The Future of Canadian Technology Access Centres:

Thriving in a Rapidly Changing Global Economy

- **David Berthiaume**, Executive Director - *Kemitek, Cégep de Thetford* and ex-officio President of *Tech-Access Canada*
- **Nathalie Méthot**, Director, Research and Innovation - *La Cité College* and Chair of *Tech-Access Canada*
- **Ken Doyle**, Ken Doyle, Executive Director, *Tech-Access Canada*

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Introduction

As Canada begins a comprehensive review of its innovation policies to turn the tide on its lagging record in the subject, the moment is prime to articulate a vision for the future of Canada's Technology Access Centres (also known as TACs). In fact, according to the World Intellectual Property Organization's Global Innovation Index report[1], Canada ranks 15th, trailing behind Switzerland, Sweden, the Netherlands, Finland and Denmark, to name just a few. Given this underwhelming performance, we are profoundly motivated to propose a renewed vision for all Canadian Technology Access Centres. TACs have been well established for the past 10 years and have more than proven their relevance and success, yet their future remains in doubt. In creating these college-based applied research centres to serve better their local industry and community, the Natural Sciences and Engineering Research Council of Canada (NSERC), which pioneered the model at the federal level, demonstrated an ambitious and forward-looking vision. Today, however, we are struggling to find the operating funds needed to sustain the model's growth and make this vision work across Canada.

Therefore, we firmly believe that now is the time to propose a renewed vision and the means to ensure the growth and sustainability of TACs. This means understanding what a successful TAC should look like: the model, its mission and values, its operations, its sources of funding and how to measure its impact to ensure that past, current, and future investments continue to pay off sustainably so that Canada may lead the way on innovation.

The Proposed Model

The current technology access centres model established ten years ago and based on the proven template of the *Centres collégiaux de transfert de technologies (CCTT)* in Quebec remains highly relevant but requires some review and improvement. As presently defined, the main focus of the TACs covers primarily applied technological research and economic development. But what is often overlooked is that both innovation and applied research have a social dimension and social implications. The objective of social innovation is to improve the public's quality of life by means of innovative social practices that benefit the overall development of our society. The term *Innovation* with a capital "I" must propose multidisciplinary solutions to the challenges faced by the community. Hence the importance of a broad and systemic approach which encompasses social innovation. To date, several college research centres are dedicated to responding to challenges in such areas of social innovation as sustainable development, gerontology and integrating newcomers.

Moreover, the current TAC model does not establish national priorities for economic sectors or emerging fields to focus on when creating new TACs (directed calls). The 60 TACs currently in operation have all been brought forward and integrated by their host colleges following local priorities and/or the priorities and capabilities of the college in question. While these centres certainly meet the needs of their private sector partners, the question needs to be asked whether we should consider creating TACs, or clusters of TACs, in key government focus areas such as climate change, renewable energy, emergent technologies, access to health care, and fostering reconciliation with First nations communities. The aim is also to examine the complementarity of TACs across the region and to guide future developments to ensure that critical Canadian industries are adequately represented. Some centres are set up to serve established industries needing to pivot, while others are set up as a stepping stone for an emerging area of activity. Both models are helpful and should be allowed to co-exist and collaborate.

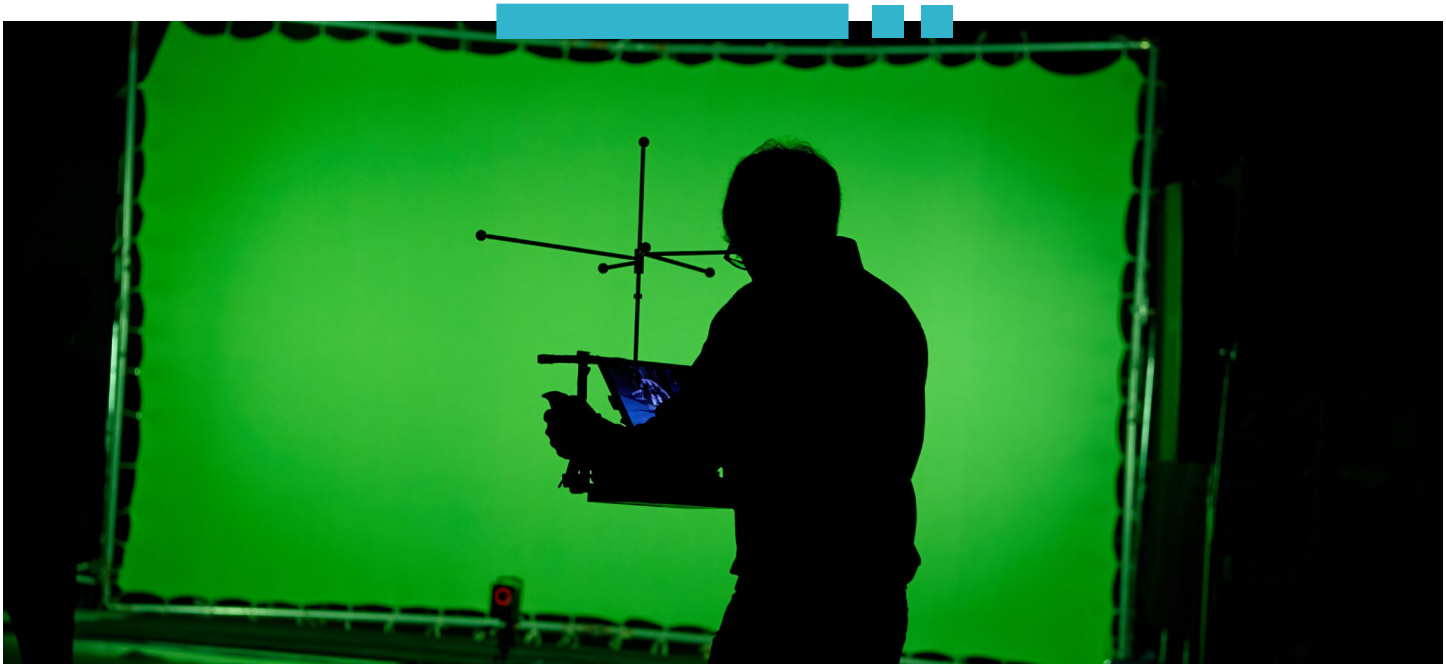
Furthermore, TACs must be able to continuously and sustainably address government (both regional and national) and industrial priorities. The response of TACs and colleges to the challenges of the COVID-19 pandemic demonstrated this short-term adaptability. There was a significant volume of applications for exceptional funding opportunities from NSERC and CFI. Several private companies and applied research teams at colleges quickly shifted their focus to providing concrete solutions such as the mass production of surface protein, a vital component of the COVID-19 pandemic vaccine, disinfectant gel production or personal protective equipment. Nevertheless, the fundamental challenge is to ensure sustainability and a long-term development perspective that will enable the TACs to continuously refocus their strategic action and adjust their offer according to the evolving needs of governments and the industries they cater to.

(1) https://www.wipo.int/edocs/pubdocs/en/wipo-pub-2000-2022-en-main-report-global-innovation-index-2022-15th-edition.pdf

The Vision and Mandate

To advance the mission of TACs and render an even more significant benefit to Canada, we envision that these centres could support both technological and social development in Canadian businesses, community organizations and governments. In line with the current trend towards a systems approach to innovation, we propose to broaden the nature of the services (technological and social) and the beneficiaries (private, NPO and government). Any given technological invention can only be successful if it is integrated into a coherent system which involves essential human factors (e.g., change management, marketing, perceived value, etc.). This broader mission proposal is also consistent with the redesign of NSERC's College and Community Innovation (CCI) grants, which are created to the same ends. While primarily serving their regional communities, it is understood that TACs also work with partners across Canada and abroad in their areas of expertise. TACs must also impact the training of highly qualified personnel to enrich the socio-economic fabric of this country.

Today, Canada's 60 TACs span a wide range of industries and sectors of the economy. Added to this is a substantial number of college research centres that operate similarly to TACs without the official designation. The impact on the innovation ecosystem would largely be achieved and optimised if these research initiatives were to join the existing network of TACs – Tech-Access Canada. Within a structured system established with a long-term development vision, one can reasonably expect that 100 geographically distributed centres would allow Canada to position its innovation better and develop a skilled and dedicated workforce.



Vision of the TAC system

By 2030, a network of 100 Technology Access Centres, in partnership with other players in the innovation ecosystem, will be instrumental in the success of technological and social innovation initiatives in all strategic sectors of Canadian business and organizations and in allregions of the country, thereby positioning Canada as one of the top 10 countries on the Global Innovation Index.

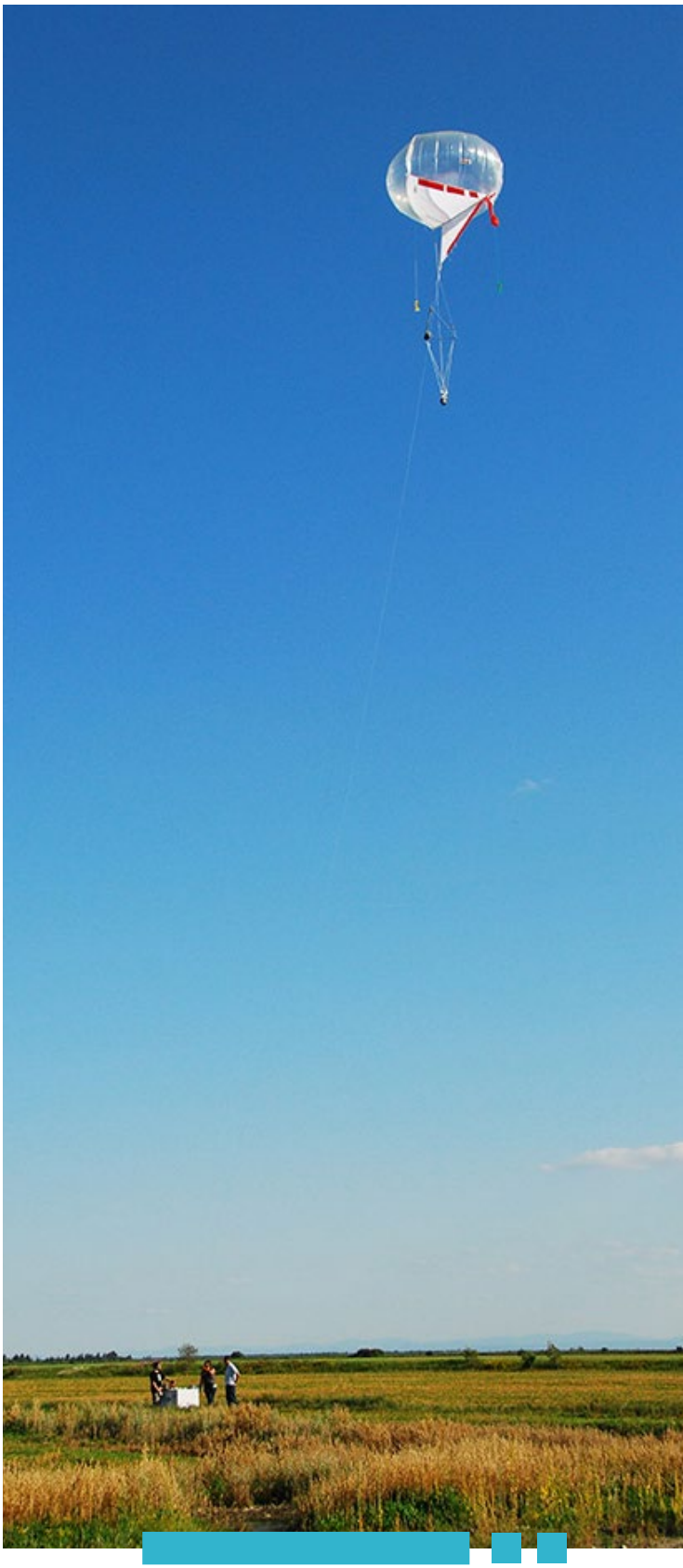
Mission of the TACs

By providing applied research, technical services, training and expert knowledge engagement, to assist Canadian companies and organizations in achieving successful innovation projects, ensuring positive economic, labor and environmental outcomes and in developing skilled and engaged citizens.

Values

TAC's core values are the following:

- **Innovation:** with a view to continuous improvement through creativity and creative thinking, we are always looking for partners proposing new ideas to develop and bring to the user community;
- **Excellence:** we deliver the best possible levels of service to our partners and provide them with high-quality projects;
- **Collaboration:** we work with our partners to provide maximum benefits to businesses and Canadians;
- **Entrepreneurship:** we actively embrace opportunities and are driven to get results for our partners;
- **Objectivity:** we offer an unbiased, candid and independent perspective on the technologies that exist to meet the specific needs of our clients;
- **Equity, diversity and inclusion:** we promote an inclusive culture that respects diversity. Alongside the different individual characteristics of our community members, we champion the appreciation of all knowledge, wherever it comes from: universities, colleges, government or private laboratories, and large or small organizations. Everyone has a contribution to make.



Infrastructure and Human Resources

There are several existing models of college and university research that differ in many ways. For example, at the college level, grants are awarded to the host college, not to individuals. In this context, TACs are expected to develop an applied research capacity that is shared among the multidisciplinary team members. This expertise requires time, financial resources and foreseeability.

In addition, the research team must have a high level of technical expertise, but be flexible enough to adapt quickly to clients' needs and carry out various projects in different niches in parallel. The team must also have expertise in designing applied research projects based on a statement of need from the client, and propose a multidisciplinary approach that may require using a network of external collaborators. Team members must also have mastered the art of communicating with diverse stakeholders in the field, many of whom have their own

vocabulary and ways of doing things that do not always fit with an academic approach. Finally, team members need to build trust while explaining the intricacies of applied research and accompanying their clients through the complex process of transferring technology into innovation, including financing and marketing aspects. These unique and specific college research skills all need to work together to achieve the highest impact of projects for the benefit of industry. Developing a fully operational college researcher takes 2 to 3 years or more.

To be effective, any team of researchers must be surrounded by resources that support its work: technical staff (technicians/technologists/operators/advisors) to carry out projects properly, a business developer to recruit clients, a communications manager to disseminate the knowledge, and finally administrators/managers who are responsible for governance, ensuring accountability to clients and funders.

Moreover, applied research requires instruments and spaces dedicated to applied research. These spaces must be available and accessible to carry out the scientific work necessary to resolve technological uncertainties or unknowns. Examples of such facilities include laboratories, state-of-the-art equipment, software or computing capabilities, spaces for collaboration, co-working and networking, access to data and scientific literature, or simple administrative spaces. All are critical to the realization of the mandate. The CFI's Online Research Facility Navigator lists state-of-the-art college research facilities available for collaboration between industry, colleges, universities and governments.

The Innovative Vehicle Institute - Saint-Jérôme, Quebec

The IVI is the leading authority on applied research and development of vehicle technologies that minimize the ecological footprint associated with transportation. IVI has more than 25 years of experience developing all kinds of electric vehicle prototypes. The Institute is an innovation accelerator that helps the Quebec, Canadian and International industry position itself in a rapidly growing market. With production and assembly workshops, state-of-the-art laboratories and dynamometer facilities adapted to both light and heavy vehicles, the IVI has everything needed to become a unique innovation facility for both the province of Quebec and Canada. In addition, IVI has the research and development expertise to advance navigation and driving assistance systems for autonomous vehicles, particularly for the automotive, agricultural and industrial industries.

Course of Action

The main objective of applied research at TACs and colleges is to promote innovation in the private sector by developing technologies that meet industry demands (market-pull approach). This distinguishes TACs from other innovation players because they do not claim intellectual property rights or an equity stake in these projects. Generally, they undertake projects quickly once the objectives are clearly defined, and the TAC has the necessary resources to carry them out. Projects vary in monetary value and duration but are usually short to medium-term. In addition, companies typically renew their engagement with TACs over several years.

TACs are positioned as prime partners in the innovation market for applied, problem-oriented research with a problem-solving mindset. To promote themselves, TACs recruit companies through direct canvassing (e.g., company visits, cold calls, etc.), third-party referrals (e.g., Industrial Technology Advisors from the Industrial Research Assistance Program (IRAP)), involvement in technical conferences/symposiums, social network presence, web advertising, etc. These marketing efforts are necessary to develop successful relationships between TACs and their customers.

The Network Effect

One vital component of the TAC system is networking. While a TAC is a centre specializing in a specific field of activity, companies' needs are often multidisciplinary and require access to complementary expertise. Occasionally, the client's requirements are outside the scope of the local TAC. In these cases, the full power of the TAC network is vital.

Through the years, TACs have built up mutual knowledge, trust and practices that facilitate referrals and collaboration through Tech-Access Canada. As a result of this networking, a client, no matter where they are in Canada, whether in an urban or rural area, can access the resources of every TAC across the country. It is atypical for an SME (Small and medium-sized enterprise) to forge links with a research centre situated thousands of kilometres away. Nevertheless, a TAC in the area could allow the company to minimize this distance through credible referrals to this resource, which is relevant to its activities, even if it is far away.

Developing a pan-Canadian network takes dedication, commitment, consistency and investment on the part of everyone involved, but such a network's sheer strength and effectiveness are well worth the effort. We believe that based on the successes observed in this type of networking of the *Centres collégiaux en transfert technologique (CCTT)* in Quebec, this same mobilizing force for innovation can be further developed throughout Canada and in every critical sector necessary for Canadian growth and competitiveness.

Sources of Funding

TACs encourage innovation in SMEs that lack the means to invest in research and development. In this context, government investment is crucial as it reduces the financial and technological risk and burden of SME projects, given the operating realities of the SME partners. However, assuming that a TAC can be 100% self-financed is unrealistic. This would mean that the funding available to TACs acts as a catalyst for innovation in the industry. The contribution of TACs to developing skills, the economy and spin-offs locally and nationally mean that their funding must come from different sources. To carry out an enhanced mission, TACs would ensure three types of funding requirements:

Nonetheless, private companies are also expected to contribute financially to the services of the TACs, even though their financial situation is often precarious. For instance, they may be in the start-up stage, do not yet have any revenues and are financed by venture capital. As one of the objectives of TACs is to stimulate expenditures on R&D by private companies (BERD), these companies should invest at least 20% of the project costs through a cash contribution. Their in-kind contribution is also essential, as collaborations in which companies invest time and other resources are much sought after.

1. **Core funding,** providing the governance, business development and accountability framework. This funding requirement is significant (e.g., $500,000/year), over five years, and would be renewable. This funding ensures the sustainability and development of the Centre to serve partners.

2. **Project funding** to initiate collaborations with industry and to achieve specific goals. These grants vary in amount and duration, and many programs already exist at the federal and provincial levels.

3. **Financing of infrastructure** that allows the building of applied research facilities with essential equipment will help the Centre achieve its mission and expose emerging enabling technologies to hundreds of SMEs. However, these supports require substantial investments (usually calculated in millions of dollars) shared between jurisdictions.

Performance Assessment

Assessment Criteria

Key performance evaluation criteria are essential and should be used to assess the potential of a new TAC or the performance of an existing TAC. These criteria include three main components of equal importance: value-added, capacity and impact. Each is broken down into three sub-criteria. Appendix 1 lists 28 proposed merit indicators to quantify the performance criteria.

Added Value

The first consideration in assessing the relevance of a TAC is the potential for innovation in response to societal, government and regional industry priorities. It is useful to stay on top of trends, needs studies and consults with economic development agencies, experts in the field and private companies. This methodology for identifying gaps warrants investing in and developing a particular applied research initiative using the TAC model. It is the development of innovation capacity that makes communities thrive, according to Dan Breznitz. Once the needs have been identified, it is vital to outline the services that will be offered to effectively meet those needs by defining the areas of specialization. It makes sense to build on the expertise of the staff and the research infrastructure available, as well as to show how new expertise will be added. In defining the TAC's service offering, particular attention must be paid to ensuring that these services are not in competition with the private sector since they will be partially publicly supported. Last but not least, collaborations with other partnering research centers should be encouraged and recorded, demonstrating how the services are complementary. The TAC model aims to create synergies that will benefit Canadian innovation.

Capacity

While there are several operational models, a TAC must be a Centre comprised of a dedicated team of management, business development and marketing staff, research and technical staff, and supporting faculty members with expertise in the TAC's field. An organizational chart of the staff and their roles and responsibilities must be presented. These personnel must have the entrepreneurial, academic and technical skills to ensure strategic development, project and service development and management, operations management, service delivery and succession planning. The prospective TAC must also have dedicated space for its operations and research infrastructure, including specialized

equipment, ensuring a unique service offering. And lastly, to assist in training a qualified workforce, which is one of its mandates, the TAC should be closely aligned with college academic programs and anticipate the inclusion of students in the research teams.

Impact

A well-performing TAC, in its role as a service provider, will play the role of an innovation hub for a range of private companies, community organizations, and other partners in its area of expertise, locally and regionally in the early years, but expanding across Canada and even internationally over time as the services become more specialized and recognized. Several impact measures exist to assess the impact of a TAC-industry research partnership, such as company stability and growth; developing prototypes, products, processes or services; moving the technology up the Technology Readiness Levels (TRLs); accelerating market entry; protecting intellectual property; recruiting college graduates; and publishing technical reports. For TACs working on social innovation, other performance indicators are required.

The TACs, as research centers affiliated with Canadian colleges, should have core government support for operations and funding opportunities for specific projects. In addition, partners are expected to contribute financially to the innovation support services they receive. With this in mind, the TACs should aim for a leveraging factor of at least one when it comes to the return on the base funding support. There is evidence that the ROI factor increases with the maturity of the TACs. The training of the next generation of college students, through the incorporation of research projects into the curriculum, the hiring of research interns, or the provision of Centre services, fosters the development of technical skills specific to the discipline but also of cross-cutting skills (creativity, entrepreneurial spirit, collaboration) sought after in the labour market.

Evaluation Process

Assessing a TAC's performance

The criteria for evaluating the performance of a TAC with respect to its mission are well defined, and it is up to the host college to propose, based on the list of merit indicators, the targets to be reached annually over a five-year period. On an annual basis, a review of governance, resources, activities and merit indicators is presented in a report which provides relevant information on the activities carried out to achieve the objectives according to the three main evaluation criteria. For instance, major developments in strategic direction or service delivery and collaboration with other research centers may be reported. Additionally, the report will present the evolution of the team, the research infrastructure and the synergy with academic programs. Finally, to describe the impacts, it is appropriate to cite stories of successful partnerships and to describe the training activities of the next generation of innovators.

We recommend that the formal evaluation of the TAC be carried out over a five-year period upon submission of the following:

- The annual reports and action plans, a five-year review and strategic plan, financial statements and projected budgets;
- Quantitative data on general indicators related to the overall mission of a TAC (e.g., number of companies served, number of student trainees, number of ongoing projects, volume of funded research, volume of investment in infrastructure, number of research staff, etc.).

Moreover, suppose an organization chooses to support TACs to further specific elements of its mission (e.g., training industry, economic development activity, social development projects). In that case, the TAC needs to know in advance the specific expectations of the supporting organization. In addition, if the supporting organization has accountability expectations beyond what is provided in the general mission accountability of the TAC in question, these expectations should be clearly articulated. Finally, the supporting organization should have identified clear minimum deliverables to be achieved, such as:

- Quantitative data on specific metrics that are useful to the agency;
- Specific, quantified performance criteria, such as leveraging the funding support they receive.

Evaluation Methodology

Any evaluation of a TAC's performance should be done objectively and as part of a long-term process of ongoing improvement with clear indicators and expectations for the Centre. To do this, the evaluation process should be led by an ongoing and stable expert body, with a mandate to ensure the development and maintenance of a coherent and effective TAC system that best meets the needs of Canadians. This role should not, in our view, be assigned to an ad hoc peer review committee, as is typically the case for one-off grants for scientific projects. Instead, a holistic and comprehensive overview of the TAC system, including its strengths and weaknesses, coupled with an understanding of best practices elsewhere in the system, is necessary to provide valuable and relevant feedback to drive a TAC forward and continuously improve. Most importantly, existing TACs should be supported in a range of ways to ensure their continuous improvement and to maximize the impact of public and private sector funding over the long term.

We recommend that an accredited centre applying for renewal of its designation should be assessed on an individual basis and not be put in competition with other potential new applicants. The Centre should compete against itself for renewal but must demonstrate its continued relevance and impact in its niche of expertise, industry, region, and steady progress over time.

A TAC that does not perform as well as desired could be renewed conditionally or even for a shorter period, pending a turnaround. On the other hand, a centre that fails to correct a problematic situation brought to its attention during an evaluation process or that does not meet its objectives on an ongoing basis following such a warning may have its TAC status withdrawn in the interests of the collective good and to maintain the quality of the TAC system as a whole.

Benefits to Canada

The importance of investing in Research and Development (R&D)

There are over one million private companies in Canada, 97.9% of which are small businesses with under 100 employees. Recent studies by Statistics Canada and Innovation, Science and Economic Development Canada (ISDE) have shown that SMEs that do invest in R&D and innovative activities see positive impacts. These businesses enjoy more growth and sustainability than those that do not innovate. Moreover, SMEs that own intellectual property (IP) are most likely to be successful, export their products, and experience significant growth.

SMEs may not always have sufficient means to invest in R&D and, consequently, own their IP. This limits their ability to innovate and expand. As the primary clientele for TACs, these companies strive for innovation and growth and need access to a TAC and its facilities, equipment, and expertise. These companies will, over time, grow and develop to the point where they can maintain in-house R&D activities without the support of TACs, which is a significant step in steering them toward success.

What TACs can offer

Technology Access Centres harness a unique business model within the Canadian innovation ecosystem to deliver valuable economic and social benefits to Canadians: helping partners commercialize Canadian innovations, growing exports, creating wealth, training the workforce, providing student internships, and leveraging public investments in research infrastructure. However, these benefits are currently limited by an existing imbalance in TAC capacity: there is much more demand for TAC-delivered services than the TACs can supply. Yet a strong network of TACs would help address Canada's economic challenges and equip Canadians with the resources to keep up and flourish in a rapidly changing global economy.

Last year, the 60 TACs worked with almost 4,200 businesses (see Table 1). Based on our analysis, increasing the base funding for TACs to $500,000 per year for all 60 centres would result in the following impacts within two years:

- an increase of 140% in the number of private sector businesses served annually by the TACs, bringing the total to 10,000;

- an increase of 100% in the number of students engaged in TAC services (from colleges and universities) to 4,600;
- an increase of 100% in private sector spending on TAC services to a minimum of $120 million.

At present, it is estimated that at least 30 other Canadian colleges have established significant applied research capacity that would merit inclusion in the TAC network. Given the nearly $55 million invested in non-TAC colleges in the past four years for initiatives to build applied research capacity and state-of-the-art infrastructure, it is our view that the college sector has demonstrated the sort of excellence that would warrant the establishment of a network of at least 100 Technology Access Centres in Canada, working together to support SMEs in meeting future innovation goals and challenges.

The rationale for a network of 100 TACs to be developed over the next five years, all working under a shared vision and proven operating model, would be to serve 20,000 Canadian SMEs and organizations each year with their innovation challenges. The increase in Canadian SMEs investing in business R&D each year would lead to a high return on investment through an increase in Canada's GDP per capita.

Table 1. Findings from the TAC model, based on actual data from 2018 and 2021, and projections under two different scenarios.

	Number of TACs	Number of businesses served (Per annum)	Number of student placements (per annum)	Value of innovation activities (Per annum)	Partner R&D expenses (Per annum)
Current Data	30 (2018)	1,967	988	$ 23 M	$ 13 M
	60 (2021)	4,161	2,353	$ 57 M	$ 31 M
Projections	60* (@$500k)	10,000	4,600	$ 120 M	$ 63 M
	100* (@$500k)	20,000	9,000	$ 200 M	$ 105 M

Recommendations

1. That the following overarching objectives guide any development of the TAC network:

    - Addressing government priorities;
    - Addressing different industrial sectors;
    - Broad geographic distribution;
    - Avoiding any duplication of R&D (in terms of research areas and geographical location).

2. That evaluation of TACs is assigned to an expert, ongoing and consistent body mandated by the various supporting organizations to assure that a coherent and effective TAC system is developed and maintained to best meet the needs of Canadians.

3. That core funding for TACs is increased to $500,000 annually and indexed for inflation.

4. That the number of TACs be increased to 100 over the next five years.

5. That the evaluation of the TACs be carried out with a view to continuous improvement and with a progressive and sustainable vision.

6. That the mission of the TACs includes supporting social innovation in their sector.

7. That policymakers protect the critical elements of program design that make TACs uniquely Canadian.

8. The development of innovation talent within post-secondary institutions and industry is an important element of the TAC model.

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Appendix 1

Annual, Key Performance Indicators *(KPIs)*

Criteria	Indicator
Added value	2.1 Business Priorities 2.2 Private companies 2.3 NPOs 2.4 Public sector 2.5 Website URLs for services offered 2.6 Social media URLs 2.7 Ongoing collaborations with existing research centers 2.8 Referencing vs. other research centers
Capacity	3.1 Scientific and technical personnel (number of persons and FTEs) 3.2 Management and administrative personnel (number of persons and FTEs) 3.3 Faculty (number of people and FTEs) 3.4 Cumulative value of research infrastructure 3.5 Academic programs
Impact	8.1 Applied research projects 8.2 Service offerings 8.3 Training activities 8.4 Promotion and information activities 8.5 Prototype/products/processes 8.6 New commercialized products 8.7 Improved commercialized products 8.8 Jobs created with clients 8.9 Revenues from private companies 8.10 Revenues from NPOs 8.11 Revenues from the public sector 8.12 Revenues from provincial subsidies 8.13 Revenues from federal funding 8.14 The Leveraging Factor 8.15 Number of students hired (number of people and hours) 8.16 Number of Students Trained (number of people and hours)