions

The impacts of the CFI and partner investments in research infrastructure are high across all the OMS outcome categories. The impacts are not just from the sum of individual projects, but are instead intimately tied to the collective power of integrated suites of state-of-the-art

equipment, usually housed in purpose-built facilities, and deliberately sited to maximize their accessibility, and multidisciplinary, multi-sectoral effects. This “facility” effect is substantial, although still “a work in progress” at some institutions.

This collective power is greatly strengthened where the institutions have deliberately and explicitly addressed its ramifications in their strategic research plans, have translated this into their facility designs, and have organized their research, training, and innovation-related knowledge and technology transfer activities around it. The “organization” effect is very strong, as demonstrated by situations where in less cohesive themes these effects, and the outcomes observed, were less pronounced.

The OMS process itself has so underscored the effects of strategic and integrated research planning and the dramatic impacts of the integrated CFI-funded facilities that the institutions themselves are voicing even more ambition than before in the themes studied. For example, several are planning more integration of the themes within both institutional and external research programs, and are preparing additional, related large-scale projects. These effects would not have been apparent to the CFI through typical evaluation activities, and in some cases had not been apparent to even the institutions themselves, prior to the OMS process.

Considering the size of the CFI investments, and the presence of the facility effect and the organization effect, almost certainly the impacts documented by the OMS would not have arisen to nearly the same extent through funding programs focused on individual researchers or through programs driven by individual equipment requests, or that do not have the strategic research plan requirement.