

National BioEngineering Innovation Centre (NBEIC) Framework

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UNIVERSITY OF
CALGARY



Background

Bioengineering is the application of engineering principles and techniques to the health field, combining the design and problem-solving skills of engineering with health and biological sciences to solve important problems facing humanity. The field of bioengineering includes: research, testing and medical laboratories, medical imaging and medical devices, equipment and technology.

The bioengineering sector is highly research and development intensive, built on innovation. This innovation is, in turn, borne from strong collaborative ties with universities, research hospitals and government laboratories. Time to market for bioengineering products is short compared to other health related products. The biggest positive impact on health care cost and quality of life is in prevention, early diagnosis, and medical devices, all of which can be impacted upon by advances in bioengineering. Convergence of technologies, particularly those in life sciences and engineering, will drive the development of innovations with the greatest impact.

Canada lags the world in both the development of the bioengineering industry and in bioengineering training. As a nation, we have a choice. We can choose to remain a net importer of people and equipment, or we can invest in development of skilled professionals and create a market share in a rapidly growing sector.

The Opportunity

The opportunity is ripe to build on the proven track record of the existing National Research Council (NRC)–University of Calgary partnership to create the National BioEngineering Innovation Centre (NBEIC) in Calgary that will:

- accelerate the development and commercialization of Canadian bioengineering medical devices;
- improve the competitiveness and productivity of the Canadian bioengineering sector;
- diversify Alberta's economy and create employment in Alberta's private technology sector; and
- be the model for innovative and leading edge trans-disciplinary research and education.

The Vision

Canada will be a global leader in bioengineering research, health product development and commercialization, by 2020.

The Need for Partnership

To achieve the vision we have to work together. We all recognize the need for public/private partnership to accelerate discovery and commercialization. Canadian research organizations do not have the luxury of going it alone – our resources are too limited – partnership is the key to our success, both in order to leverage resources and to take advantage of private sector opportunities.

Canada's Science & Technology strategy recognizes health as a priority research area, and, also recognizes the economic benefits which will arise from commercialization of innovations in bioengineering. This is an area in which Canada has the opportunity to be a world leader. Alberta understands that health research attracts investment, encourages entrepreneurship, and creates quality jobs. Bioengineering is a key strategic opportunity for the University of Calgary. NRC recognizes health and wellness as a top Canadian priority and is committed to intensifying the global competitiveness of bioengineering as a key Canadian industrial sector. Partnering to create NBEIC is a perfect means of executing on these aligned strategies.

The Partnership Track Record

We have a proven partnership track record on which to build. The University of Calgary, NRC-Institute for Bidiagnostics (NRC-IBD), and their commercial partners have established a vigorous research and development program in Calgary, focused on biomedical imaging. This collaboration began with the development of the intra-operative magnetic resonance imaging (MRI) and the 3T MRI program at the Seaman Family Magnetic Resonance Centre, and has more recently led to the collaborative

development of the University's Experimental Imaging Centre (EIC). The University's prominent position in Canadian biomedical imaging research is due largely to its collaborations with the NRC, which are also an important component of the University's research and training effort.

For the past 15 years the University of Calgary and NRC, with support from the Provincial government, industry and private sector, have been bringing together experts from different disciplines to converge on critical medical problems, resulting in breakthrough medical technologies and successful companies such as:

- IMRIS: now rolling out its intra-operative surgical MRI equipment to hospitals around the world. Foothills Medical Centre was the first hospital to use the IMRIS equipment that provides neurosurgeons with an image before, during and after neurosurgery without moving the patient. The equipment has been used as an adjunct to surgery in over 1000 operations at FMC.
- Kent Imaging Inc: currently developing a specialized optical imaging system that acts as an objective aid in a physician's assessment of compromised tissue health.
- MRITech: producing, in Canada, electronic consoles for MRIs to be sold worldwide.

The University of Calgary and NRC have also contributed to the development of the neuroArm surgical robot, which, controlled from a computer workstation and operated in conjunction with real-time MR imaging, provides neurosurgeons with unprecedented detail and control, enabling them to manipulate tools at a microscopic scale.

The University is actively involved in successful research collaborations with NRC in Québec on cardiovascular imaging and robotic surgery, and with NRC in Ontario in the field of neurochip and sensors development, application and commercialization.

These successful partnership developments in bioengineering commercialization provide the basis upon which to build an enhanced partnership among the Province of Alberta, the University of Calgary and its community, and the federal government that will support the accelerated growth of high technology industries – a goal both Canada and Alberta support.

Resources and commitments which can be leveraged:

University of Calgary

Currently, the University of Calgary has 102 researchers involved in bioengineering, an increase of 11.5% since 1997. Bioengineering has achieved a critical mass at this institution, involving researchers from five faculties (Medicine, Engineering, Kinesiology, Veterinary Medicine, Nursing and Science) and many disciplines. Interconnectivity among the different research programs ensures sharing of infrastructure and cross-fertilization of ideas, concepts and solutions and, most importantly, technology development linkages.

The University provides in excess of \$7M annually in support of bioengineering, including operational support, awards to the bioengineering faculty, and contributions to Canada Research Chairs in bioengineering.

National Research Council

At the University of Calgary, NRC currently has 10 full-time employees and 10 Guest Workers and provides an annual operating budget of approximately \$1.5M. Over the past 8 years NRC has contributed approximately \$6M to capital equipment used jointly by NRC and University employees.

Across the country, NRC has national facilities and expertise in medical imaging, robotics, surgical simulation, nanotechnology, advanced materials, photonics; informatics, together with biological, chemistry, and other more traditional life sciences and engineering expertise, which can all be leveraged through the NBEIC. NRC as a whole, is currently investing about \$25M a year in medical devices and supporting technology platforms, including areas such as simulation and visual reality systems;

implantable devices, nanofabrication for pathogen detection; magnetic resonance technologies; medical photonics technologies; IT-based decision support systems; robotics; advanced materials, nanoelectromechanical systems, biosensors, device prototyping, and others. This expertise and infrastructure will be easily accessible through NBEIC.

The Province of Alberta's Commitment to Bioengineering at the University of Calgary

The Province has significantly invested in bioengineering at the University of Calgary, including:

- Since 2003, core funding for an undergraduate degree specialization in biomedical engineering offered by the Schulich School of Engineering. To date, the Province has provided \$5.9M in ACCESS funding, which includes funding for faculty positions. The Alberta Graduate program in Biomedical Engineering (University of Alberta/University of Calgary joint program) has produced approximately 200 MSc and PhD graduates, since 1999;
- The Province has provided funding for the Health Research Innovation Centre (HRIC), which will house some bioengineering laboratories. Funding has also been obtained from the Canada Foundation for Innovation (CFI), donors and the University of Calgary;
- The Calgary Centre for Innovative Technology opened in 2002, with funds from the Province, CFI and the private sector. This building provides state-of-the-art equipment and laboratory space for several bioengineering researchers, who are working across disciplines, including engineering, kinesiology, and medicine;
- The Alberta Heritage Foundation for Medical Research (AHFMR) has provided salary support for two bioengineering professors, who have been recruited to the Schulich School of Engineering.

With the creation of NBEIC, we estimate that over the next 15 years, new funding totaling \$2B will be attracted from provincial, federal and private sources for bioengineering commercialization and research activities in Alberta. Based on U.S. data, it is predicted that at least 50% of locally produced bioengineering intellectual property will undergo commercialization, which will add value to the Alberta economy.

Community and Philanthropic Commitments

Philanthropic interests, donors and private sector funding have played a pivotal role in advancing the University's strength in bioengineering. Current activity in Calgary includes:

- Significant philanthropic support for bioengineering related research – evidenced by donations from the Seaman, McCaig, Libin, and Hotchkiss families;
- Recent steady growth in related receptor companies, such as Calgary Scientific (3-D radiology software), InnerVision (ultrasound imaging), Imaging Dynamics (digital x-ray), Microbotics (surgical robotics), and NeuroSilicon (brain cell-computer chip devices);
- The resources of the Boone Pickens Centre for Neurological Science and Advanced Technologies (Hotchkiss Brain Institute), the Alberta Bone and Joint Health Institute, the Seaman Family MR Research Centre, the Ward of the 21st Century, the NRC-Institute for Biodiagnostics (West), and the Experimental Imaging Centre;
- Strong partnership with the Calgary Health Region, which provides approximately \$1M/year to the Faculty of Medicine for bioengineering research. Together, the University and Calgary Health Region are developing a technology interface capacity which will accelerate the technology commercialization process by introducing biomedical products and services into the clinical environment for evaluation.

Future Opportunities

The University is in active discussion with Alberta Ingenuity Fund (AIF) regarding the funding of an AIF Accelerator as part of NBEIC, and is optimistic that this will provide \$10M/year for 10 years (\$100M total). The AIF Accelerator would support the recruitment of 3 world class bioengineering scientists to NBEIC, and operating support for their research programs and staff.

The University's recent Letter of Intent (LOI - January 2008) for an AIF Centre for Commercialization and Research in "Integrative Biomedical Technology", which will be an integral research centre in NBEIC, is

one of 8 LOIs selected by AIF to proceed to the full proposal stage. If successful, the award will provide \$2.5M/year over 5 years (total \$12.5M) from AIF. The Centre will focus on new imaging methods, devices and related therapeutic interventions, and integrated materials characterization tools and technologies.

The National BioEngineering Innovation Centre

NBEIC will bring together, in one building, world-class, multi-disciplinary, focused teams of university, government, and private sector researchers and commercialization experts who will drive innovation and new medical product development. Specific areas of research and development will include robotics and simulation, biosensors and biomodulators, laser technology, optical imaging; nanotechnology, molecular imaging; informatics, magnetic resonance imaging, biomaterials, therapeutic products and devices, and brain cell-computer chip interfaces.

By expanding the existing partnership between the University, NRC, the Province and the private sector, we will have the unique combination of a critical mass of researchers and clinicians required to successfully commercialize Canada's federally-supported research and development build a more globally competitive bioengineering sector.

Based on the highly regarded collaboration model established at the NRC-Institute for Nutrisciences and Health, the University and NRC will co-locate resources at NBEIC to:

- create breakthrough developments in medical devices;
- transfer these technologies to the private sector;
- create and grow medical device companies; and
- train the necessary highly qualified personnel required to sustain the growth of this sector.

How We Will Create NBEIC

As with the National Institute for Nanotechnology (NINT) based in Edmonton at the University of Alberta, NBEIC will be one of the world's most technologically advanced facilities in the field. Located at the University of Calgary, the Centre will become the premier hub for world-class bioengineering research in Canada.

The University will:

- provide 0.3 acres of land located between the TRW and HRIC buildings on the medical campus - clearly visible from the Trans Canada Highway - upon which it will build the required "dedicated infrastructure". NBEIC will be adjacent to the Foothills Medical Centre – a major teaching hospital which will provide pragmatic access to the critical integrated clinical testing environment. The six storey plus basement facility will provide research laboratories, prototype development, commercialization and entrepreneurial support, training, and offices, which will enable the private sector to work with university and government researchers;
- through a new integrated PhD/MBA program across its sciences and engineering programs (CREATE), provide training for the next generation of commercialization experts. Additionally, aspects of entrepreneurship will be introduced to the existing undergraduate specialization in Bioengineering, one of the most comprehensive programs in Canada;
- locate several new and existing Research Chairs, together with their research teams related to bioengineering and medical devices at the Centre;
- provide core infrastructure facilities and technical expertise to enable small- and medium-sized enterprises small- and medium-sized enterprises access to the equipment and expertise that will enable a competitive advantage with the product development pipeline;
- create the essential networking environment for integrating researchers, industry, Calgary Health Region and clinicians, as well as Bioengineering business development experts.

The National Research Council will:

- lease space for its activities at the Centre from the University;

- locate additional R&D and innovation staff (~50) in disciplines complimentary to those currently existing at the University and NRC nationwide at the Centre;
- ensure its existing national infrastructure and expertise is integrated with activities at the Centre. Where prudent for purposes of enhancing its capacity to provide national support to the sector and avoid duplication, augment its existing national infrastructure and expertise in locations other than Calgary;
- locate business development expertise at the Centre, provide commercialization and innovation support and operate an Industry Partnership Facility which will enable the private sector to work in close proximity with the University and NRC researchers;
- locate NRC-IRAP Industry Technology Advisors (ITA) at the Centre and engage its national ITA network to inform companies across the country of the R&D capabilities, services and infrastructure available through the Centre. IRAP would also increase funding for medical device companies;
- locate a Canada Institute for Scientific and Technical Information (NRC-CISTI) information and intelligence service office at the Centre to provide competitive intelligence and other information sources of benefit to both researchers and industry.

The Centre

The Centre will accommodate approximately 50 NRC staff, as well as approximately 40 University of Calgary faculty and staff, and 10-20 visiting scientists and staff from industry, other universities, and other partners. The Centre will also provide training opportunities for 200 undergraduate and graduate students, as well as postdoctoral researchers and trainees. The building will include specialized spaces for laboratories as well as SMART classrooms.

Facility construction estimates based on current (2007-2008) trends figures as follows (exact size yet to be determined):

| Square Metres | Square Feet | Total Construction Cost 2008 (excluding outfitting and operations) | Total Construction Cost 2011 (excluding outfitting and operations) |
|---------------|-------------|---|---|
| 6,300 | 67,788 | \$51,136,364 | \$71,156,250 |

Year 1 – 15%, Year 2 - 10%, Year 3 – 10%

*overall cumulative increase = 39%

Proposed 5-Year NBEIC Budget

| | Federal Govt | Provincial Govt | U of C | Total |
|--------------------------|---------------|-----------------|---------------|---------------|
| One-time Capital | \$25M | \$25M | \$75M | \$125M |
| Annual Operating Funding | | | | |
| Year 1 | \$20M | \$20M | TBD | |
| Year 2 | \$20M | \$20M | TBD | |
| Year 3 | \$20M | \$20M | TBD | |
| Year 4 | \$20M | \$20M | TBD | |
| Year 5 | \$20M | \$20M | TBD | |
| Total Annual Funding | \$100M | \$100M | \$50M | \$250M |
| Total Funding | \$125M | \$125M | \$125M | \$375M |