

1. Objectives of the BCIT Strategic Research Plan

BCIT's Vision:

Integral to the economic, social and environmental prosperity of British Columbia.

The British Columbia Institute of Technology (BCIT) is characterized by: a culture of direct interaction with business and industry; a broad and seamless range of educational programming at levels from trades certificates and technology diplomas to undergraduate and graduate degrees; a focus on career-oriented training and education of highly qualified and skilled personnel; and a focus on applied research and innovation which enhances practical research experience of our faculty and graduates, advances the state-of-practice within industry and the research community, and increases economic and commercial activity within British Columbia and Canada.

To remain integral to the province's prosperity BCIT must provide a level of education that makes our graduates the first choice of many businesses and industries in BC and around the globe. BCIT must continue to challenge our students through programs that provide real-life, contextual instruction that integrates applied research and entrepreneurship into our curriculum.

BCIT's Strategic Plan 2014-2019, sets out as one of the Institute's Mandates "... *applied research to enhance the learner experience and advance the state of practice*", and asserts BCIT's role "... *in enhancing the productivity growth and innovation agendas in the country through our research and development, by forging closer working relationships with business and industry, by emphasizing applied research, and by finding innovative solutions for small and medium enterprises.*" The Strategic Plan 2014-2019 also affirms that "*Through our programming and applied research in strategic areas, BCIT will remain at the forefront of technological change and the state of practice to meet the needs of industry partners and maximize the institute's impact on economic development and environmental sustainability.*"

As such, the BCIT Strategic Research Plan focuses on the following core objectives:

- Enhance and expand research at BCIT by fostering and supporting new and existing student and faculty researchers and research programs.
- Foster trans-disciplinary research at all levels to advance the state-of-practice in industry while increasing faculty and student knowledge and career readiness.
- Collaborate with other academic, institutional and industrial partners to maximize research benefits by taking advantage of the combined knowledge, skills and infrastructure these partnerships bring.
- Maximize the economic, educational and academic benefits of applied research through student entrepreneurship, effective technology transfer, commercialization and knowledge translation.

To achieve these objectives, BCIT aims to:

- Reinforce BCIT's role as a leader in linking research to social, cultural, scientific, educational, technological and economic development.
- Enhance student participation and training in applied research.
- Ensure effective dissemination, application and commercialization of research results.
- Increase internal and external funding and partnerships to foster research excellence.
- Increase the number of faculty and students engaged in research activities.
- Enhance research infrastructure.
- Promote provincial, national and international partnerships and collaborations.
- Expand partnerships with communities, scholars, industries, institutions, government

ministries and agencies for the purpose of identifying and pursuing common and complementary objectives.

- Expand institutional capacity for research management, support and facilitation.
- Support and mentor students in entrepreneurship, and the creation of spin-off companies.

2. BCIT Research Priority Areas

Since its creation in 1964 as an Institute of Technology, BCIT has responded to the needs of industry partners by developing a unique and comprehensive portfolio of trade, technology and degree programs focusing on sectors key to the economic future of British Columbia. For the past 25 years, BCIT has also invested in research and technology development capacity in strategic areas to meet the needs of industry partners and maximize the Institute's impact on economic development and environmental sustainability. Through the vertical integration of research and technology transfer, outcomes include new knowledge, technologies, national and international standards and codes, changes to industry practice and government policy, and training of highly qualified and skilled personnel.

Both training and research capacity have been enhanced by the development of a number of Bachelor degree programs and since 2011 have been further advanced with the addition of Master's programs in Applied Science and Engineering. The securing of Canada Research Chairs (CRC) in key strategic areas is providing the foundation for expanding research capacity and impact. The priority areas build upon and enhance existing concentrations of highly qualified faculty, industry partners, academic collaborators and state-of-the-art facilities, which all serve the research needs of the local and national community. In this regard our areas of highest research priority closely align with activities within BCIT's Technology Center as well as activities within our Schools of Business, Computing and Academic Studies, Construction and the Environment, Energy, Health, and Transportation.

Core research infrastructure has been developed including facilities that are unique in Canada and potentially unique internationally. As stated earlier, one of BCIT's main strategic objectives is to expand collaboration both internally and externally. Due to BCIT's unique position within the university, polytechnic and college communities, BCIT has been able to develop strategic partnerships with industry, government, aboriginal and other community groups as well as national and international post-secondary institutions and researchers. Future CFI funding will be used to augment existing research infrastructure to enhance our existing long term programs.

2.1. The Built Environment

Research strength in this area includes: Architectural Ecology, Acoustics, Building Science, Civil Engineering, Construction, Green Roofs, Living Walls, Structural and Earthquake Engineering, Non-Destructive Evaluation of Building Materials, Sustainable Development, and Whole Building Performance. Established research initiatives and facilities include: The Building Science Centre of Excellence, the Centre for Architectural Ecology, the Sound Transmission Facility, a research collaboration (with Simon Fraser University) on Multi-scale remote sensing, the Afresh Home, the Building Science Materials and Instrumentation Laboratory, the Building Envelope Test Facility, and the Water Penetration Test Chamber.

The CRC in Whole-Building Performance is based at the Building Science Centre of Excellence that was created in 2005. The Centre's vision is to establish BCIT as a key provider of applied building science knowledge, and train graduates through advanced educational programs, leading edge applied research, technology development, and knowledge transfer. Initial infrastructure development and research activities are centered on themes related to the performance a building as a whole, including the building envelope and its durability and energy performance, and healthy indoor environment.

Research conducted through the Centre advances best practice guidelines and building codes and

standards, helps to resolve current and future deficiencies in building design and construction, and improves the overall performance of buildings, thus contributing to sustainable development. Current research capacity includes evaluation of building envelope performance (i.e., hydrothermal, energy, durability) at materials, components, and building systems levels through laboratory and field testing and advanced modeling and computer simulations. Securing the CRC and an allocation of CGS-M scholarships have allowed BCIT to evolve the Building Science Centre to the next level and enable BCIT to increase its national and international leadership in this area.

2.2. Information and Communications, Wireless and Sensor Technologies

Research strength in this area includes: Artificial Intelligence, Cellular Gateways and Networks, Cyber-Security, Wireless Networks, Software Development, Games Design, Optics and Imaging, Sensor Technology, Sensor Technologies based on Cold Atom Physics, including the miniaturization of sensors and Prototype Development aiming at Commercial Applications, Data Analysis, Data Mining, Modeling, Digital Signal Processing, Distributed Computing, DNA Profiling, Network Communication Infrastructure and Protocols, and Network Security, prevention of cyber-attacks on industrial control/ SCADA systems.

Internal and external funding support has led to the establishment of facilities and research initiatives at BCIT. These include an on-going collaboration with UBC investigating the development of Atom Based Quantum Sensors, novel sensor technology based on Cold Atom Physics, the Internet Engineering Laboratory, and the Centre for Cybersecurity.

The Centre for Cybersecurity is an interdisciplinary centre for research and education related to the analysis of secure communications and the development of secure systems. This Centre involves researchers from Computing, Forensics, and Engineering with a common interest in exploring technological and policy-based solutions to problems in security. The Centre advances the state of practice in security by taking a holistic view which includes finding vulnerabilities in systems, formal reasoning about security, knowledge-level analysis of deception, and provable guarantees of security. The Centre takes a hands-on approach, developing practical solutions and collaborating with partners in private industry.

Canada performs exceptionally well at basic and exploratory research output. The next step is to translate this extraordinary research productivity into commercial applications that can increase the economic benefit to Canadians. BCIT's initiatives, including the applied research based on Cold Atom Physics, represents one approach to address the shortfall between knowledge generation and economic benefit by leveraging existing research expertise with BCIT's expertise in product and prototype development. In doing so, a new field of cold atom engineering, carried out as a national collaborative network, is expected to emerge, through which BCIT plans to establish itself as the world leader in ultra high vacuum metrology. At the same time, a new model for knowledge transfer from the research laboratories through to commercialization in Canada is expected to evolve.

2.3. Bioscience and Human Health

Research strength in this area includes: Safety and Chemical Analysis of Natural Health Products, Provenance and Quality of Agri-foods, Plant and Animal Development using Spatial Modeling, Development and Prototyping of Medical Devices, Orthotics and Prosthetics, Prevention of Birth Defects, Drug Development and Delivery, Molecular Diagnostics, Application of Translational Genomics, Molecular and Cell Biology to Human Diseases such as Autoimmunity, Infectious Disease, Cancer, and Inflammation, Biomedicine, Bioscience, Biotechnology, Food Science, Food Technology, Forensic DNA Analysis for Human Identification, Drug Analysis, Phytoanalytics, and Chemical Analysis. Established research initiatives, facilities and working groups include: HEAL (Herbal Evaluation and Analysis Laboratory), CREATE (Centre for Rehabilitation Engineering and Technology that Enables), the Dr. Tong Louie Living Laboratory, the Integrated Molecular Biology Laboratory, the Rehabilitation Engineering Design Laboratory, a research collaboration (with Simon Fraser University) on Wearable Biomedical Technologies, the Advanced Laboratory for Prototyping Health and Automation, and the Learning and Teaching Centre.

Technological innovations have begun to advance solutions to improve independent living and community access for people living with disabilities and the aging population. At the same time rapid advances in electronics, communications and materials have changed how the general population communicates, moves and lives. The CRC in Rehabilitation Engineering Design, supported by BCIT's Schools of: Construction and the Environment; Health Sciences; and Computing and Academic Studies, generates new solutions for disability-related problems regarding access, mobility, and assistive technology, and will advance BCIT's vision to remain integral to the province's prosperity by conducting research that makes a tangible contribution to our society. The Schools of Health Sciences and Computing and Academic Studies, and CREATE (Centre for Rehabilitation Engineering and Technology that Enables) at BCIT, as well as the UBC/Vancouver Coastal Health's ICORD (International Collaboration On Repair Discoveries) research initiative are partners of this multidisciplinary research and development effort.

The CRC in Phytoanalytics is a unique research program in Canada focused on the validation of analytical methodology and application of metabolomics as a quality assurance tool for natural health products, while advancing the state-of-practice in product development and informing policy development in the regulation of natural health products. Advancing our understanding of medicinal plant chemistry will provide insight into the variability that exists between commercial producers, elucidate the challenges and opportunities afforded by the processes of genetic selections in breeding agricultural crops, and the potential to develop new specialty crops for the value-added food and natural health product sectors, thereby playing a future role in human health and nutrition. This approach enables direct mobilization of research findings to improve agricultural management practices, advance laboratory testing of these products, support development of novel therapeutics, and effect policy in the regulation of botanical-based natural health products. The Institute's role as a leader in linking research to social, cultural, scientific, educational, technological and economic development is reinforced through this research program, ensuring Canadian's can achieve the potential health and economic benefits afforded by medicinal plants and natural health products.

2.4. Natural Resources and the Environment

Research strength in this area includes: Sustainable Resource Management, Water and Wastewater Treatment, Management, Protection and Restoration of Rivers and Streams, Contaminated Site Remediation, and Mining and Mineral Exploration. Established research initiatives and facilities include: the Rivers Institute.

2.5. Energy, Manufacturing and Transportation

Research strength in this area includes: Advanced Manufacturing Processes, including the integration and use of advanced sensors; Marine Manufacturing, Alternative Fuels, Bio Diesel, Liquefied Natural Gas (LNG), Demand-Side Energy Processes, Energy Systems, Industrial Energy Applications, Industrial Networking Technology, Industrial Waste Recycling, Pulp and Paper, Mechanical Pulping, Wind Energy, Renewable Energy Sources, Energy and Environmental Testing, Engine Performance Using Alternative Fuels, Composite Materials, Plastics, Water-Based Paints, Simulation and Industrial Instrumentation. Established research initiatives and facilities include: BCIT's Smart Microgrid including the NSERC Smart Microgrid Network (NSMG-Net) and the Internet Engineering Lab, the Centre for Energy Education and Research (CEER), the Industrial Instrumentation Process Laboratory, the Advanced Prototyping Hub, Engine Performance Testing Laboratory and Marine Vessel and Port Simulation Facilities, and the Centre for Innovation in Manufacturing.

2.6. Business, Economy, Human Capital, Culture and Education

Research strength in this area includes: Business Intelligence, Sustainable Resource Management,

Transportation Economics, Millennial Students, Clinical and Education Practice, Mobile Devices for Clinical Teaching and Learning, eHealth, Technology Assessment and Utilization, Digital Learners in Higher Education, Crime and Intelligence Analysis for Public Safety and Security initiatives, Outcomes Analysis for Student Selection as well as Course Completion.

3. Institutional Planning and Approval Process

BCIT's six main campuses (Burnaby Campus, Downtown Campus, Marine Campus, Aerospace Technology Campuses, Anacis Island Campus, and Great Northern Way Campus) and a number of satellite campuses at various locations in British Columbia are home to 1,600 full-time faculty and staff and 600 part-time faculty and staff. Student enrolment exceeds 48,000 annually. With an annual operating budget of \$270M, the Institute's activities span six Schools: the School of Business; the School of Computing and Academic Studies; the School of Construction and the Environment; the School of Health Sciences; the School of Energy; and the School of Transportation.

A Research Task Group (RTG) with representation from all areas at BCIT is in charge of developing and maintaining policies regarding research at the Institute. The RTG operates under the leadership of the VP Academic and the Dean Applied Research. The RTG builds upon the existing work completed by previous BCIT committees and workgroups to stimulate research in alignment with the institutional Strategic Plan as well as assess progress towards the meeting of BCIT's research objectives.

In addition, BCIT has in place significant administrative and operational infrastructure to support its research activities. BCIT's Institute Research Committee (IRC) as well as School Research Committees (SRCs) in all of the schools have been created to operationalize and administer research policies, practices and funding. These committees monitor the research performance of BCIT as a whole as well as for each of the schools. They also review the progress of research activities in the priority areas and review and approve applications for internal and external funding. Additionally the IRC is responsible for administering the selection process for BCIT's CRC candidates.

Research activities are also supported by the Applied Research Liaison Office (ARLO), which assists with developing research proposals, sourcing and securing funding for research activities, technology transfer, intellectual property management, as well as entrepreneurship and commercialization activities, and liaising with private industry and publicly funded clients/sponsors. Research activities are also supported by the expertise of the BCIT Technology Centre in: design and development of prototype devices, systems and applications; analysis, testing and evaluation of new technologies; and commercialization and licensing of new technologies and products.

BCIT retains an independent Research Ethics Board (REB) with both internal and external members from other BC universities and related organizations. Research involving human subjects can only be carried out after review and approval by the REB.

Internal Funding and CRC Support

In addition to approximately \$2.7M annual funding to support ARLO and the Technology Centre, as well as additional funding from within each of the schools, two sources of funding exist to support applied research across the Institute: The Research Seed Fund which is intended to allow new and existing researchers to explore new areas of interest and the Discovery Parks Fund which is intended to allow existing research programs to leverage their current research and funding to obtain further resources.

Our CRC research programs are targeted to benefit multiple research areas at BCIT to promote our multi-disciplinary industry focused approach to research. Funding for the development of CRC applications and establishing new CRCs at BCIT are also drawn from these internal funds.