Final Report

Evaluation of the College and Community Innovation Program and SSHRC's Community & College Social Innovation Fund

September 2018

NSERC CRSNG

Canada

Acknowledgements

Table of Contents

List of tables

List of figures

List of acronyms

ARD	Applied Research and Development
ARTI	Applied Research Tools and Instrument
CCI	College and Community Innovation program
CCSIF	Community and College Social Innovation Fund
CFI	Canadian Foundation for Innovation
CFD	Computational Fluid Dynamics
CIHR	Canadian Institutes of Health Research
CU-I2I	College-University Idea to Innovation
IE	Innovation Enhancement
IRCC	Industrial Research Chairs for Colleges
NSE	Natural Sciences and Engineering
NSERC	Natural Sciences and Engineering Research Council of Canada
R&D	Research and Development
RSF	Research Support Fund
SMEs	Small and Medium Enterprises
SSH	Social Sciences and Humanities
SSHRC	Social Sciences and Humanities Research Council
TAC	Technology Access Centre

1. Introduction

This document constitutes the final report of the evaluation of the College and Community Innovation (CCI) program and the Social Sciences and Humanities Research Council's (SSHRC) Community and College Social Innovation Fund (CCSIF). The evaluation of the CCI program is mandated as per the evaluation coverage requirements, stipulated in the Treasury Board's *Policy on Results* and Section 42.1 of the *Financial Administration Act*. The evaluation of the CCSIF was initiated to respond to a desire for evidence regarding its impacts prior to the end of its funding term. The evaluation assessed the achievement of program objectives and expected outcomes and was conducted jointly by the NSERC's and SSHRC's Evaluation Division, and Prairie Research Associates (PRA) Inc.

The CCI program is administered by NSERC, in collaboration with the Canadian Institutes of Health and Research (CIHR) and the SSHRC. The CCI provides funding for Canadian colleges[1] through seven different grants: Innovation Enhancement (IE), Technology Access Centre (TAC), Engage, Applied Research and Development (ARD), Applied Research Tools and Instrument (ARTI), Industrial Research Chairs for Colleges (IRCC), and College-University Idea to Innovation (CU-I2I). The CCI, through its various funding opportunities, aims to increase the economic development of Canadian communities and create new skilled jobs by increasing the capacity of colleges to undertake research and development (R&D) activities and projects in partnership with the private sector, particularly small and medium enterprises (SMEs), and contribute to local and regional innovation by fostering the commercialization, technology transfer, adaptation and/or adoption of new products, services, and technologies (NSERC, 2016d).

The CCSIF aims to foster social innovation in Canada by connecting the talent, expertise and capabilities within Canadian colleges with the research needs of local community organizations (NSERC, 2017). It is anticipated that funded projects will develop new or existing ideas and solutions to social challenges, as well as products, initiatives, processes, or programs that create a positive impact on society (SSHRC, 2016). In 2017, the CCSIF was integrated within the broader CCI program.

The CCI program evaluation covers the period from 2010-11 to 2016-17, while the CCSIF evaluation focuses on the period between 2014-2015 and 2016-2017. The evaluation used similar methods to examine issues related to the relevance, design, delivery, and efficiency of both programs. They also assessed the extent to which the programs achieved their expected outcomes (i.e., effectiveness). However, only three of the CCI grants were assessed on this point: TAC grants; IRCC grants; and ARD grants with two possible funding levels (ARD2 and ARD3).

Table 1 outlines the evaluation questions.

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[1] The term college is also used in reference to polytechnics and CÉGEPS.

Table 1: Evaluation questions

Relevance
1. Is there a continued need for the CCSIF and the CCI program, in light of the current research context in Canada?
2. To what extent is funding applied research in Canadian colleges an appropriate role for the federal government?
Design & Delivery
3. To what extent is the design of the CCSIF and the CCI program appropriate to support the achievement of expected outcomes?
4. To what extent is the delivery of the CCSIF and the CCI program supporting the achievement of expected outcomes?
Effectiveness – CCI & CCSIF
5. To what extent are the grants under the CCI program (particularly the TACs, IRCCs, and ARDs) and the CCSIF: a) Facilitating applied research and knowledge mobilization activities at Canadian colleges/polytechnics/CÉGEPS, as well as fostering innovation within local communities?   b) Enabling the development and/or maintenance (CCSIF only) of innovation-focussed partnerships with local companies and other organizations?   c) Contributing to the provision of an experiential learning and training environment for students that enhances their skills and employment prospects?
6. What impact is the CCI program having on local companies and/or other types of organizations?
7. What impact is the CCSIF having on local organizations?
Efficiency
8. To what extent are the CCSIF and the CCI program delivered in a cost-efficient manner?

Evaluating the extent to which the CCI program and the CCSIF achieved their objectives and expected outcomes required multiple lines of inquiry, including: a literature review, document reviews, administrative data reviews, cost-efficiency analyses, case studies,[2] and key informant interviews. Additional lines of inquiry were also used as part of the evaluation of the CCI program, including an online survey with TAC clients (with telephone follow-up), interviews with TAC directors working at colleges that were not selected for a case study, and a file review.

1.1. Challenges

► *Inconsistent reporting:* The extent to which some of the data collected through the TAC and IRCC Chair reports could be analyzed and/or compared over time was limited. This may be attributed to the fact that some of the questions included in the reports, submitted by the TACs or IRCCs, are broad and unclear, and/or that institutions were given slightly different versions of a particular report, which resulted in incomparable data. Additionally, because many of the reports are in the form of a Word document or PDF template, the respondent can omit to answer certain questions without explanation (note that ARD and Engage reports are now available to be completed online and that NSERC is continuing to work to ensure that all grant reports are available online within the next few years). The evaluation used multiple lines of evidence that helped either corroborate findings extracted from the reports or fill gaps where information was not available from the reports.

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[2] Case studies included interviews with: institutional research coordinators; project leads/TAC directors; project partners or collaborators; clients of the TACs; students (when available); and other relevant stakeholders.

► *CCSIF grants not yet completed*: Most of the CCSIF-funded projects were not completed at the time of data collection. It was, therefore, difficult to measure the projects' actual achievement of objectives and outcomes. Additionally, societal impacts and benefits of Social Sciences and Humanities (SSH) R&D often take a long time to occur, which further increased the difficulty of measuring the impact of the CCSIF-funded projects during this evaluation. Using multiple lines of evidence, such as key informant interviews and case studies, the evaluation team extracted the available qualitative outcome information from the CCSIF-funded projects.

2. Supporting Applied R&D at Canadian Colleges

Innovation is an important determinant of a country's ability to compete within a global market, and is therefore crucial to a country's economic growth and its residents' quality of life. Over the past decade, the importance of innovation has become increasingly apparent for Canada's economy, competitiveness, and the well-being its citizens. In order to continue to drive global innovation, growth, and well-being, a diverse range of actors, including academia, practitioners, and Indigenous communities alike, must be involved. It includes Canadian colleges, which are becoming increasingly engaged in applied R&D activities. Their activities, coupled with their knowledge of industry and community needs, strongly position them to partner with Canadian organizations in an effort to increase their innovative, and thus, their competitive abilities. Through these partnerships and R&D activities, students at these institutions are provided with opportunities to acquire additional knowledge, skills, competencies, and attitudes, which in turn will help them become more productive members of the Canadian workforce. Therefore, the applied R&D activities at Canadian colleges support the federal government's intention to build a stronger economy and create new, quality jobs for Canadians. As granting councils, NSERC and SSHRC are appropriate mechanisms through which the federal government is able to provide funding in support of applied R&D at colleges across Canada. This support is primarily achieved through the CCI program and CCSIF grants, which provide different levels of funding. These two programs are considered by the majority of respondents interviewed to be the main sources of funding for applied R&D at Canadian colleges, and without them, it is expected that applied R&D would occur on a much smaller scale or not at all.

3. CCI and CCSIF Program Design and Delivery

Overall, stakeholder relationships with NSERC and SSHRC appear to be very positive. There are, however, a few aspects of the CCI program and/or the CCSIF grants that could be improved and/or that members of the applied R&D community would like to see addressed. They include:

Greater opportunities for funding projects in the SSH or health-related disciplines.
Since 2010-2011 the CCI program has received and funded very few applications for IRCCs and ARD[3] projects in the SSH (1%) or health-related disciplines (2%). Stakeholders report that the CCI program primarily targets applied R&D in the Natural Sciences and Engineering (NSE) disciplines. The perception that the CCI program favours the NSE disciplines stems from funding eligibility requirements and proposed areas of research, as outlined in the program

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[3] Unless specified, the term "ARD" will be used in reference to ARD2 and ARD3 grants.

documentation. In particular, the requirement for industry partners has been argued to limit the extent to which colleges can work with organizations whose primary applied R&D needs are connected to the SSH or health disciplines (i.e., community organizations, hospitals, non-profit organizations, etc.). The inability to work with non-industry partners is further considered by some stakeholders to be a detriment for Canadian colleges and communities, as it limits opportunities to foster social innovation (i.e., the development of new ideas or the use of existing ideas to find solutions to societal challenges) through applied R&D; thereby, inhibiting community, social, and possibly economic development. Consequently, they would like to see the definition of partner broadened to include all organizations that may benefit from applied R&D.

Increased recognition for the importance of in-kind contributions from R&D partners.
Most of the CCI grants require industry partners to provide a certain amount of cash and/or in-kind contributions. The required cash and/or in-kind contribution amounts vary significantly across the CCI grants and tend to increase every year for longer-term grants, or when a grant is renewed. Opinions vary regarding the appropriateness of contribution requirements. While the majority of evaluation participants agree that it is necessary to require contributions from partners to demonstrate their commitment to working with colleges on applied R&D, some are concerned that in-kind contributions are not as highly valued as cash contributions. For example, the requirement for a cash contribution from partners for several of the CCI program grants was noted by stakeholders as supporting the argument that, despite being delivered in collaboration with SSHRC and CIHR, the CCI program primarily targets applied R&D in the NSE disciplines. Organizations whose primary applied R&D needs are in the SSH and/or health-related disciplines may only be able to provide substantial in-kind contributions (instead of cash contributions). There are also concerns that the cash requirements may limit the ability of small organizations to engage in larger or longer-term projects with colleges, as they may not have the financial capital needed.

Greater consideration of the issues surrounding the current mechanism for faculty release time.
Involvement of college faculty in applied R&D yields several positive outcomes (as highlighted throughout this report), but release time for faculty members to engage in applied R&D is an ongoing issue for many colleges across Canada. Faculty are expected to carry full teaching course loads, which leaves them little to no time for applied R&D activities (Bélanger et al.,2005; Fisher, 2010). The CCI program attempts to address this barrier by offering funds for release time and course load reductions. Funds from the CCI program can also be used towards engaging existing part-time faculty to participate in applied R&D activities. For example, the IRCC grant covers the Chairholder's salary and direct benefits, while eligible expenses for the other CCI grants includes teaching release: up to $9,000 per course, per semester for the cost to replace faculty, so they can be involved in applied R&D projects and activities.

Despite the availability of funds for teaching release, this mechanism does not appear to be entirely aligned with the operational requirements of colleges and does not fully address the underlying issues associated with faculty release, namely:

► Finding individuals versed in the subject matter area who are available to work;
► Resources at the college who are available to focus on finding and hiring replacement faculty; and
► Enough funds to cover the costs of replacing faculty.

The issues are especially prevalent among small colleges and/or colleges located in rural and/or remote areas, as they have a harder time finding qualified replacement faculty or the funds to offset the costs associated with faculty release time.

Faculty release time is a challenge for CCSIF-funded projects as it is not a specific, eligible expense of the grant. Instead, colleges could use part or all of the 20% of the grant allotted for overhead and administration expenditures (i.e., indirect costs) towards release time. This was considered to be insufficient; however, it is important to note that the inclusion of CCSIF in CCI (announced in Budget 2018) resulted in $9,000 per course, per semester for the replacement of faculty for CCSIF.

Shorter turnaround time to review grant applications.
The process for reviewing applications for several CCI program grants is considered to be too long by some stakeholders and it has had adverse consequences for the colleges. On average, it takes three to seven months for a college to receive a decision from NSERC regarding their application for an ARD grant. Stakeholders noted that length of time does not coincide with the short-term needs of industry. However, there has been an upward trend in the number of ARD applications being processed in shorter periods of time, and a declining trend in the number of applications that take five to six months to process. Over time, the size of the CCI team has increased and so the number of files per person has decreased, but this is also due in part to the CCI team getting faster at processing files and improvement in the quality of applications.

Stakeholders would like to see the turnaround time for applications reduced to align more with the needs and speed of industry partners. Stakeholders highlighted that because the application review process took too long, they have lost a few potential project partners. Additionally, there are difficulties finding replacement faculty and/or hiring students, as the research coordinator, project lead, IRCC Chairholder, or TAC director could not plan ahead for these resources; thus, they may not have been available when the project began.

Increase the proportion of grant funds that can be used for indirect costs and eligible expenses.
Costs related to applied R&D at colleges may be categorized as direct and indirect costs. The former are costs incurred towards specific R&D efforts; the latter are the costs incurred by the institution in support of R&D that are not readily attributable to a specific project or activity (e.g., salaries for staff or students who provide administrative support; operating costs). Currently, up to 20% of the funds received for an Engage, ARD2, ARD3, IE, IRCC, CU-I2I, or CCSIF grant may be used towards indirect costs. Stakeholders consider this amount to be insufficient, as the proportion of indirect costs for applied R&D at colleges can be closer to 30% — this can be especially true for smaller colleges, since they are less likely to have larger, longer-term funding, including TAC grants, which provide the greatest opportunities to offset indirect costs.

Additionally, some stakeholders would like to see certain ineligible direct and indirect expenses become eligible or have additional funds become available to compensate for them. These expenses include the purchase of equipment, recruitment of faculty, and attendance at scholarly conferences. While some grants are available to colleges for equipment expenses (e.g., Canada Foundation for Innovation [CFI] equipment grants), the grants are perceived as difficult to get or the funds available are insufficient. One option mentioned by stakeholders would be abandoning the proportion of CCI and CCSIF grant funds allocated for indirect costs and for Canadian colleges to become eligible for the Research Support Fund (RSF). The RSF provides grants that

offset the indirect costs of research. RSF grants are proportional to the average amount of eligible funding from the granting councils an institution has received in the previous three years.

Changes to the reporting requirements for certain CCI program grants.
Many stakeholders found the reporting requirements for several CCI program grants cumbersome. For example, the timing of when reports must be submitted to NSERC may result in a situation where grant recipients are submitting multiple reports a year. In certain cases, this prompts the grant recipient to maintain more than one set of records so that they can track their results as required by the different reporting requirements; thereby, increasing workloads and the possibility for confusion when preparing reports. For instance, project leads, IRCCs, and/or TAC directors are required to submit their annual financial report and a short progress update to NSERC by March 31st, and are often subsequently required to submit an update of the same or similar information to their college a few months later in June. Moreover, several of the CCI grants require some form of progress report(s) with submission dates aligning with the award of the grant, but they may overlap with other report submission dates. As a result, grant recipients may be preparing and submitting multiple reports simultaneously.

4. Enhancing R&D Capacity at Canadian Colleges

Findings from the evaluation suggest that colleges are enhancing their capacity for applied R&D through the CCI program and the CCSIF grants by using the funds provided to support human resources, including release time for college faculty and hiring students, to purchase and/or maintain equipment, to develop hubs or centres of research, and/or to build or maintain a Research and Innovation office within the college. The CCI program and the CCSIF enhance the capacity of colleges to engage in applied R&D, placing colleges in an advantageous position to partner with organizations on a short-term basis with a targeted focus (e.g., a project to develop a specific product or service). Consequently, colleges offer resources accessible by Canadian organizations (particularly SMEs) that may lack in-house applied R&D resources.

> "Since the update of our website and since the announcement of the widening of our fields of expertise, we have no difficulty in attracting new customers."
>
> CCI Case Study Participant, TAC Director

Canadian colleges also rely on the funds received through the CCI program and CCSIF grants to build or advance their capacity to engage in applied R&D because of the availability (or lack thereof) of funding for applied R&D in Canada, and because of the variety of grants available through CCI which meets a multiplicity of needs – needs which vary from college to college, but also within a college over time. For instance, one college was awarded an IE grant in 2009 for an applied research and technology transfer program. When that grant was almost complete, the college applied for and received a TAC grant, which allowed them to continue developing their R&D capacity in the same discipline. Since receiving their TAC grant, the college also applied for and received several ARD and Engage grants, which are generally used to fund projects conducted through the TAC. The CCI and CCSIF have the ability to address the different funding requirements of colleges based on their size, the length of time they have been conducting applied R&D, and the specific discipline area or activities undertaken. In particular, the IE, TAC, ARTI, and IRCC grants support long-term capacity-building, while the ARD, Engage, CU-I2I, and the CCSIF grants are more project focussed.

4.1. Addressing the Applied R&D needs of Canadian Organizations

Canadian colleges are well-suited to take into consideration the R&D needs of organizations both within and beyond their community, and adapt their R&D focus in order to suit these needs. For instance, one TAC announced in 2017 that it was expanding its applied R&D activities into new areas. While the centre has a strong reputation for its work in a highly specialized sector, over time the science has evolved

> "We knew exactly what we needed… we needed a very sophisticated system, and we knew that the college would deal with building and developing a hardware system for us."
>
> CCI Case Study Participant, IRCC partner

and the TAC is now receiving requests from partner organizations to use other raw materials that were not available when the centre began a number of years ago. The TAC's unique expertise has paved the way for projects in a new related sector, thereby providing the TAC with the capacity to address the applied R&D needs of Canadian and international organizations.

Findings from the evaluation suggest that by supporting colleges in this endeavor — through funding — the CCI program and the CCSIF grants are strengthening the recognition and reputation of these colleges and the experts who work within them. For example, stakeholders noted that involving faculty in the research activities of the TAC provides the benefit of allowing them to demonstrate their abilities to conduct research, thereby increasing the profile of the institution. For instance, 50% of the ARD project partners indicated that their organization initiated the project with the college, while approximately 30% of partners involved with IRCC Chairholders (as noted in the 18, 36, and 54 month partner reports) indicated they sought the services of the Chair or were advised to do so by a business partner. Of the surveyed TAC clients, 24% indicated that they were referred to the centre by a business contact, which aligns with reports from many case study participants stating that clients often contact a TAC for services once they become aware of the centre through word of mouth referrals.

4.2. Enhancing Applied R&D through Partnerships

The partnerships with community organizations and SMEs fostered through the CCI and CCSIF are important because they help ensure that the education offered by colleges is relevant and responsive to the labour market. The concept of partners varies slightly for each of the three CCI grants under examination. Briefly, TAC partners are generally key regional organizations that provide cash and/or in-kind contributions towards the establishment and/or ongoing operation of the centre because they know it is an important contributor to the economic development of their region.[4] IRCC partners may be similar to TAC partners, but may also be similar to TAC clients. TAC clients are companies that seek out the services of the centre for a particular project and provide the required cash and/or in-kind contribution for the said project. ARD and CCSIF partners are similar to TAC clients.

Overall, between 2010-11 and 2016-17, 958 partners were involved in one or more applied R&D activities funded by a TAC, IRCC, and/or ARD grant. The majority of these were companies and industry partners, followed by government institutions and non-profit organizations (see Figure 1).

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[4] Generally these organizations are providing support without expecting R&D services in return. This is different from IRCCs.

Figure 1: Partners involved in a TAC, IRCC, or ARD grant by organization type and grant (2010-11 to 2016-17)
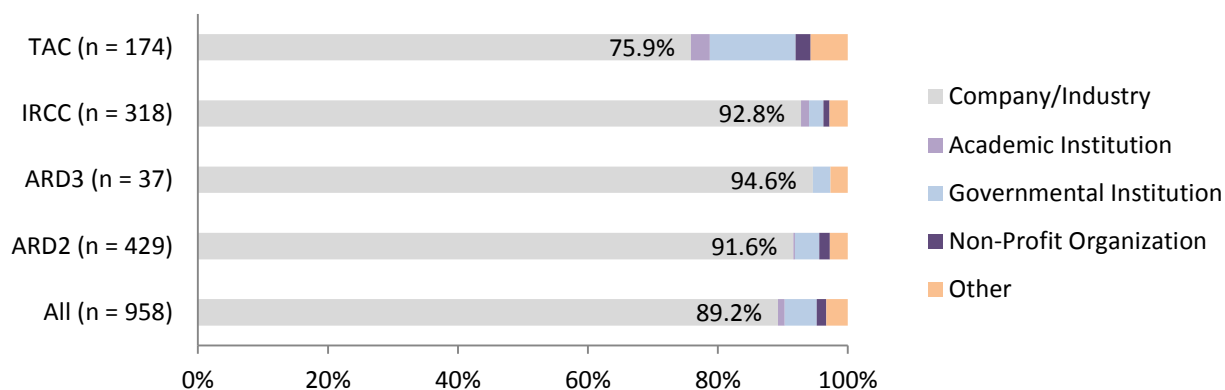
While the CCI program is expected to primarily support partnerships with SMEs, colleges continue to partner with large organizations because of the integral financial and in-kind resources they are able to provide. For example, 17% of TAC partners and 25% of IRCC partners, between 2010-11 and 2016-17, were considered large partners.

There were a total of 187 partners across the 62 CCSIF-funded projects. The majority of partners were not-for-profit organizations or higher education institutions, while business organizations (i.e., companies) represent about 10% of partners.

> "We were looking for the best way to support people – our community members and local businesses and industries."
>
> CCSIF Case Study Participant, Partner

There are a variety of reasons that Canadian organizations become involved in partnerships with colleges or seek out services from a TAC. These reasons tend to be specific to the needs of the organization and align with the applied R&D activities made possible through a particular CCI program or CCSIF grant. For example, according to the TAC client survey, Canadian organizations most commonly sought the services of a TAC for help with applied R&D (62%), technical and business services (40%), and access to specialized equipment (31%). Unlike TAC clients, the main reason why companies partner with an IRCC Chairholder is not to address a specific need, but because they have a genuine interest in the applied R&D area of the Chairholder (81% at 18 months; 68% at 36 months; and, 91% at 54 months), and/or because they want to access and/or acquire greater knowledge (66% at 18 months; 57% at 36 months; and, 73% at 54 months).

Overall, Canadian organizations have indicated their satisfaction with their involvement and work with the TACs, IRCCs, and ARD projects. For example, according to the TAC client survey, the majority of TAC clients were satisfied with the overall quality of the interaction they had with the centre (84%). When asked if they would work with the IRCC Chairholder again, the vast majority of partners said yes (94% at the 18 month report; 96% at the 36 month report). Finally, ARD researchers were asked in their final reports about future plans and more than half (57%) indicated that they planned on a collaboration with the same partner, but on a different project, while just over a third of researchers (35%) wanted to continue working with the partner on the same project, supported by another grant from the CCI program.

4.3. Enhancing Applied R&D through Knowledge Mobilization

Knowledge mobilization to partners, communities, and other potential end-users mainly takes place through formal and informal meetings with partners during a project, final project reports provided to the partners, final reports and main findings being available on the college and partner websites, and workshops with end-users (e.g., SMEs, industry members, academia, government). Additionally, a major component of many of the CCSIF projects is knowledge mobilization to the community — often in a format (e.g., videos, posters) that is more impactful and user-friendly for the community. For example, a couple of CCSIF projects hired college students from the college's communications and visual arts programs to help with knowledge mobilization. In these cases, the students were applying their schooling to present the results of the projects and reach and engage the intended audience and the general public (e.g., documentary videos, posters).

Within and across colleges there are several knowledge mobilization activities undertaken to share the lessons learned and best practices discovered since the implementation of the TAC, IRCC, ARD, and CCSIF grants. The bi-annual meetings hosted by Tech-Access Canada for TAC directors and staff, and the IRCC bi-annual best practices meeting hosted by NSERC for Chairholders, are more formal in nature. Informally, knowledge mobilization occurs within the colleges through faculty and students that participated in the R&D activities sharing their experiences with their colleagues and other students. Faculty may also enrich their curriculum and provide students with experiential learning opportunities; thereby, improving the quality of education provided to students.

> "I have been networking and hosting the reclamation workshop to transfer the knowledge to the users through these venues. The audiences are quite diverse: about 50% SMEs, 25% industry members, and 25% from academia and government. We make a conscientious effort to reach out to all of these people."
>
> CCI Case Study Participant, IRCC Chair

5. Enriched Curriculum & Experiential Learning for College Students

5.1. Enriching the Curriculum

Findings from the evaluation show that the opportunities at colleges to share information about and/or to engage faculty members in the applied R&D activities funded by the CCI program and the CCSIF often had a positive impact on the education offered to students. Improvements in the content of courses has occurred in one or more of the following ways: integration of examples, case studies, and research findings into course content; updating teaching materials in terms of analytical techniques and protocols; providing students with more opportunities for hands-on training (i.e., working in a laboratory); and making project reports mandatory course readings. Faculty are gaining knowledge through direct participation in R&D or through faculty sharing information amongst each other, and then faculty taking their learned current skills, techniques, and results into their classrooms.

To a lesser extent, the CCI program and the CCSIF grant led to the development of new courses. A few case study participants highlighted that the applied R&D activities at their college, particularly the work of the TAC, influenced the development of several new courses (e.g.,

regarding construction management for green building technologies), as well as a new degree program (e.g., in mobile computing).

The college curriculum is also being enriched by providing students with new and/or improved experiential learning opportunities to further expose them to applied R&D. For instance, there are some TACs that engage classrooms of students from certain program streams to participate in some of the TAC's applied R&D activities. In particular, one TAC working with livestock provides opportunities for students (and sometimes their instructors) in a specific program stream to engage in the applied R&D activities of the TAC and learn about new technologies related to livestock production.

> "We've got a new post-degree in climate change policy. A lot of the work for it has come out of the Northern Climate Exchange and was done through the ARDs and CCSIF as well. We worked on an advanced course on permafrost, also coming out of our projects and program knowledge work."
>
> CCI/CCSIF Case Study Participant, Research Coordinator

5.2. Experiential Learning Opportunities for College Students

The number of students involved in applied R&D activities varies significantly across colleges and their affiliated grants. For example, an average of 18 students were involved with a TAC at year three of the grant, with the number of students per TAC ranging from two to 77, while in year five the average number of students involved with a TAC was eight and the number of students per TAC ranged from two to 21. For IRCCs, at 18 months after the grant was awarded, the average number of students involved in at least one project was 12 and the number of students per Chairholder ranged from zero to 37; at 36 months, the average number of students was 23, with the number of students per Chairholder ranging from two to 103.

College students are generally hired to work on applied R&D activities funded by the CCI program or the CCSIF on a part-time basis (anywhere from ten to 24 hours a week) during the academic year, and/or full-time in the summer. In some cases, students may work with a TAC or an IRCC Chairholder on a full-time basis during the academic year as their co-op placement or as an internship for course credit. Several students involved in CCSIF-funded projects have also received course credit for their participation. For example, students could use their experience in their final capstone project for course credit.

Students' roles in applied R&D activities at Canadian colleges vary significantly based on the R&D discipline, the needs of the partner or client, available resources, and the students' existing knowledge and/or skills. Some examples of specific tasks in which students may be asked to engage include, but are not limited to: equipment maintenance and calibration; conceptualization of a product; literature reviews, environmental scans; field work; mapping; testing; web design; attending meetings; training; reporting (i.e., writing and presenting); and conferences or trade shows. The extent to which students interact with partners and/or clients also varies according to the TAC, IRCC, ARD, or CCSIF project lead, the applied R&D activities underway, the client's willingness to work with students, and/or the researchers' comfort level with students working directly with clients.

Through participation in applied R&D activities, college students gain exposure to real world challenges that help them develop a new knowledge base and subsequent skills. Several students noted that by engaging in applied R&D activities funded by the CCI or CCSIF, they are able to

utilize the theoretical learning from their classrooms and gain hands-on experience doing the work they are being trained to do through their program. Some of these learned and applied skills include writing for industry, project management, time management, data collection and analysis, operating specialized equipment/machinery, independence, and networking. Students were also offered opportunities to access research results, state-of-the-art technology and equipment, and high-quality laboratories that would otherwise not be available to them.

> "My classes taught a lot of the theory behind mechanical engineering, but these projects gave me hands-on experience with practical applications."
> CCI Case Study Participant, IRCC Student

> "I think this is a great experience and opportunity for students; it builds skills and confidence."
> CCSIF Case Study Participant, Student

Almost all of the students who participated in applied R&D activities funded by the CCI program at their college found employment after graduation. Some students were hired by a partner company or client they worked with during their involvement in funded activities.

> "Students are our best champions when they start working in industry [by] referring their company to the TAC."
> CCI Case Study Participant, TAC Director

In some cases, recent graduates were hired by the colleges, IRCC Chairholders, or TACs to support ongoing applied R&D activities, particularly when the graduate was previously involved with these activities when they were a student. These opportunities provide graduates with a chance to further develop their knowledge and/or skills; thereby, likely increasing their ability to find employment in the future.

Examples of students working on CCSIF-funded projects finding employment was limited because the CCSIF was still relatively new at the time of this evaluation. However, one college noted that some recent graduates found employment, which they attribute to their participation in a CCSIF-funded project.

6. Supporting Business Innovation and Economic Development

Regardless of the grant and the type of involvement of the partners and TAC clients, overall consensus from project leads, TAC directors, Chairholders, partners, and TAC clients is that the projects almost always address the needs of the partner or TAC client companies. For example, ARD lead researchers and partners on average rate the success of their projects as a 6 on a 7-point scale. The TAC client survey had clients rate the success of their projects in terms of whether specific outcomes had been or were likely to be achieved, with about two-thirds indicating the following outcomes had or would be achieved (see Figure 2):

Figure 2: Achievements of specific outcomes according to TAC clients
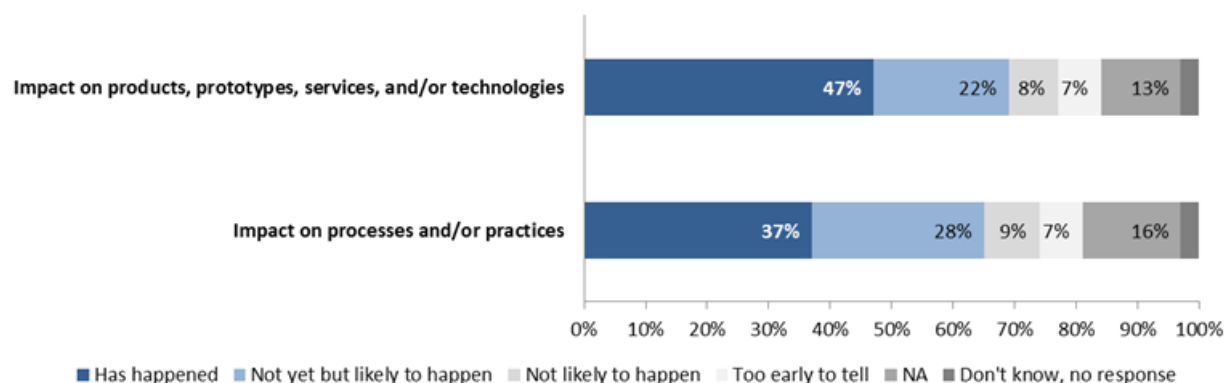
Additionally, according to their progress reports, the majority of Chairholders and IRCC partners perceive their projects as having achieved their expected outcomes, with the level of perception of the achievement of outcomes increasing over time. Finally, most IRCC partners have either already implemented, are implementing, or are undertaking further research with the college to eventually implement the results from their IRCC projects. Again, these percentages increase over time.

Projects undertaken with various CCI grants have resulted in new products, services, and/or technologies, as well as the improvement of existing products, services, and/or technologies. For example, an IRCC has developed an operational app and an electronic book, and one TAC highlights developing reports, videos for communication, training, fixtures and other products from their 3D printer, blueprints, Computational Fluid Dynamics (CFD) simulations, and maintenance and repair protocols. Additionally, some partners and TAC clients have been able to access new markets with their products. For example, a partner, with the help of a TAC, was able to move from 100% wastage of its apple residues to the production of a marketable syrup.

> "I consider the college to be the R&D arm of our company. They have assisted with enhancing and developing a majority of our technologies, from our capstone rain barrel product to some of the next-generation storm water products and connection grid technologies."
>
> CCI Case Study Participant, TAC Client

The new and improved products, services, and/or technologies developed through these partnerships lead to enhanced R&D by SMEs and larger organizations, either internally or through continued work with the colleges. For example, over a third of the TAC clients (38%) indicated through the survey that the project increased overall R&D capacity at their organization. More specifically, a company said they increased their R&D investment through the purchase of new equipment and modifications of existing equipment. Additionally, partners' and TAC clients' continued work with TACs and IRCCs is also cited as evidence that partners are increasing their R&D investment and continuing to support innovation in their communities.

> "The company has grown and has developed further technology based on this project."
>
> CCI Case Study Participant, ARD Project Lead

These projects also lead to increased revenues and a larger workforce for some companies. For example, almost a third (29%) of surveyed TAC clients, who had completed an applied R&D or technical and business service project, indicated that their revenue increased. As a more specific example, a partner noted an increase in the business' revenues due to the increase in farm productivity and crop diversification as a result of the CCI-funded project. In terms of the larger workforce, about one in 10 surveyed TAC clients (8%) indicates they hired one employee, and one in 20 (5%) indicates they hired two employees. Extraordinarily, one surveyed TAC client indicated that they hired over 30 employees. One prime concrete example is a project led by a mining company; a plant was opened thanks to a TAC's expertise, and 150 jobs were created.

7. Supporting Social Innovation and Community Development

Social innovation has an important role to play in the development of communities and improving the lives of Canadians. As previously noted, the CCSIF was designed to support Canadian colleges to develop their applied R&D capacity to help them address the research needs of local community organizations. In 2015, 62 projects focused on supporting social innovation and community development were funded.

The CCSIF, with its lack of a requirement for industry partners, provides an important opportunity for colleges to address social innovation. Two key factors related to the concept of social innovation differentiate the CCSIF-funded projects from the majority of projects funded through the CCI program. Firstly, project results are expected to be used to initiate social change at the local, regional, provincial, or national level. For instance, one project's results involve the dissemination of photo voice stories from students through which they reveal issues within their schools, such as a lack of gender neutral bathrooms or the food quality in the schools. It is expected that this project and its results will help the students lead changes in their school. Another project focused on adding a training component for a branch of law enforcement officers and employees of a province's Health Services within a local community to help them better understand the symptoms of a mental health crisis; thereby, helping them to differentiate between symptoms of mental health and substance abuse.

The second factor – and another key component of social innovation – is knowledge mobilization, in which project results are broadly communicated to ensure that other organizations, communities, and/or society at large may benefit from their findings, products, and/or services. While CCSIF projects are conducted with a specific partner, the results (i.e. products and/or services) are often applicable to and/or intended for a broader audience.

For example, one CCSIF-funded project resulted in a product that is currently available to academics, of which there are 8,000 in the field; however, this project is intended to expand to practitioners and this potential audience is in the range of 275,000. Another CCSIF project aims to combine its findings with other projects going on at the college in order to advocate for the Abecedarian Approach[5] across many communities.

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[5] The Abecedarian Approach is an intervention that focuses on children with multiple risk factors to learning (D`Souza, 2016)

Consequently, as part of their CCSIF-funded project many colleges and/or partner(s) dedicated resources to develop materials to communicate their project results so that other organizations, communities and/or groups of society at large may benefit from their findings, products and/or services. At times results were communicated directly with organizations offering similar services to partner(s) or groups working in the same sector, while other times the results were readily available to the general public. The types of communication materials developed include, but are not limited to: websites, blogs, data portals, short videos, and plain language reports (i.e. non-academic papers), conference presentations and academic publications.

> "As a result of this program we will create a mentoring system for our clients that will support them as they seek employment and get integrated into the workforce. This will be beneficial for us and for our clients. It will provide a value-add for the employee as they are being integrated into their employment as it is expected to provide them with improved support."
>
> CCSIF Case Study Participant, CCSIF partner

(Preliminary) Success of CCSIF funded projects

Although many of the funded projects were not completed at the time of the evaluation, a number of projects had resulted in the development of new products and/or services for the partner(s); and other case study participants expected similar results once their project is complete. Examples of products and/or services developed through CCSIF-funded projects include:

► The creation of a website and corresponding tip sheets that provided guidance for individuals' technology utilized in the project. These products helped partners continue to use technology past the projects end.

► A communications product comprised of photos and videos that show the results of the project, and communicate findings in plain language for the communities that were involved.

► The generation of findings that resulted in the college including a mentoring component to two of its courses, while the partner will add a mentoring system for their clients that will support them as they seek employment and get integrated into the workforce.

► The preparation of a participant guide and a legal guide for the organization's clients, as well as implementation of a more specific regional guide. These guides will all eventually become public.

Other CCSIF-funded projects concentrated on improving or enhancing existing products and/or services within the college and/or of their partner(s). In such cases the goal was often to utilize the resources and knowledge at the college to generate efficiencies within the partner organization and/or to increase its client base. Some examples of CCSIF-funded projects that focused on improving or enhancing existing products and/or services include:

► One partner is using information generated from their CCSIF-funded project to improve their orientations sessions with clients and staff regarding the Canadian education system. In particular, the findings from the project allowed the organization to tailor these sessions to meet the needs of clients (i.e. change the context of the information so that it is more relevant to different client groups).

► One CCSIF funded project led to the enhancement of an application to be usable for young children. The college was able to alter the "app" and this led to ongoing mutually beneficial work.

8. Cost-Efficiency

Overall, it appears that the CCI program and the CCSIF are administered in a cost-efficient manner. A common measure of the operational efficiency of a program is to assess the ratio of administrative expenditures (i.e., operating costs)[6] in relation to the total amount of grant expenditures (i.e., funds awarded). This ratio represents the cost to the council of administering $1 of grant funds. A program's operational efficiency may also be presented as the percentage of administrative expenditures within the total expenditures for that program.

8.1. Cost efficiency of the CCI program

Between the 2010-2011 and 2016-2017 fiscal years, total program expenditures for the CCI program almost doubled from $29,905,792 to $55,779,951 as a result of announcements in the 2010 and 2012 federal budgets to increase the budget of the CCI program and the implementation of six new grants in addition to the current IE grant. Between the 2010-2011 and 2013-2014 fiscal years, the total annual grant expenditures for the CCI program increased significantly from $28,033,866 to $46,897,830.[7] This is when the budgets for the TAC, CU-I2I, and IRCC grants ramped up other while additional funds were also distributed among the remaining CCI grants.

During the same period, the administrative expenditures of the CCI program also increased by almost one million dollars. This increase is partially a reflection of the costs required to manage the changes to the program resulting from the 2010 and 2012 budget announcements. As a result of the increase in administrative expenditures, the efficiency ratio of the CCI program also increased from 6.7¢ in 2010-2011 to 8.1¢ in 2013-2014. Once all of the new grants were fully implemented and more competitions occurred, particularly for the TAC and IRCC grants, the efficiency ratio declined in the 2014-2015 fiscal year and remained relatively steady at approximately 6¢ of administrative expenses for every dollar of grant funds awarded.

Table 2 presents the expenditures and operational efficiency of the CCI program from 2010-2011 until 2016-2017. For this analysis, the costs associated with services provided to NSERC without charge[8] were not included in the calculation of the efficiency ratio as they are not actually an administrative expenditure and would skew the results. The direct salary amounts, however, include the Employee Benefits Plan.

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[6] Administrative expenditures include the direct and indirect costs of administering the program. Direct costs include salary and non-salary expenditures, which relate to the adjudication of the award, post-award management, corporate representation, and general administration of the directorate in which the grant is housed. Indirect costs include common administrative services for the council, such as Human Resources, Finance and Awards, IT, etc. Both direct and indirect costs are included in the total calculation of costs and estimated using the ratio of total grant funds awarded to total council grant funds.

[7] After the 2013-2014 fiscal year the annual grant expenditures for the CCI program remained relatively steady between $47 million and $52 million dollars.

[8] Services provided without charge consist of accommodations provided by Public Service and Procurement Canada, contributions covering the employer's share of employees' medical and dental insurance premiums provided by Treasury Board Secretariat, audit services provided by the Office of the Auditor General, etc.

Table 2: Operating expenditures for the CCI program

Year	Administrative expenditures	Grant expenditures	Total program expenditures	Efficiency ratio (administrative $/grant $)	Operating expenditure as a percentage of total program expenditures
2010-2011	$1,871,926	$28,033,866	$29,905,792	6.7¢	6.26%
2011-2012	$2,366,960	$31,620,420	$33,987,380	7.5¢	6.96%
2012-2013	$2,873,123	$35,623,001	$38,496,124	8.1¢	7.46%
2013-2014	$2,734,150	$46,897,830	$49,631,980	5.8¢	5.51%
2014-2015	$2,728,327	$47,929,635	$50,657,963	5.7¢	5.39%
2015-2016	$3,084,396	$46,936,912	$50,021,308	6.6¢	6.17%
2016-2017	$3,169,880	$52,610,071	$55,779,951	6.0¢	5.68%
Total	$18,828,761	$289,651,735	$308,480,496	6.5¢	6.10%
Source: Finance and Awards Administration Division, NSERC					

Overall, the administrative expenditures for the CCI program's suite of grants were $18,828,761 from 2010-2011 to 2016-2017, while overall grant expenditures for the same period were $289,651,735. During this time NSERC spent on average 6.5¢ to administer $1 of grant funds for the CCI program. This was similar to the 6.1¢ it cost on average to administer $1 of grant funds within the Research Partnership (RP) Directorate, but slightly higher than the 4.6¢ it cost to administer $1 of grant funds for NSERC as a whole. Also, the average proportion of operating expenditures for the CCI program was 6.1%, which is slightly higher than the RP Directorate's average 5.7% and NSERC's average of 4.4%. The higher efficiency ratio for the CCI program is likely due to 1) the significant number of smaller grants funded by the program, and 2) the significant number of grant types (each with program documentation and policy to manage) that required additional staff to implement and manage.

8.2. Cost efficiency of the CCSIF

As per Table 3, the overall the administrative expenditures for CCSIF were $531,450 for fiscal years 2015-2016 and 2016-2017, while the overall grant expenditures were $10,348,926, with a small increase in expenditures between the two fiscal years. For this analysis, the costs associated with services provided to SSHRC without charge[9] were not included in the calculation, as they are not actually an administrative expenditure and would skew the results. The direct salary amounts, however, include the Employee Benefits Plan.

Table 3: Operating expenditures for the CCSIF

Year	Administrative expenditures	Grant expenditures	Total program expenditures	Efficiency ratio (administrative $/grant $)	Operating expenditure as a percentage of total program expenditures
2015-2016	$321,631	$5,050,700	$5,372,331	6.4¢	6.0%
2016-2017	$209,819	$5,298,226	$5,508,045	4.0¢	3.8%
Total	$531,450	$10,348,926	$10,880,376	5.1¢	4.9%
Source: Finance and Awards Administration Division, SSHRC					

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[9] Services provided to SSHRC without charge consist of accommodations provided by Public Service and Procurement Canada, contributions covering the employer's share of employees' medical and dental insurance premiums provided by Treasury Board Secretariat, audit services provided by the Office of the Auditor General, etc.

CCSIF's operating ratio dropped from 6.4¢ to administer $1 of grant funds in 2015-2016 to 4.0¢ in 2016-2017, and CCSIF's operating expenditure as a percentage of total program expenditure declined from 6.0% in 2015-2016 to 3.8% in 2016-2017. The higher cost of administering the CCSIF during the 2015-2016 fiscal year may be accounted for by the additional human resources required that year to implement this new initiative and administer the two competitions launched between March and November 2015, and the outreach related expenses (e.g., college visits, presentations) that occur when a new funding opportunity is launched.

For the 2015-2016 and 2016-17 fiscal years, it cost SSHRC an average of 5.1¢ to administer $1 of CCSIF grant funding. This is slightly higher than the cost of 3.1¢, to administer $1 of grant funds for the Partnership Grant (PG) and 3.9¢ to administer $1 of grants funds for the Partnership Development Grant (PDG), which are the two programs used to develop the model for the CCSIF. During the same time period, the CCSIF's average proportion of operating expenditures was 4.9%. This is higher than the average of 2.99% for the PG and more comparable with the average of 3.71% for the PDG. The higher cost of administering the CCSIF may be accounted for by the fact that it was a new program and required additional human resources for its development and implementation. The higher efficiency ratio for CCSIF is also likely due to the smaller size of the grants distributed through this initiative, the smaller number of grants overall for the CCSIF in comparison to the other programs, and the outreach activities that were required to promote the newly created program (mainly travel across Canada to make presentations).

9. Conclusion and Recommendations

9.1. Conclusion

Over the past decade, the importance of innovation has become increasingly apparent for Canada's economy, competitiveness, and the well-being of its citizens. Canadian colleges are becoming increasingly engaged in applied R&D activities and, with their knowledge of industry and community needs, are in a strong position to partner with Canadian organizations in an effort to increase their innovative, and thus, their competitive abilities. CCI and CCSIF are two of the main sources of funding for applied R&D at Canadian colleges, and evidence from the evaluation shows that the funding received through CCI and CCSIF is enhancing Canadian colleges' R&D capacity. The multiple funding opportunities available through the CCI and the CCSIF grant ensure that colleges of different size, R&D experience, and discipline specialization can take advantage of the funding opportunities, address R&D needs of organizations within and beyond their community and adapt to them. Evidence from the evaluation shows that the enhanced capacity of Canadian colleges to undertake R&D, is being recognized by SMEs and large Canadian organizations through their work (and often continued work) with Canadian colleges on R&D activities. Consequently, partnering companies are seeing increased opportunities to proceed with and develop improved and new products using the colleges' expertise, leading to enhanced R&D and, in some cases, increased revenues and a larger workforce.

The evaluation also provides strong evidence that Canadian colleges' increased participation in R&D is enriching colleges' curriculum and students' learning experiences. Faculty members are being provided the opportunity to participate in R&D projects and to then share their increased knowledge and experiences with their colleagues and, often through improving their course

content, with their students. In addition to improved curriculums, students benefit by being directly involved in TACs, IRCCs, and ARD- and CCSIF-funded projects, providing them the opportunity to apply their classroom learning to a "real world" environment, continue to improve and increase their knowledge and skills base, and improve their potential for employment, once they graduate from college.

9.2. Recommendations

Recommendation 1: **Continue funding the CCI program. Innovation is an important determinant of a country's ability to compete within a global market and, as such, is a crucial contributor to a country's economic growth and the quality of life of its residents.** The CCI program support bridges the research capacity of colleges and SMEs, and contributes to limiting the risk associated with investing in research and innovation for SMEs. Canadian Colleges are well-suited to support innovation in SMEs through the provision of applied research services. Colleges are increasingly engaging in applied R&D activities and, coupled with their knowledge of industry and community needs, are well placed to partner with Canadian organizations to help them become more innovative and, thus, more competitive. Such partnerships and R&D activities also provide opportunities for college students to acquire additional knowledge, skills, competencies, and attitudes, which in turn will help them become more productive members of the Canadian workforce.

There are, however, a few aspects of the CCI program, as well as the CCSIF grants, that could be improved and/or that members of the applied R&D community would like to see addressed. These are described through recommendations 2 to 4 below.

Recommendation 2: **It is recommended that the management and staff of the CCI program conduct discussions with eligible institutions about the challenges experienced around faculty release to help identify possible alternative mechanisms.** Release time for faculty members to engage in applied R&D is an ongoing issue for many colleges across Canada. Despite the availability of funds for teaching release, this mechanism does not appear to be entirely aligned with the operational requirements of colleges and does not fully address the underlying issues associated with faculty release noted throughout the evaluation. The issues regarding release time are especially prevalent among small colleges and/or colleges located in rural and/or remote areas, as they have a harder time finding qualified replacement faculty or the funds to offset the costs associated with faculty release time. CCSIF project leads, college research coordinators, and some key informants noted faculty release time as a particular challenge for the CCSIF-funded projects, as faculty release time was not a specific, eligible expense of the grant while administered by SSHRC.

Recommendation 3: **The CCI program should review and consider updating the mechanism it employs to support the indirect costs of research, including the proportion of grant funds that can be used towards indirect costs (i.e., 20%).** One of the main concerns highlighted throughout the evaluation is the proportion of grant funds that can be used towards indirect costs. It was noted that 20% is generally insufficient and, in some cases, the proportion of indirect costs for applied R&D at a college is closer to 30% (reported levels of indirect costs range from 27% to 35%) of the total costs of R&D. Additionally, on a related note, some stakeholders would like to see some ineligible expenses related to direct and indirect costs become eligible or to have additional funds made available to offset these expenses, as they are deemed crucial to helping colleges build their capacity and reputation

for applied R&D. These expenses include the purchase of equipment, recruitment of faculty, and attendance at scholarly conferences. Finally, some stakeholders would like to see the allocation of a proportion of grant funds for indirect costs abandoned by the CCI program and the CCSIF, and for Canadian colleges to become eligible for the RSF.

Recommendation 4: **It is recommended that the CCI program examine and revise its reporting requirements, particularly for the TAC and IRCC grants, to ensure that the information collected is useful, accessible, and comparable at different points in time and/or across grants, and also to reduce the reporting burden.** At times, the quality of the data collected through the reports administered by the CCI program is questionable, which in turn limits the extent to which the data can be analyzed and/or compared over time. This may be attributed to the fact that some of the questions included in the reports, particularly for the TAC and IRCC grants, are broad and unclear, and/or that institutions were given slightly different versions of a particular report, which resulted in incomparable data. By reviewing its reports to ensure that the questions are clear, and that the information it requests is relevant (and, thus, used by the program and/or council), the CCI program may be able to streamline its reports and facilitate the reporting process. Additionally, there are concerns that the reporting burden for the TAC and IRCC grants is high, as the institutions that receive one or both of these grants have to provide multiple reports to NSERC on an annual basis, such as the performance and financial reports, as well as reports to their institution and/or other funders. In an effort to reduce the reporting burden, the CCI program could examine the possibility of aligning the submission dates of some of its reports, thereby asking the institution to submit all reports at once instead of different reports at different times during the year.

Recommendation 5: **It is recommended that the CCI program consider a targeted follow-up study to further examine the progress and results of the CCSIF projects funded in 2015, in order to assess the extent to which the program achieved its expected outcomes.** During the time of the evaluation, the majority of the CCSIF-funded projects funded in 2015 (i.e., competitions one and two) was ongoing. Therefore, only a limited number of findings regarding the results of these projects were available, and, consequently, the outcomes of the CCSIF. Without this information, it was not possible to draft any specific recommendations about the program. In order to gain further insights into the outcomes of the CCSIF, it is recommended that the CCI program consider the possibility of a follow-up study focussed on assessing the extent to which the CCSIF achieved its expected outcomes. In particular, the study could target the project leads and partners who participated in the evaluation to get an update on the results of their projects, including how their project addressed the needs of the community through social innovation. Such a study would likely provide additional information regarding the impacts of the CCSIF on grant recipients, partner organizations and/or the communities they served, as well as confirm program parameters and/or enable program improvements. This study should occur after the original 62 projects funded by the CCSIF are completed. This study would also provide an opportunity for management to think about how to integrate or rethink support for social innovation within the context of CCI.

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