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Summary of Institutional Activities on the *COMMERCIALIZATION* of research

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Survey of Institutions on their Approaches to Benefits to Canada in the Context of their Research Planning

Written by David Strangway

In the fall of 2001, each institution that has received support from the Canada Foundation for Innovation was asked to give a brief description of their strategies for ensuring that their research would result in benefits to Canada. The institutions supported by CFI include not-for-profit, non-government, research-performing institutions. This includes mainly universities, teaching hospitals, colleges and a few others.

84 of 101 institutions have replied. A brief summary of each reply is part of this report.

Benefits to Canada may be defined in many ways. It was left to each institution to identify their own strategies in their response. One element of benefits to Canada that has received wide attention is commercialization. We did ask for specific information on this element. One institution suggested that all research was a benefit to Canada. Perhaps this is one way of stating that a thriving research enterprise at a level of international excellence that will attract the world's best researchers in a competitive climate is a major benefit to Canada. Many pointed out that benefits to Canada came in many forms and urged CFI not to focus only on commercialization. Many were quick to point out that significant benefit accrued to Canada from many different fields including the social sciences and the humanities. The reason for asking for advice on this topic was to be sure that CFI can be of maximum assistance to the institutions in ensuring that they are able to deliver benefits to Canada. CFI continues to report on the impact of the funding to Canada. The recent Killam lecture by John Evans clearly identifies the challenge facing the institutions.

> The world's successful technology clusters are always built upon a university-based core of research excellence that is a sufficient attractor, that the private sector cannot afford not to be present if they are innovation based.

This is the basis for well known clusters such as Silicon Valley, Route 128 around Boston and the complexes around Cambridge, England, Tsukubba, Japan, Taejon, Korea, the Research Triangle in North Carolina, Singapore and Louvain, Belgium among others. It is clear that the activities of the universities, hospitals and colleges are actively reinforcing and developing clusters in all parts of the country. Some are large, some are small. Some are focused on local opportunities while others are regional or national. Some are attracting significant international attention as magnets for knowledge based activities. Of course, these clusters can be complemented by federal and/or provincial laboratories.

Several institutions pointed out that they had a very strong record in creating spin-off companies. This large number is at least in part due to fact that in Canada there are few private sector receptors for new approaches and new ideas based on research. This commercialization productivity index is higher than in the United States while licensing income is lower. Several universities report the creation of a hundred or more spin-off companies, in turn employing thousands of people. Market capitalization of the companies spun off from these institutions is often several billion dollars.

What is evident is that institutions in all parts of Canada are moving aggressively to develop commercialization activities. Some have been in the business for a long time and have quite mature operations, while others are rapidly developing policies and strategies and are examining the best approaches for their institution.

Some larger institutions developed the approach some decades ago and have seen much evolution and now are seeing a significant dollar return to funding their research base. One institution for example, reports the start of investment in developing spin-offs, licences and patent protection starting with investments in 1987. Today, all the initial investment has been returned to the university and now there is a significant "profit" being returned to fund more research at the parent university. We might call this patient capital funding, against a well-conceived business plan that took about a decade to become profitable. This is a common pattern in commercialization of university research.

There are similar results at a number of institutions. The investment in the University Industry Liaison Offices (UILO) can be thought of as defined subsidies. The main component of these subsidies comes from: a) the university itself; b) the provincial government; and c) specific seed funding from various granting agencies, in some cases from the local government. Several institutions refer to the Intellectual Property Management Program of the granting councils as providing seed money for starting these offices. The UILO's are then entitled to a negotiated portion of the licensing, contract overhead and equity funds. In all cases, the long term business plan for the UILO's is that they will become profit centres, no longer needing ongoing subsidy. In many cases, they are expected to pay their initial subsidy back. Some have already become profit centres and are returning money to the institution and to the inventors depending upon the policies of the institutions.

The even better news is that those institutions that have not yet established UILO's are moving rapidly in this direction. They are establishing business plans to show the expected returns and seeking bridge funding both from internal sources and from a number of provincial programs established for this purpose. In some cases, these offices combine the efforts of several institutions and in some cases, municipal governments are assisting in the bridge funding.

Of course, it is also important to stress that many institutions (including the colleges) have partnerships with local, national or even international businesses and are taking steps to reinforce these partnerships.

Several institutions emphasize partnerships. This is demonstrated in the CFI process since the institutions are only awarded 40% of the projected capital cost of approved projects. The institutions have to date been able to find 1407 funding partners for their CFI applications to fund the remaining 60%. Much of this comes from provincial governments. Of these, 945 are private sector partners. About 10% of the overall funds for CFI projects have come form the private sector (i.e. will lead to a projected total of nearly $250M when the current projects are finalized).

Several institutions report that they are strengthening their ethics/conflict of interest policies to be quite clear on the role of the investigator in partnerships or spin-off companies, largely around the confidentiality of research results.

In addition to patenting, licensing and the development of contracts and spin-off companies through the UILO's, there are a substantial number of physical incubators now in operation or in development under the aegis of the not-for-profit institutions. Again, there are many that have been successful in delivering results based on their business plans. These incubator centres also aim to become profit centres to their owners (or at least not for loss) and some have reached this stage. The record of successful transitions of companies that have been incubated to listing on the stock market is considerable and growing. The record of success in the ongoing companies is high, with 80-90% of them still in business after several years. But again, early investment requires patient capital before they typically break even. They often start with a defined subsidy - in the case of universities in British Columbia - this was in the form of a provincial land asset provided many years ago. In the case of one university in B.C., there are plans to complete the development of 200,000 square feet of physical space on campus. Of this, 90,000 square feet is up and running successfully without subsidy from government or university (except the original land) and developing enough "profits" to invest in the next facility. The successful companies then return licensing income, equity positions and significant research contracts to the university and to its inventors.

There are many indications of successful incubators already established or being established in different parts of the country that sometimes have initial provincial and/or university investment to get them started on their business plans. In several cases, there are private investments being made (often with a view to the real estate possibilities) and always with a view that they will not only break even, but also become profit centres for the owners.

The overall picture that comes from this survey is one of encouragement. Institutions are beginning to assess their success in terms of what benefits they are bringing to Canada as a result of their research. This moves the focus for success to the results and the impact and away from the more usual indicator of the money they attract to do the research.

Of course, it is more difficult to report on the results of research, than it is on the dollars successfully competed for. If Canada is to be and is to be seen to be a more innovative nation, it is what the institutions do with the support they receive that matters. There is a widespread commitment to delivering benefits to Canada and great confidence that they will be able to demonstrate this by actions already taken or in progress.

But while already highly competitive in commercialization productivity, the universities through the AUCC, have committed to tripling their commercialization of research by 2010. The following summaries suggest that this objective is being taken seriously in all parts of Canada.

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Attachment 1

Commercialization Productivity

This is a summary of a study by Bruce Clayman of Simon Fraser University. He documents, based on the 2000 data of the Association of University Technology Managers (AUTM), the commercialization productivity of U.S. and Canadian universities. Productivity is based on several key indicators in proportion to the level of sponsored research.

Some of these indicators as a ratio of sponsored research funding are:

- invention disclosures
- licences and options executed
- licence income received
- U.S. patents issued
- start-up companies formed.

The summary data are shown on the attached table. What is truly remarkable is the similarity of productivity both in Canada and in the U.S.

Everything else is similar.

Several universities attribute those differences to the lack of receptor capacity in Canada. Universities in Canada have to create spin-off companies since there are few receptors. Hence the licensing revenue is less and they tend to license to their own spin-offs. The Conference Board reports "There are reasons to believe that Canadian universities are doing well, and will continue to do even better, in commercializing their research output to such an extent that it could far outpace the Canadian private sector's receptor capacity".

Nevertheless, Clayman concludes that there is a simple linear relationship between sponsored research funding and commercialization in both countries. This relationship, more research funding, more commercialization is remarkably constant over time and between the two countries. Institutions operate in different ways, perhaps best defined by three categories:

i) the institution owns the IP and shares with the inventor;
ii) the inventor owns the IP, is required to disclose it to the institution and may or may not be required to share with the institution;
iii) the inventor owns the IP with no obligation, but works with the UILO on a negotiated basis.

The University of Sherbrooke is by far the highest in commercialization productivity and is ahead of all North American universities.

TABLE 1

Commercialization Productivity
Canadian Universities
(2000 data)

	Invention Disclosures	Licence & Options Executed	Licence Income Received	U.S. Patents Issued	Start-up Companies Formed
Univ of Toronto .	45	0.09	6,660	.05	.03
U of Alberta .	44	0.11	7,562	.08	.03
Univ of Montreal	.39	0.22	1,997	.08	.06
McGill Univ	.77	0.21	3,674	.15	.05
UBC	1.12	0.29	25,024	.20	.07
U of Calgary	1.62	0.31	45,085	.18	.03
UWO	0.25	0.35	346	.05	.02
Guelph	1.86	0.29	16,176	.05	.02
McMaster	0.76	0.33	5,202	.04	0*
Queens U	0.63	0.19	103,733	.36	.06
U of Waterloo	0.16	0.23	8,647	.10	0*
U of Manitoba	0.25	0.31	25,137	.11	.03
U de Sherbrooke	0.43	0.81	176,842	.09	.15
SFU	2.15	0.30	10,377	.18	.54
Concordia U	0.70	0.09	2,724	.00	.09

*** It should be noted that these institutions have stimulated spin-offs but they are not recorded in the AUTM data.**

- U.S. $

TABLE 2

Commercialization Productivity
U.S. Universities
(2000 data)

	Invention Disclosures	Licence & Options Executed	Licence Income Received	U.S. Patents Issued	Start-up Companies Formed
U of California system (many campuses)	**.41**	**.15**	**128,448**	**.16**	**.01**
Johns Hopkins	**.34**	**.12**	**14,129**	**.10**	**.01**
MIT	**.58**	**.14**	**43,265**	**.21**	**.04**
U of Washington	**.32**	**.19**	**46,471**	**.09**	**.01**
U of Illinois	**.34**	**.14**	**9,468**	**.05**	**.01**
U of Wisc-Mad	**.50**	**.23**	**41,373**	**.17**	**.01**
U of Penn	**.42**	**.12**	**52,649**	**.09**	**.01**
U of Mich	**.34**	**.10**	**7,957**	**.15**	**.02**
SUNY (many campuses)	**.41**	**.08**	**36,839**	**.16**	**.01**
Stanford	**.57**	**.36**	**83,156**	**.22**	**.02**
Penn State	**.46**	**.05**	**2,953**	**.10**	**.01**
Harvard	**.31**	**.16**	**38,398**	**.13**	**.00**
North Carolina St	**.41**	**.11**	**6,156**	**.11**	**.01**
U of Minn	**.53**	**.21**	**56,258**	**.16**	**.03**
Texas A&M	**.35**	**.15**	**15,227**	**.06**	**.01**

- **U.S. $**

TABLE 3

Cumulative Totals - Commercialization Productivity (2000 data)

	Productivity (U.S.$) (top 15 universities)	
Performance Indicator per $1M U.S. of sponsored research	**U.S.***	**Canada**
Invention disclosures	**0.64**	**0.69**
Licence and options executed	**0.22**	**0.22**
Licence income received	**36,810**	**18,864***
U.S. patents issued	**0.21**	**0.11**
Start-up companies formed	**0.02**	**0.05****

- **adjusted for indirect costs estimated at 52%**

***** **Information provided during the survey about very significant licensing income leads to a projection of about $30,000 for 2001.**

****** **If McMaster and Waterloo spin-offs were recorded, it can be estimated that this number would rise to .06 to.07.**

Attachment 2

Institutional Summaries

WEST

The western universities (including Lakehead) have formed a consortium known as WestLink, that surveys and reports on University Technology Transfer in Western Canada. A brochure that provides an excellent summary of sponsored research, patents, licensing and spin-off companies is attached. Except for the B.C. Cancer Agency, the universities incorporate reports from their affiliated teaching hospitals. In B.C., Discovery Parks operates incubator centres at UBC, SFU and BCIT and will soon build one at UVic. These are self-financing based on an 85 acre parcel of land made available by the Province in the 1970's. In Alberta, the InnoCentre model from Québec, has been adopted to address the company creation gap which aims to be self supporting after an initial provincial investment. The cost is covered by rent and the return to the university is about 10% of the equity position.

1. University of British Columbia
   ……..

The University of British Columbia has identified its research activities in 10 clusters:

Society in Global Context
Culture and its Representation
Population Health, Services and Human Development
Human Health and Genomics
Neuroscience and Cognitive Systems
Sustainability/Environment
Biotechnology and Genomics
Origins and Mathematical Structure
Quantum Structure and Information
Microelectronics and Information Technology

Each of these clusters crosses traditional discipline boundaries and each has benefits to Canada given the opportunities in the Life Sciences, the Physical Sciences, the Social Sciences and the Humanities.

The principal source of support to the $3M operation of the UILO is university awards, share of revenue, after patent fees are cost recovered. UBC has set an objective of 15 spin-off companies/year.

Commercialization has a long record at UBC perhaps starting in the 1930's with the spin-off of Sherrit Gordon. Today, three incubator centres (and a fourth in development to provide 200,000 sq. ft.) operate under the aegis of Discovery Parks, an organization controlled by the universities and originally started with a provincial land asset. The University Industry Liaison Office report for UBC in 2000/01 had $199.8M in research funds, $38.8M of this from industry, licence income of $8.6M and held equity in spin-off companies worth $11.2M.

Thirteen spin-off companies were created that year bringing the total to 104 since 1984. 135 patents were disclosed and 62 patents issued. Returns to UBC from spin-off companies now total $27.3M in research funding and $5.9M in royalties including the affiliated teaching hospitals. In addition, TRIUMF has spin-off activities and several companies operate in the private sector at the BC Research Corp. facility.

1. BC Cancer Agency
   ……..

They are focussing on developing new knowledge through investing in translational research.

The focuses are:

1) Recruit and retain researchers and clinicians of international calibre.

2) Develop world class facilities and a collaborative and nurturing environment. They are creating the Genome Sequence Centre and the Tumour Tissue Repository.

   A new research facility is being established in Victoria and they are a partner with UBC in the
   Centre of Integrated Genomics and the focus of Genome BC.

3) Provide in-house support for the translation and commercialization of innovations.

   Recently established a Technology Development Office to manage IP funded by BCCA and
   venture capital partners.

   11 patent applications made last year and three spin-off companies in the works. BCCA has
   an equity position in companies involved with drug delivery systems, cancer vaccines and medical devices.

   They expect developments for the market in Bioinformatics, Biotechnology, Cancer Diagnostic, Cancer Therapeutics, Clinical Research, Cancer Vaccine and Therapeutic Monoclonal Antibodies.

2. British Columbia Institute of Technology
   ……..

With CFI support, BCIT has reinforced three areas:

i) Centre for Rehabilitation Engineering and Technology that Enables (CREATE)
   This project helps Canadians with disabilities. It is a partnership with the Research Division of the Neal Squire Foundation.

ii) Photovoltaic Energy Applied Research Lab (PEARL)
   The focus is on photovoltaic solar electric power generation, with demonstration projects and industry partners.

iii) Internet Engineering Lab (IEL)

This lab contains equipment that is unique to Canada, to allow advanced testing of high performance networks. There are many universities and industrial partners, including larger companies and start-up companies, working with this centre.

BCIT has been involved in applied research for approximately 12 years. Focusing mainly on contract research with industry, the Institute has developed a Technology Centre (similar to a UILO with 48,000 sq. ft.) and a research park (with Discovery Parks) at its Burnaby Campus. An incubation service for start-up medical device companies has recently been established in collaboration with a private company.

3. Forintek

Forintek is Canada's national wood products research institute as a private, not-for-profit partnership. Revenue of operation is $23.3M/yr (45% industry, 24% federal, 31% provincial).

They are developing and implementing the most advanced techniques to reduce production cost, improve productivity, and increase the quality and variety of wood products.
Mainly in Vancouver and Québec City with satellites in Ottawa, Prince Albert, Edmonton and Prince George. Their whole activity is to develop locally adapted solutions and technology transfer of its National Research Program.

4. Malaspina University College

This university college is developing specific niches in collaboration with local industry and the community in:

i) environmental chemistry
ii) Centre for shellfish research
iii) Centre for applied computing in the Arts and Humanities.

5. University of Northern British Columbia

They play a key role in regional economic development by focusing on research that helps:

i) manage the resources and environment
ii) understand factors that influence community stability and sustainability
iii) improve health status and health services.

They are constructing a research and development park in partnership with a private developer and are promoting the development of spin-off and start-up companies. They have received a patent and applied for another. Already they have an anchor tenant in the park. This tenant is a major IT company.

They are now addressing the following issues:

- The biology and control of forest pests
- Factors which control productivity
- The role of fungi in the breakdown of soil components and provision of essential nutriments
- Potential impacts of climate change on forest species.

6. Royal Roads University

This new university has created a full scale research quality, innovative wastewater treatment plant in collaboration with an industrial partner that will use this in developing an international market. This facility also is leading to new regulatory regimes.

7. Simon Fraser University

SFU reported on its commercialization activities. They are a member of WestLink and through Discovery Parks have a research park adjacent to the Burnaby campus (with 120,000 sq. ft. of space available). This serves as an incubation centre for spin-off companies and those working with SFU researchers. There is also an incubator facility at the downtown campus that houses new spin-offs.

They have a wholly owned, for-profit company SF Univentures Corp. which holds equity positions in spin-off companies or helps to find corporate partners. At SFU, the inventor is the owner of patents, but in all cases disclosure is required and SFU provides many services for a negotiated arrangement. The UILO budget is about $500,000 supported largely by the university and the province and they receive a portion of the royalty income of $313,000. They have a record of 60 spin-off companies, six of these last year, and they hold equity worth $300,000. Last year there were 22 disclosures (total to date 357), 18 patents filed and four patents issued.

Their strategies are aimed at:

- Identifying and assessing technologies
- Providing IP advice and protection
- Funding prototype development
- Partnering researchers with the private sector
- Identifying industrial partners for commercialization
- Creating new ventures.

8. Vancouver Aquarium Marine Science Centre

The Vancouver Aquarium has a strong focus on communication and has developed a major research centre in support of this mandate. The North Pacific Marine Mammal Species at Risk Research Centre is a consortium (UBC, U of Alaska, U of Washington, Oregon State U) working on the patterns/causes of decline and abundance of marine mammals.

9. University of Victoria

To maximize the transfer of knowledge and intellectual property from the university to benefit Canada, UVic provides specialized funding and services that range from conference grants, to commercialization assistance through their Innovation Development Corporation (IDC), to a planned facility to house spin-off and start-up companies. The university recently revised its Intellectual Property Policy to streamline and enhance the process for disclosing and disseminating the products of research that are created by their faculty. A recent restructuring of contract services will provide
for greater cooperation between the Office of the Vice President Research and IDC. They are pursuing strategies for strengthening the ties to the local and regional communities in an effort to create more partnerships and to maximize the synergy with the industrial and commercial sectors.

10. Okanagan University College

Okanagan University College has an extensive history of collaboration with other universities, with government departments and crown corporations, with industry and with not-for-profit societies in the area of water resource science. Examples of the first group include Wilfrid Laurier University, the University of Northern British Columbia, the University of New Brunswick, Laval University, Simon Fraser University, the University of Ottawa, the University of Massachusetts, the University of Lund, the University of Sherbrooke, Michigan State University, Rutgers University and the University of British Columbia. Examples of the second include Agriculture and Agri-Food Canada, Environment Canada, the BC Ministry of Forests, the city of Kelowna, the municipality of Lake Country and the Central Okanagan Water Board. Examples of industry partners include Interior Lumber Manufacturers Association, Weyerhaeuser Canada Ltd, Riverside Forest Products Ltd, Tolko Industries, Slocan Forest Products, Gorman Brothers Ltd. Examples of not-for-profit societies are Central Okanagan Naturalists Club, BC Watershed Stewardship Alliance and BC Lake Stewardship Society.

11. Open Learning Agency

The Open Learning Agency plays a key role in the development of distance education in the province and nationally, by focussing on research that develops:

i) new delivery models
ii) more efficient technological infrastructure support systems, and
iii) more flexible and efficient course development applications.

By collaborating with other institutions through organizations such as the Canadian Virtual University and Canada Virtual College, there is a direct spin-off from this research.

12. University of Alberta

The University of Alberta describes an active and aggressive technology transfer program that is accelerating rapidly. This includes research contracts with industry, licensing of

technology and the creation of spin-off companies to act as receptors of university research. After covering costs, licensing income is shared by inventor, inventor's faculty and the university. Total sponsored research is $256M.

From 1963 to March 31, 2001 they document 66 companies spun off, eight in the past year alone. All but 15% continue in business.

A few statistics for 2000/01:

$40.2M in industry sponsored research
53 invention disclosures
19 licensing agreements
$7.6M licensing revenue
$2.0M returned in research contracts from spin-off companies
$10.4M held in equity
grant and contract indirect costs $4M

They have created the Research Transition Facility as an incubator centre - 26,000 sq. ft. charging market lease rates with the expectation that the companies will eventually move to the Edmonton Research Park. A second phase is being planned within the context of the new Health Research Innovation Facility. The University of Alberta was also a founding member of Inno-Centre Alberta (ICA) which is modeled after the highly regarded InnoCentre Québec model and which will return equity in spin-offs to the university.

They are members of several networks including WestLink (a consortium of western universities) and the Alberta Technology Commercialization Network (ATCN). The cost of operating the ILO is $3.3M/yr funded largely by U of A ($750K), a share of licensing revenue ($1,000K) and the province ($750K).

13. University of Calgary
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Benefits to Canada include:

i) research to increase quality of life
ii) actively pursuing commercialization
iii) participating in discovery networks across the country, and
iv) developing partnerships with government and industry to contribute to economic growth and diversification as well as educating the next generation of researchers and citizens.

Quality of life - health (cancer, genomics, osteoarthritis, nutrition, human performance and basic biomedical research).

- biotechnology, energy, information and communications technology (ICT)
- social and human sciences - language training, public policy research, military and strategic studies.

Commercialization - through either a wholly owned company, University Technologies International Inc. established in 1989, or through Research Services. IP is creator owned and

U of C is in the top two or three Canadian universities for revenue generated. There is substantial royalty income. The University Research Transition Facility was announced in 2001 an incubator for spin-off companies. In addition, one facility, the Calgary Centre for Innovative Technology, is now under construction and a second is in planning. A Health Research Innovation Centre will have a research transition facility.
Off-campus, InnoCentre has been franchised from Québec into the Province of Alberta. Calgary Technologies Inc. was started in 1981 as the Calgary Research and Development Authority by the City, the Chamber of Commerce and the university. They operate a 120,000 sq.ft. facility incubator facility with more than 300 companies assisted since 1990.

Industry Linkages - Many activities are under way with local industry including the Advanced Energy Research Initiative.

14. University of Lethbridge
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This university is new to IP management but is creating a knowledge and technology transfer office. They are developing research policies and procedures and education of faculty. They have become a member of WestLink which is helping them in developing this new mission. They are a founding member of the Southern Alberta Technology Council linking the university and local business. They are creating a Water Institute for Semi-Arid Ecosystem (WISE) using Canada Research Chairs.

WISE will address research questions like:

- Relationships of agricultural management practices on enteric diseases outbreaks
- Predicting the impact of climate change on a watershed basin
- Developing reliable and low cost water treatment alternatives.

15. Lethbridge Community College
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They are developing applied research in fresh water aquaculture to develop a viable business, In turn, the water from the fish tanks is used in a greenhouse for aquaponics research projects by recycling 98% of the water. Several businesses are being planned that will make use of these technologies.

16. Olds College
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Olds College Centre for Innovation is a new, comprehensive approach to assisting agri-business and resource industries in creating new products, new technologies and in successfully capturing more market opportunities. OCCI is a dedicated new resource that was developed to help the Alberta agriculture industry grow its total agricultural outputs to $20 billion per year by 2010.

Since its inception in 1999, OCCI has raised more than $7.5 million from industry and government. The Centre employs 13 staff including three World-class researchers.

CFI funding has contributed to the development of infrastructure for three key initiatives:

1. Composting Technology Centre - a new windrow turner and an in-channel composting system to help solve waste management and site remediation problems, using wastes as feedstocks.

2. Plant Stress Physiology Lab - growth chambers, microscopes, ovens and freezer systems to allow for state-of-the-art stress physiology research in turfgrass and field crops, and

3. Livestock Improvement Centre - equipment and infrastructure to compliment a new Animal Health Technology Centre and a Livestock Handling Pavilion. The Centre addresses problems and provides practical solutions in the areas of animal nutrition, breeding and genetics.

17. Southern Alberta Institute of Technology

SAIT has 150 partnerships with national and international businesses and others. They have nine Centres of Technology Development and have recently created the Innovation and Technology Development Office to provide business and industry access to their facilities for prototyping, testing, improvements and field trials. This office protects IP, negotiates licences, etc. They are developing a plan to allow faculty to actively pursue technology research and development using a prototype development fund.

Three recent research projects at SAIT include:

- Developing a wheelchair that can handle a wider variety of terrain. The project is advancing to the pre-production stage with several prototypes to be tested.
- A water-heating system to adapt a heating unit for the Asia markets
- Speech therapy software to improve speech quality.

18. Athabasca University

E-learning as an industry is one of the fastest growing sectors in the knowledge economy. Athabasca University's research agenda is focused on e-learning as a business and focuses specifically on pedagogical, cost-effectiveness and scalability issues. Through its participation in national and international consortia, the university is actively developing markets worldwide.

19. The King's University College

Support for research infrastructure from CFI will greatly strengthen King's institutional capacity to form two-way partnerships with the private sector and national and international collaborators. Their focus in this first CFI award is on basic infrastructure to support research programs in Chemistry and Biochemistry. Faculty and undergraduate student research collaborators will be equipped with core tools for elucidating chemical structures and understanding reaction pathways. These tools provide an important impetus to the creation of

a unique centre of research excellence in the overall research environment in Alberta. Benefits to Canada are in priority areas such as environment, health, and basic science. The King's University College Natural Science Division has carefully identified several niches for collaborative projects.

Technology transfer will occur directly, through strengthened research collaborations in the pulp and paper and agricultural sectors, and indirectly, through the extensive research training of undergraduate students in chemistry and biochemistry.

20. University of Saskatchewan

The university has created University of Saskatchewan Technologies Inc. (UST) to assist faculty members in transferring technology to the marketplace. This company has been active in protecting IP through patenting and has been active in licensing. They have spun off 40 companies to date.

On the campus of the U of S is a very successful research park known as Innovation Place. This is home to over 100 companies, many of them direct products of U of S research.

Innovation Place was started in 1977 when the province leased 783 acres from the University of Saskatchewan and today they have 1,000,000 square feet of space.

Of course, U of S is home to the synchrotron and many benefits are projected including interest by the private sector. They also refer to:

- the Saskatchewan Structural Sciences Centre
- the Saskatchewan Centre for Biomolecular Research
- the College of Agriculture laboratories for research in applied animal, plant and microbial biotechnology
- expansion of the Veterinary Infectious Disease Organization which has marketed many animal health vaccines
- Mass spectrometers for earth science research
- Computational biology research laboratory

21. University of Regina

To better support research initiatives at the University of Regina, the University recognizes that it needs to focus on select areas and strive to be among the best in those select areas. Thus, the University defined the areas of strategic emphases as Social Justice, Population Health, Culture and Heritage, Informatics and Energy and Environment. To this end, several institute and centres have been created with the support of the CFI to provide support and collaborative opportunities to researchers.

Population Health is going forth with the newly established Aboriginal Capacity and Developmental Research Environments (ACADRE) program to facilitate the development of Aboriginal capacity in health research. Projects impacting the aged and cardio health care are ongoing as well.

Informatics includes the Technology Transfer Office as well as several other centres, institutes and laboratories essential to ongoing research projects in subatomic physics, new media production and virtual reality and intelligent multimedia software.

The Energy and Environment area has established several institutes and centres to facilitate research in greenhouse gas, heavy oil, and CO2 capture and sequestration. Emphasis has also been given to environmental quality analysis of the Canadian prairies and soil and groundwater contamination. A Scanning Electron Microscope for Materials Characterization in Energy and Environmental Research has been purchased with future application potential.

There are two incubator buildings on campus housing 20 companies and agencies. Planning is under way to expand this by 300,000 sq. ft.

22. Brandon University

Three CFI projects have helped Brandon build capacity in the following areas:

Nuclear Magnetic Resonance is preparing people in academe, agriculture, and ultimately diagnostic medicine.

Microscopy and Molecular Systems Research Lab is helping to characterize fungal strains with significance nationally and internationally.

Resource Geology Lab is leading to discoveries of new mineral deposits with a focus on specialty minerals and rare earth elements as well as understanding the geology of specific oil and gas fields.

23. University of Manitoba

The commercialization of university technologies is managed through the University Industry Liaison Office, which provides its programs and services to Brandon University, University of Winnipeg, and CancerCare Manitoba, through formal strategic alliances.

The University of Manitoba has a strong record of technology commercialization through licensing. It holds more than 70 patents for technologies and annual royalty income from 53 licenses and options totaled $1.8M in 2000/2001.

Two new recently established programs are designed to stimulate and support start-up company creation: VentureBox, a comprehensive program designed to successfully create and grow high-tech/biotech start-up companies at the University; and the Springboard Fund, a partnership with the largest venture capital pool in Manitoba, to provide early-stage, proof-of-concept research funding to VentureBox companies. Genesys Ventures has opened a 17,000 sq. ft. incubator centre with spin-offs housed. They have a 15 acre site for a health technology incubator.

As a result of new program and service initiatives, disclosures have risen, which will lead to start-up companies for the benefit of Manitoba and Canada.

The University of Manitoba is a member of WestLink and 15 of 22 Networks of Centres of Excellence. Manitoba's Agricultural Research and Development Initiative supports linking research to commercial opportunities in the agri-food industry. Manitoba is examining the idea of a high tech corridor to South Dakota.

24. University of Winnipeg

They have identified research clusters in the following areas:

- Aboriginal People in an Urban and Regional Context
- Cognition and Information Studies
- Culture and Change in the Hudson Bay Watershed
- Culture of Childhood
- Environment and Sustainability
- Urban Change and Adaptation

From these clusters have emerged several sustained research teams, incorporating researchers from the social sciences, humanities, natural and life sciences. Knowledge and technology transfer are an important part of all of these research areas. For example, three formal centres have arisen from the research area *Environment & Sustainability*, two funded by CFI and one currently under consideration.

C-FIR: a centre for forestry research, which is a co-operative venture between university researchers and industry to determine the critical questions in the industry and to apply scientific rigour and interdisciplinary perspectives to produce the most useful solutions to forestry stakeholders.

C-SCAPE: a centre for scientific and curatorial analysis of painting elements uses materials analysis and remote sensing techniques to art to solve problems of conservation of Canada's cultural and artistic heritage.

CAPR - a centre for advanced polymer research, which includes significant industrial partnerships, related to industrial thermoplastics customized to solve industry and environmental problems.

All of the centres bring together researchers from different sectors, whether industry, university, government, or grassroots organization.

With increased external partnership activities from these centres and research teams, the University is seeking external funding to establish a position dedicated to the development of industrial partnerships. It is anticipated that the revenue generated by this position will support the position beyond external funding commitments. Additionally, the University is a member of WestLink and is a participant in an application to the NSERC Intellectual Property Management program.

Note - Red River College has not been a CFI recipient until recently but they are developing a downtown Cyber Village.

25. St-Boniface General Hospital

The St-Boniface General Hospital Research Centre is committed to the commercialization of its research. In the past few years, they have launched six spin-off companies aimed at bringing new health technologies to market in fields such as robotic pharmacy systems, image-guided surgery, HIV, diabetes, cardiovascular disease (restenosis), and transgenics. One of the major challenges to commercialization of medical technologies in Manitoba has been a lack of access to venture capital, particularly in early stage financing.

In 1999, their Research Centre organized a group of local angel investors to form the $4M Keystone Technologies fund, specializing in start-up investments of <$500K/enterprise. In 2002, this fund will be replaced by a new $90M Western Life Sciences Fund capable of making investments of <$3M/enterprise in life sciences projects across Manitoba and Saskatchewan. They project the number of spin-off companies at their Hospital to double within two years.

To further facilitate commercialization, they have recently announced the construction of a new Clinical Research Institute (100,000 ft2) to complement their wet-lab based Research Centre. This new CRI will incorporate a substantial commercial component including Phase 1 clinical trial facility and incubator space for spin-off companies. When the new Clinical Research Institute is fully operational, it is projected that the research enterprise at St. Boniface General Hospital will reach $60M/annum in revenues and 600 scientific, technical and support staff. Commercial activity is expected to play a prominent role in this expansion and they have a track record of success in this regard.

ONTARIO

In most cases, the hospitals report separately from their affiliated universities. This is almost unique to Ontario.

26. Brock University

Brock's concept of benefits of research to Canada is broadly conceived and encompasses the humanities, fine arts, social sciences as well as natural and physical sciences. They describe the Cool Climate Oenology and Viticulture Institute as a substantial benefit for the improvement of processes in the wine and grape industry and to regional tourism and cultural industries. Brock assigns the IP to the inventor and has created a seed fund to assist in commercialization.

They report two successful spin-off companies. Brock is also a member of a group of six universities that have applied to the Tri-Council Intellectual Property Management fund (IPM).

27. Lakehead University

Lakehead works closely with the local resource firms (forestry and mining) helping them to improve applications and processing techniques. They have established an Intellectual Property Management Office with the assistance of NSERC's IPM program. This will assist them in licensing and developing spin-offs.

They report one major biotechnology spin-off company.

28. McMaster University

Commercialization is relatively new with the Intellectual Property Board formed in 1998. Already in 1999/2000 the following statistics hold:

Number of disclosures	41
Patents filed	17
Technologies licensed	10

They are developing a research park in collaboration with the City of Hamilton. They are involved in a major biotech initiative that will see the creation of substantial campus incubator space.

29. Niagara College

They talk explicitly about the Centre for Advanced Visualization, which strengthens their capacity to work with their local businesses as part of their technology transfer activities.

30. Laurentian University

Laurentian reports significant collaborative research with the mining industry examining issues of environmental toxicity, mineral deposit studies, mineral exploration techniques and automation applied to mining itself. In addition, there is a focus on bio-complexity of the environment and issues of nuclear and waste management. It is anticipated that spin-off companies will be established.

31. Queen's University

Queen's has a distinguished record of commercializing technology through its arms-length commercialization organization PARTEQ. On its $90 million sponsored research base, Queen's has high commercialization productivity. Queen's manages two captive funds in the total amount of $9.5 million for investment in early stage technologies. Through the efforts of PARTEQ, over $110 million has been raised for new venture creation and these new spin-offs have raised over $230 million to invest for the development of licensed technology. The spin-off companies have created employment for over 150 people in Canada.

In addition to commercial benefits of research, Queen's has a long history of policy research contributions in the social and physical sciences that impacts the lives of Canadians.

32. Ryerson University

Ryerson's research dimension has been recently implemented but they document rapid progress. In the Centre for the Study of Commercial Activity they have 70 industry members.

They have other programs in fields such as photonics which have led to the development of a "Novel high frequency ultrasound imager for the monitoring of apoptosis" with industry partners.

They are part of the IPM6 consortium (Ryerson, Toronto, York, Brock, Windsor and McMaster), with support from the IPM program.

33. Sault College

Sault College is partnered with the Upper Lakes Environmental Research Network which brings together partners from academia, government, industry and not-for-profits in developing tools for managing forestry and aquatic systems sustainably. Students are learning how to use remote sensing to map and monitor changes in forest stands.

34. Seneca College

They refer to two areas: Bioinformatics and internet-based in-service teacher education. They work with York University in the Research Centre for Technology in Education.

This is not expected to lead to spin-off companies or patents, but is expected to lead to licensing opportunities.

35. Sir Sandford Fleming College

Sir Sanford Fleming College, through the Institute for Healthy Aging @ Fleming College and the Technology Training & Innovation Center, sponsors the applied technologies for Healthy Aging Researcher (ATHAR) laboratories and beta testing site. The St. Joseph's Care Group are building a long-term care facility on Fleming's Sutherland Campus (St. Joseph's @ Fleming) which will become the teaching/learning environment for many of the projects that they are developing, such as personal locators, remote office access, audio/video streams and Bluetooth applications. Fleming collaborates with a sleep behaviour researcher at Trent University. Applied research projects are integrated in the technology curriculum. Research projects are often tied to new and proposed programs such as Building Automation and Health Information Systems. The work is done in partnership with the private/public sectors.

36. University of Guelph

They have established a number of institutional research themes. These are: Environment; Food; Biotechnology; Advanced Analysis; Health and Well-Being; Culture and Society, Communities and Families.

They work with the Guelph Food Technology Centre to bring new products and services to market. They have established a for-profit arms-length company to assist in technology development by creating new technology-driven companies or by licensing technology to established companies.

Their Centre for Food and Soft Materials Science should lead to the following benefits:

- Advancing research in cancer through studies on P-Glycoprotein structure and function
- Training of next generation of Food and Soft Materials researchers
- Enhanced food packaging technology
- Developing an edible, biodegradable soy-based packaging.

They have also formed a venture capital company raising money on the stock market to invest in their spin-off companies.

37. University of Ottawa

The University of Ottawa has made impressive advances in research and innovation in recent years, which has resulted in significant technology transfer and spin-off companies. The University now ranks 6th in Canada in research intensity (compared to 14th four years ago).

Spin-off companies were launched last year in engineering (photonics), medicine, and science. Also, awards from CFI have markedly enhanced the magnitude of technology transfer (e.g. patents emanating from the Centre for Catalysis Research and Innovation).

The University is the headquarters for the CFI funded Canadian National Site Licensing Project, and for two NCE's (Canadian Stroke Network and the StemCell Network).

The Technology Transfer and Business Enterprise sector of the University is undergoing major expansion.

38. University of Toronto

The University of Toronto, with the important support of federal and provincial government programs, including CFI, among other partners, has made significant investments in research. It has also endeavoured to transfer the results of that research for the public benefit - through collaboration with Canadian industry and non-profit organizations, through technology licensing, the creation of new companies and other means. Reflecting this commitment, it has:

- In the 1990s, increased the number of professional staff working in this area from 3 to 18 and, in addition, has created a technology transfer intern program that has trained six new professionals in the past two years and aims to enhance dramatically its training capacity in this arena.

- Increased the number of invention disclosures from 23 (in 1990) to 128 (in 2001) and, in the same time period, annual licence revenues from $0.3 million to $3.7 million.

- In the 1990s, facilitated the creation of 70 new companies, which in the past four years alone, have attracted more than $36 million in capital investment.

- Created a new business incubator, The Exceler@tor, for start-up companies in the information technology sector, and, in cooperation with five of their affiliated teaching hospitals, will be developing a biotechnology incubator.

- Has been a founding member and contributor to the establishment of the MARS Discovery District, which will be a "convergence centre" in Toronto for the creation of new companies in the medical and non-medical technologies sector;

- Created an "intellectual property consortium" of six universities in southern Ontario, that use a common source of commercialization expertise, UofT's Innovations Foundation, and jointly administer an early-stage seed-fund;

- Sponsored the creation of several Community Small Business Investment Funds (CSBIFs), currently valued at $16 million and focused on seed investments in UofT start-up companies.

The benefits that Canada has derived from this activity has also been significant. They include healthy, established companies, like MDS Sciex and GlycoDesign, and new, highly innovative ones, like Integrative Proteomics Inc. and BIOX Inc. They also include the introduction of new technologies, such as the salt-tolerance gene, a diagnostic test for Alzheimer's Disease, new materials for dental implant to software for geological analysis, among many others.

39. St. Michael's Hospital

They describe a program, Critical Care Unit for Research Excellence, which looks to outcomes in critical care which will lead to improved patient outcomes, cost savings and spin-off companies.

They are doing research on inner city health focusing on determinants of health, barriers to care and development of novel interventions to improve the care of disadvantaged populations. Effort will be focused on bioinformatics.

40. Sunnybrook and Women's College Health Sciences Centre

S&W is a grouping of three campus: The Sunnybrook Health Sciences Centre, Women's College Hospital, including the Center for Research in Women's Health, and the Orthopaedic and Arthritic Institute. Together they have a research budget of $40M. Research infrastructure supports work in: bioengineering, cancer biology, cardiovascular sciences, imaging, immunology, and neurosciences.

Over the last two years, significant investments have been made towards expediting the development of intellectual property; technology transfer and commercialization:

- established the Technology Transfer Commercialization Centre, focused on uncovering early stage research that has commercial potential, and to provide the resources to protect and develop this intellectual property. Two spin-off companies have been launched:
  - Nimble Inc.
  - VisualSonics Inc.
- in partnership with Working Ventures Inc., initiated the Sunnybrook and Working Ventures Medical Breakthrough Fund to provide funding early-stage commercialization
- implemented Clinical Trials Management, aimed at furthering private sector partnerships to increase clinical trials activity
- establishing a "dark fibre" network to implement a gigabyte connection amongst its campuses and the University of Toronto and all of the affiliated teaching hospitals.

Reciprocal Benefits arising from hosting private sector partners:

- Aventis Pasteur has located the global headquarters of their cancer vaccine project at S&W, now the largest single site of their Pan-Canadian Cancer Vaccine Network. This initiative funds S&W cancer biologists and immunologists, which has led to information exchange, as well as providing employment opportunities for students, fellows and technical staff.
- Lorus Therapeutics has located their wet bench cancer research laboratories at S&W. This has resulted in employment opportunities for graduates of University of Toronto programs based at S&W.
- the Imaging physicists at S&W have established a preferred partnership with General Electric. This collaborative initiative is supporting the development of innovative imaging hardware and software in the detection and treatment of cancer and cardiovascular disease.

41. University Health Network
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This is a grouping of campuses (Ontario Cancer Institute, Toronto General Research Institute, and Toronto Western Research Institute). Together they have a research budget of $102M.

They refer to:
Oncology Infrastructure – attractive to private sector
Centre for Clinical Genomics – this microarray lab sells to 130 commercial and academic customers and has created a spin-off company.
Institute for Regenerative Medicine. This institute has a number of research agreements with the private sector and has created a spin-off company.

They are developing a new IP policy that requires investigators to disclose inventions or discoveries of potential commercial interest. They are then assessed and the institution owns it, protects and markets it by licensing agreement or by incubating as a spin-off company. Profits are shared with inventor, division and institution.

This is supported by a Research Business Development Office. In 2000/2001,

Disclosures 31
Patents filed 14
Licenses 17
Companies 4

They have submitted a proposal to the tricouncil IPM.

They have created seed fund jointly with Innovation Foundation (UofT), Mount Sinai and Hospital for Sick Children and are in the MARS project, which will include a provincially sponsored incubation centre.

Their commercialization virtuous circle is an interesting way to show benefits to the community and to spin-off activities (see attached sketch).

42. University of Waterloo
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The University of Waterloo recently commissioned a study by PricewaterhouseCoopers (LLP) to assess the economic impact of the university on the Waterloo Region. The report covers many aspects of economic impact in the valuation study, as well as examining the creation of spin-off companies based on IP from the university, and the growing impact of the area's high-tech cluster. Waterloo's position on IP is one of creator-ownership.

This impact is sizable: the university's Technology Transfer and Licensing Office reports that by 1994, 106 spin-off companies were attributed to the university. Similarly, by 1999 StatsCan's report on Intellectual Property Commercialization identified 454 spin-offs from 84 universities - 292 form the 12 largest universities. PWC estimates in its report that Waterloo is responsible for 100 (or 22 per cent) of those 454 spin-offs.

PWC reasons that aggressive spin-off company creation results from the limited receptor capacity of existing businesses in Canada. To address this issue Working Ventures, a labour-sponsored investment fund, has established Waterloo Ventures - a $5 million seed capital fund. Waterloo's spin-offs also have access to Waterloo Tech Capital, a $23 million fund.

Entrepreneurship is a key feature of the university. Waterloo is home to the largest co-operative education program in the world, placing more than 10,000 students each year in four-month work placements in government and industry. It is also home to Innovate Inc. - a novel approach to business pre-incubation within a university setting. Using this culture of innovation as a backdrop, PWC surveyed selected companies the university considers as its spin-offs to determine to what degree "the university influenced the start-up and/or continued operations of the subject company". 56 per cent of the respondent companies indicated, "This company would not exist but for the University of Waterloo". The remainder indicated they "relied on the University of Waterloo (11 per cent) or were influenced" at least in part by the University of Waterloo (33 per cent).

The University of Waterloo is the headquarters for the new Canadian Water Network (a federal Network of Centres of Excellence) and CRESTech (the Centre for Research in Earth and Space Technologies). And Waterloo is now investing in a Research and Technology Park - a $60 million Public/Private Partnership. The university's donation of $20 million worth of land will house the Park's activities, one of which is a 21,000 square foot Business Accelerator Centre. Construction of the R&T Park will likely begin this year.

43. University of Western Ontario

The UWO reports on several projects that are bringing benefits to Canada.

- SHARC, a high performance computing facility that has several industrial partners.

- Creation of the London Regional Innovarium, allowing integration of health research facilities among Western and its affiliates. Their activities cover transplantation, fetal diagnosis and therapy and stem cell biology, all leading to new approaches to health care and the creation of spin-off companies.

- The National Centre for Audiology bringing together a group with a history of commercialization including software for hearing aids.

The Office of Industry Liaison was created in 1998 and already the revenue flow from royalties and licensing covers the full cost and returns funds to the university.

44. St. Joseph's Health Centre of London (Lawson Health Research Institute)

They have a major new centre known as London Imaging Research. These facilities make them an international imaging centre involving many partners and the research will lead to developments in many areas including information and technology development sectors. Work will involve software and hardware developers, clinicians, radiologists, medical

biophysicists and others. Intellectual property is being protected and they have filed 3 patents and created 3 spin-off companies.

45. London Health Sciences Centre
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They report on their project "Canadian Surgical Technologies and Advanced Robotics Centre." Benefits include early adoption and further developments of the technologies including instrumentation, imaging and telesurgery for minimally invasive surgery. They are working with MD Robotics and a number of spin-off activities are foreseen.

46. London Regional Cancer Centre (Cancer Care Ontario)
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Part of their mission includes translation of new knowledge to and from the clinic and the community. They foresee considerable commercialization activity in part through mentoring new cancer researchers in a variety of settings.

47. Wilfrid Laurier University
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At Laurier, intellectual property is owned by the researcher and according to the terms of the collective agreement, faculty should disclose patents to the university. All of their CFI projects have the potential to be of benefit to Canada and Wilfrid Laurier University on a project by project basis will consider supporting patent applications or other support that could assist commercialization.

48. York University
……...

With the recent establishment of the Office of the Vice-President, Research and Innovation, York University is moving aggressively to ensure greater diffusion of its research through knowledge/technology transfer in the sciences, social sciences and fine arts. They are undergoing strategic planning to determine key services and personnel required to support faculty members in achieving this objective. Their planning has a special focus on SMEs in the Greater Toronto Area, with its concentration of high tech companies. York is also a founding member of an intellectual property consortium of six universities in southern Ontario. This consortium administers an early-stage seed fund and is a common source of commercialization expertise.

Some recent examples of technology transfer/commercialization follow:

- York's Centre for Research on Mass Spectrometry is working with and spinning off results to technology companies, including MDS Sciex and Baringer Research.
- York's Centre for Research in Earth and Space Science is working in partnership with the private sector on space flight instruments and systems. These labs have already led to four start-up companies.
- York's leading-edge combinatorial chemistry facility houses a number of collaborative projects with pharmaceutical and instrumentation companies. This research has already led to two spin-off companies.

49. Sheridan College

Sheridan College in partnership with the town of Oakville has established a business accelerator to help create and grow new companies based on technologies developed at Sheridan. This will provide low cost space, business services and mentoring.

50. Carleton University

They document a) engineered structures, a seismic network that can be moved across Canada; b) study of Alzheimer's disease, epilepsy and stress benefiting health and new partnerships with drug companies; c) photonics research documenting one new start-up company and three photonics companies using their facilities; and d) environmental biology.

51. Trent University

Trent has developed a plan for a Trent Research and Development Centre. This centre will bring together researchers and partners from the public and private sectors in areas of genomics, DNA forensics, robotics. geomatics, bioinformatics, natural resource management and environmental sciences. This project is seeking Ontario funds for a project worked out with the City of Peterborough. In addition to Trent University, this project will involve Sir Sandford Fleming College, the Ontario Ministry of Natural Resources and the private sector in developing this business cluster.

52. University of Windsor

The University of Windsor is providing some resources to assist researchers in managing their IP. They are also expanding the Office of Research Services to support this activity to ensure that they are able to retain the inventions and IP developed at the university. They are also expanding partnerships with the private sector.

Their primary research areas are automotive, environmental and social justice. Highlights of the past year include:

- $550M investment of DaimlerChrysler in the joint Automotive Research and Development Centre (ARDC)
- Opening of the Centre for Automotive Research and Education (CARE)
- Building a new state-of-the-art Multimedia Learning Centre.

53. Hospital for Sick Children

The Hospital for Sick Children operates a research institute that is fully integrated with the hospital linking clinical practice and research. The hospital operates a Seed Grant competition to encourage clinicians to start research. The translation research competition provides funds to proceed to proof-of-principle or to patenting.

The intellectual property and commercial development office provides services in support of IP and commercialization. Last year, there were 136 research contracts with a value of $12.1M (60% from industry). They filed 12 patent applications and executed 28 IP licences and option agreements.

They identify the Centre for Applied Genomics and already they are seeking patents. They have partnerships with private and public bodies in the U.S. and Japan and provide services to 15 Canadian biotechnology companies.

54. Mount Sinai Hospital - Samuel Lunenfeld Research Institute

Mount Sinai Hospital and Samuel Lunenfeld Research Institute have had an active program for commercialization of research developments since shortly after the founding of the Research Institute in 1985. As indicated by the name of the office, the Office of Technology Transfer and Industrial Liaison, and as set out in its mission statement, their commercialization strategy encompasses both promoting investments in their research programs (including direct and overhead costs of the research, access to research agents, equipment and expertise) and ensuring the application of new information and technology to the promotion of wellness, the prevention, diagnosis and treatment of diseases.

Their broad scope of research collaborations with Canadian firms and the technologies they license to them strengthens their competitiveness; enhances their product development pipeline and creates (or at a minimum, preserves) jobs in knowledge-based industries, all of which serves to attract further investment in those companies. Moreover, they are actively involved in creating new companies founded on the discoveries and expertise of their researchers. GLYCODesign Inc. and MDS Proteomics, collectively employing near 200 individuals, are but two of many examples of new companies arising out of their research programs. Creation of these start-up companies provides a significant stimulus to the Canadian economy, through job creation, new investment and consequent economic spin-offs including, ultimately, manufacturing and sales of innovative new products to world markets. To further enhance their capacity in creating new companies, Mount Sinai Hospital, together with the University of Toronto, The Hospital for Sick Children, Sunnybrook and Women's College Health Sciences Centre and University Health Network have established a joint initiative to construct the Toronto Biotechnology Commercialization Centre to provide incubation facilities and support services for start-up companies arising out of their research programs.

55. Baycrest Centre for Geriatric Care

The Functional Imaging Research Network (FIRN) consortium is part of a new initiative to link up the University of Toronto teaching hospitals through a gigabit wide-area network. This will enable rapid data exchange and development of new analytical tools for medical imaging. FIRN is also part of a three provincial consortia, supported by the Ontario Research and Development Challenge Fund from the province of Ontario, whose mandate is to improve the technological transfer and spin-off opportunities through strategic alliances with industry. The focus of these consortia are: image-guided therapy, cardiac imaging and neuroimaging.

FIRN is a network of Imaging Scientists at five research institutions affiliated with the University of Toronto:

- Baycrest Centre for Geriatric Care (Rotman Research Institure)
- Centre for Addiction and Mental Health
- Hospital for Sick Children
- Sunnybrook & Women's College Health Sciences Centre
- University Health Network

QUÉBEC

In Québec the affiliated hospitals all report through their universities so this report gives a comprehensive picture.

As an effort to increase the impacts of research results on socio-economic development, the government of Québec, through Valorisation Recherche Québec (VRQ), has invested $50M to support the creation of four technology transfer companies (TTC) whose mandate is to promote commercialization either through the establishment of new start-up companies or through licensing to existing companies. These new TTC established at arm's length from government and universities are not exclusive channels for commercialization but they have signed agreements with most of the research institutions. In most cases, research institutions can also opt for other channels if it seems more appropriate.

In addition, Inno-Centre has been established as a private, not-for-profit company investing in start-ups. This initial provincial investment has yielded good results. In Montréal, the Centre has become self funding in 12 years and has started 140 new companies. 115 are still in business. They take equity in the companies and now have a portfolio valued at $500 million. Equity is limited to 10%. The model has now spread to Alberta and to Ottawa.

This new program demonstrates the importance of fostering the social and economic impacts of research activities, an objective that is shared by government and the various research institutions.

56. CÉGEP de Saint Hyacinthe

CÉGEP of Saint Hyacinthe has two Centres whose mission is to transfer technologies, the Centre for Textiles Technologies (CTT) and Cintech Agroalimentaire. Both centres, to survive, must generate more than 75% of their operating budgets from industrial contracts. This means providing benefits to the industry.

The Centre for Textiles Technologies (CTT) serves the whole Canadian industry but, in particular, Québec, Ontario and the Maritimes. With more than $2.7M of contracts, it refers specifically to innovation, to research and develop and to transfer technology on technical textiles and geosynthetic technologies.

57. Concordia

Concordia is taking steps to focus increasingly on the future needs of Canadian society e.g. curricula more focused on bio and information technologies.

- new centres/institutes providing flow of new information and knowledge
- Valorisation Innovation Plus provides licensing approaches
- Inno-Centre assists in accessing early stage venture capital for emerging university-related research which may be disseminated by spin offs

- Commercialization is achieved through agreements with both Valorisation Innovation Plus and Inno-centre.

58. McGill University
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- Reminds us that all university research is of benefit to Canada, if only by the training of highly qualified personnel.
- Since 1998 McGill has created 20 spin-off companies and expect many more. McGill holds significant equity in these.
- In 1999 Québec made $50M available to Valorisation Recherche Québec. This is a one time fund to create an arms length company to commercialize intellectual property. Taking advantage of the program developed by Valorisation Recherche Québec, MSBI, a partnership was created with McGill, Université de Sherbrooke and their teaching hospitals and Bishops. MSBI has $15M from VRQ and $11M from the institutions and they are seeking a further $14-$24M from the private sector.
- Their strategy calls for enhancing technology mining by placing Technology Transfer officers in the faculties and hospitals.

The Office of Technology Transfer and the affiliated teaching hospitals have applied to the IPM program so they can more actively seek out commercialization opportunities.

59. Université de Montréal Complex
…….
(Université de Montréal, École Polytechnique, HÉC and research hospitals)

The first two benefits of university research are 1) to enable Canada to position itself among the top knowledge-based societies in the world, and 2) to educate and train young Canadians in an international-scale, competitive scientific environment.

Providing benefits to Canada through direct transfers of research findings to users - with commercialization being one dimension of this outcome - is a priority for the institutions. The following is a brief overview of their approaches and results:

- Université de Montréal has 89 active licences. Sixty-two of these are with small to medium sized companies, 12 are spin-offs.
- Université de Montréal has a policy of sharing commercialization revenues with inventors (professors and students). It also has rigorous policies with regard to conflict of interest and ethics. An agreement has been reached with the research hospitals on a revenue sharing policy, which is ready for signature. This agreement involves a major reinvestment of the University's share into hospital research centres.
- In 2001, Université de Montréal, École Polytechnique, HÉC and the research hospitals created the Société Gestion Univalor, intended to facilitate technology transfer by protecting and commercializing IP through the creation of spin-offs and the generation of revenue to increase research activities. Univalor is administered at arm's length from the participating establishments by a Board of Directors composed of independent members.
- The strategic plan calls for a doubling of invention disclosures to one for every two million dollars in research funding within three years and for the creating of 10 spin-offs per year. These objectives will be attained thanks to a more systematic search for results and technologies displaying a significant potential to transfer.

Université de Montréal and its affiliated schools are going to build a 16,800 square metre (gross) research building, in which 700 square metre will be set aside for business pre-incubation. With its cutting-edge scientific equipment, this building will be a centre of excellence for research in the areas of nanotechnologies, aerospace, and biotechnology.

Université de Montréal is going to create highly specialized, avant-garde infrastructures for vaccine research and development. A new building will be built for the Faculty of Veterinary Medicine to house GMP-norm laboratories equipped for scaling and validating veterinary vaccines. An Immunology and Cancer Institute has just been created. In order to house both new researchers and those currently located elsewhere on different campuses, Université de Montréal will soon begin construction of the Pavillon Marcelle Coutu. This 17,600 square metre (gross) building will contain cutting-edge laboratories, a transgenic animal facility and various technological platforms.

59. Université Laval
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In 1986, Laval created its first technology transfer office, which has since been modified. In 2000, this was replaced by the Bureau de développement de la recherche en partenariat, which manages grants and contracts, protects IP and negotiates licences. In 1999, VRQ provided funding to create SOVAR (Société de valorisation des applications de la recherche), which is a commercialization arm.

SOVAR works with the researchers through the technology transfer process. It helps in establishing the proof of concept, in creating spin-off companies, and in licensing technologies.

Infrastructure obtained from CFI for professor Galtian has permitted them to file five new patents. Access Photonic Networks inc., a company funded by a former student of professor Larochelle has obtained a license for her technology and has filed a patent. This company established in 2000 has already 20 employees.

They describe a number of research projects that show partnership, spin-off companies and licensing, in tissue engineering (Altertek Bio Inc), optics and photonics (DiCos Technologies Inc). CFI investments have also led to the creation of INAF, an institute developing nutraceuticals.

60. Université de Sherbrooke (including the hospitals)
…….

Université de Sherbrooke is the most successful university in Canada and one of the best in the world in receiving licensing income on the basis of research dollars available. They have the highest commercialization productivity in North America. Last year alone, they received $15.8M. They have 265 patents. They have created 16 companies, 3 last year alone.

They are partners with McGill and Bishops in one of the VRQ stimulated institutions. They claim their success is due to the fact that the university owns the IP and the inventors share in this. They have equity in some spin-offs. Their patents on data compression are incorporated in every cell phone manufactured around the world based on a series of patents.
They report technology transfer in the area of social sciences and humanities also.

61. Université du Québec - Ecole de technologie supérieure

They have established strong partnership with many groups - Hydro Québec, the Montréal hospital network, large telecommunications companies and others.

62. Université du Québec à Hull

They are not very active in commercialization directly, but serve an important role with partnerships in the Outaouais region.

63. Université du Québec - INRS

INRS is moving aggressively to develop a technology transfer capacity. In February 2001, they created Service de valorisation des résultats de la recherche. This focuses on developing contract research and ensuring a return on investment in universities to Québec, Canada and even internationally. This organization will focus on protecting IP, working out licensing and will be the interface with VIP, the VRQ funded institution including others (e.g. Concordia and the other U of Q campuses).

- They have a strong technology mining program.
- They have also created a second technology transfer company, l'Industrielle de l'Environnement.

64. Université du Québec à Montréal

The University of Québec in Montreal has negotiated a change in its collective agreement and faculty members are now required to disclose inventions and research results to the University if they want to commercialize them. The collective agreement protects the rights of the faculty members on intellectual property and so does the regulation of graduate studies for the students. A policy on intellectual property is being developed which will recognize the contributions of those involved. The UQAM is also a member of VIP funded by the VRQ, which was set up by the Québec government.

65. Université du Québec à Trois-Rivières

This campus has an office for the development of research and this office has close partnerships with regional partnerships such a Technopole St. Maurice, Innovatech Québec, InnoCentre and they are a member of VIP. Their research foci are on hydrogen as an alternate energy source, paper of the future and the electronics industry, as well as a lab to study the performance of small and medium enterprises.

66. Université du Québec - Télé université
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The focus on distance learning leads them to have a number of partnerships and some of their products are being commercialized such as modeling of knowledge and various operating methodologies. Users include other universities, Hydro-Québec and the Bank of Montreal Training Institute.

Together with Bell, Canarie and the NCE on tele-learning they have developed a new system "Explor@" that will improve training at the work place.

67. CÉGEP de Trois-Rivières
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Le Cégep de Trois-Rivières compte deux “Centre collégiaux de transfert de technologie”. Un de ces centres oeuvre dans le domaine de la métallurgie et l’autre dans celui des pâtes et papiers. La mission de ces centres est de contribuer au développement de l’industrie reliée à leur domaine d’activité, et cela dans le cadre d’un mandat de recherche et développement, d’assistance technique et de transfert de technologie.

Compte tenu du mode de financement (auto financement dans une très large mesure) de ces centres, le volume d’activité s’est développé en fonction de la réponse aux besoins de l’industrie. Les activités touchent principalement le développement et l’optimisation des procédés de fabrication ainsi que l’amélioration et le développement de nouveaux produits.

68. École Polytechnique
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En décembre 1997, Polytechnique a créé sa corporation de commercialisation des résultats de la recherche, Polyvalor, en partenariat avec le Fonds de solidarité des travailleurs du Québec qui y a investi des fonds substantiels. Polyvalor se situe en aval du Bureau de la recherche et Centre de développement technologique - BRCDT relativement aux activités de protection et de commercialisation de la propriété intellectuelle alors que le BRDCT est le responsable administratif des activités de R-D et de transfert technologique effectuées au sein de Polytechnique, tant avec les organismes de subvention qu’avec les entreprises partenaires. Depuis sa création, Polyvalor a suscité et accompagné le démarrage de plus de 12 entreprises dérivées des travaux de R-D des professeurs et étudiants, menant à la création de plus de 225 emplois de haute technologie dans la région de Montréal. L’année 2002 verra le démarrage d’Univalor, une corporation de valorisation regroupant l’Université de Montréal (via Polyvalor), HEC et des hôpitaux affiliés à l’Université de Montréal. Univalor élargira donc le spectre d’implication de Polyvalor et bénéficiera de l’apport de fonds importants de la part de Valorisation-Recherche Québec.

L’École Polytechnique compte voir en 2002, la construction d’un pavillon de recherche de 16 810 m^2 bruts à occupation partagée entre l’Université de Montréal et Polytechnique pour des activités de recherche situées à l’interface des spécialités de chacun de ces établissements. Il s’agira d’un édifice ultra-moderne entièrement dédié à la recherche. On y abritera des équipes actives dans le domaine des nanotechnologies, du biomédical, des biotechnologies et des technologies pharmaceutiques, de l’aéronautique et de l’aérospatiale ainsi que des polymères. On y réservera également des espaces voués à la pré-incubation d’entreprises ainsi qu’à

l'innovation pédagogique et aux nouvelles technologies d'enseignement dans la "Maison des technologies d'enseignement."

69. Université du Québec
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A qualité comparable, des projets peu nombreux et qui peuvent paraître de moindre envergure à l'échelle canadienne ont parfois un impact considérable sur des établissements qui contribuent directement au développement économique et social de leur région. Plusieurs projets obtenus par des établissements de l'Université du Québec en sont des exemples probants. Mentionnons, par exemple, les projets de l'UQTR sur les pâtes et papiers et l'hydrogène, ceux de l'UQAC sur l'aluminum, le givrage atmosphérique ou la productivité végétale, le navire de recherche océanographique de l'UQAR, ou encore la création d'un réseau de recherche en imagerie médicale de l'UQAT.

70. CÉGEP de La Pocatière
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Centre spécialisé de technologie physique du Québec/ Cégep de La Pocatière

Les activités de recherche du CSTPQ/Cégep de La Pocatière se concentreront plus particulièrement sur:

a) le développement de produits à haute valeur ajoutée en électronique, en optoélectronique ainsi qu'en électromécanique;

b) l'optimisation de procédés de production mettant en causes les systèmes 3D, les maquettes virtuelles, la modélisatiaon, la simulation de production, la logique floue, la mécatronique ainsi que les hautes technologies de fabrication (HTF).

Dans la même foulée, le CSTPQ vise à ce que les résultats de ses différentes recherches trouvent la
voie du marché dans un délai très rapproché.

ATLANTIC

Hospital research is reported through the affiliated universities in the Atlantic provinces of Nova Scotia and Newfoundland.

71. Université de Moncton

Université de Moncton outlines several important areas of research of benefit to New Brunswick and to Canada:

- Environment and Natural Resources with a view of sustainable development in the estuaries and forests of N.B.
- Modern aquaculture techniques for a pilot project on shellfish.
- Geomatics applied to forestry.
- Biotechnology of food and nutraceuticals has led to the creation of a consortium and to research on prevention of breast cancer jointly with the local hospital
- Photonics research with local and national partners.

72. Mount Allison University

They have created the Mount Allison Coastal Wetlands Institute that will involve researchers from Canada and the U.S. that will include a focus on a historical atlas of east coast wetlands. This is expected to be a tool for ecotourism.

73. Nova Scotia Agricultural College

They identify four areas:

Water Quality – develop water quality strategies for regulatory process and to assist commercial farms and agribusiness;

Air Quality – research on monitoring air quality and assist the agriculture sector in dealing with greenhouse gases due to methane and nitrous oxide;

Sustainable Agriculture – research on agronomic and horticultural plan species with better nutrient and soil management practices as well as modeling of grazing systems;

Economic – Research on economically important agricultural industries in Atlantic Canada such as wild blueberry, carrot, potato and fur.

These all involve close collaboration with extension organizations and producers.

74. Nova Scotia Community College

They report research on geomatics applications in coastal zones and postgraduate programs in research processes, ethics and philosophy.

75. St. Thomas University

One project has been developed with a software firm to develop anti-hate internet filter software. This could have a widespread market.

76. University of Prince Edward Island

UPEI is a small university but they report on several disclosures of intellectual property and are pursuing patenting and licensing opportunities.

77. St. Francis Xavier

St. Fx is a small university that is developing a Centre for Applied Petroleum Sciences. This is a major effort including several Canada Research Chairs and an expectation of private sector participation. The centre's unique contribution will be commercial applications in the petroleum sciences and will include:

- Innovative applications to improve success rates in exploration, development, environmental control and remediation
- Downstream applications using new techniques in modelling and simulation
- Testing a new antibacterial compound for oil and gas companies to control the corrosion induced by microfilms on pipeline systems.

They are involved with other universities in the Atlantic in an application to the Atlantic Innovation Fund for the creation of Atlantech, an Atlantic network of technology transfer experts.

78. University of New Brunswick

The University of New Brunswick is, with increasingly regularity, basing its research priorities on its Strategic Research Plan. The Plan identifies the institution's responsibility to provide research leadership and define economic, social and cultural strategies for New Brunswick and Atlantic Canada, in keeping with the university's central role in meeting the research needs of the province and region.

The University is accomplishing these goals by:

- supporting strong links to government laboratories, the community, the private sector and its many academic partners both in Canada and abroad;
- building and sustaining a strong government and industry liaison office, and
- developing a viable technology and knowledge transfer office.

UNB embarked upon an aggressive Intellectual Property Management and Technology and Knowledge Transfer project in 1999 which currently is stewarding some four-dozen files through the transfer process.

79. University College of Cape Breton

The University College of Cape Breton is mandated to actively participate in applied research and community economic development (CED), in addition to teaching and traditional scholarly work. To this end, during their strategic planning process, UCCB considered areas where it could develop a competitive advantage, both for itself as well as the SMEs in the immediate locale. Four divergent, yet complementary, areas of research emerged as being economic development drivers, as well as areas where UCCB could build a competitive advantage: information technology, environmental research, integrative science, and petroleum development and operations. UCCB has established collaborations with researchers, industry, and community partners in these areas of research, with measurable benefits evident in the early stages of the plan implementation.

University Industry Liaison is a primary function of the Department of Economic and Technological Innovation (DETI) at UCCB. The department has eight units, each of which facilitates the transfer of knowledge from the university to the community for economic diversification. The units work with their specific partners and collaborators at various capacities from shared research to patent and licensing advice. The divergent, yet complementary units can overlap for the benefit of industry. For example, the petroleum unit is proposing and R&D project that involves wireless communication. This new technology can grow from the information technology unit.

A key area marked for growth is the information technology sector. UCCB has worked with the community for 10 years to nurture cluster growth in this sector.

Early activities focused on the manufacturing sector through CAD/CAM and mechanical engineering. This applied focus has grown to provide aid to several sectors including the IT sector: UCCB's CAD/CAM center has recently produced a prototype of a generator controller and instrument panel for a growing IT firm. The new product was successfully launched at the PowerGen International Conference in Las Vegas in December 2001 (patent pending). This is but one example of the importance UCCB places on its support of small and medium sized enterprises.

The University College of Cape Breton has successfully created spin-off companies, one of which has become the largest Environmental Services Laboratory in Atlantic Canada. UCCB's competitive advantage (which is rooted in its history of training HQP for this sector and its prime location near post industrialized waste sites) is fueling cluster development of the environment sector locally, with global applications.

UCCB has developed a technology incubation center on campus. With a successful track record for nurturing SMEs in the IT sector, UCCB's enterprise center supports cluster development for both the environment and petroleum sectors. One successful spin-off is Trakonic, a firm that developed and markets web-based security monitoring software and equipment.

80. Saint Mary's University

The beneficial effect on crop growth from inter-cropping with legumes is recognized the world over. Numerous theories on why legume soils have the ability to enhance growth of non-legume crops have been proposed, yet the evidence has never been conclusive. Now, they think they have finally solved the riddle. This project started in 1995. An international patent application on this intellectual property has been filed through PARTEQ Innovations at Queen's University. Research and development are ongoing.

David Guenther in the Department of Astronomy and Physics is a co-P.I. for MOST (Microvariability of Stars, P.I., Jaymie Matthews, UBC), Canada's own, soon to be launched (December 2002), space telescope. The telescope is designed to observe, for the first time ever, the minute luminosity variations on stars that are associated with seismic-like activity in stars. The construction and design of the satellite has occurred entirely within Canada. Most significantly, new technology has been developed to stabilize the micro-satellite. Previously, no one tried to accurately point a small satellite because their low moment of inertia (ease of spinning) made them difficult to stabilize.

81. Mount Saint Vincent University

As Canada promotes life-long learning, access to educational opportunities through technology-mediated learning becomes increasingly critical. This knowledge is increasingly attractive to what they call "export markets". Many countries are seeking education upgrading of their population, generally and in specific fields, as part of a multi-faceted approach to economic development. They have increasing opportunities to market their pedagogical expertise by developing educational software directed toward markets and partnerships. Software development will most likely lead to licensing.

As to commercialization, smaller universities such as theirs do not have the resources to start up their own technology-transfer or commercialization offices but they are working actively with an Atlantic consortium of universities and private sector partners who are exploring a cooperative approach to commercialization, perhaps based on the West Link model.

82. Dalhousie University

Dalhousie University assists faculty members, who completely own intellectual property arising from their research, to commercialize their intellectual property. The major vehicle for commercialization is NU-TECH, a not-for-profit company assisting in protection of intellectual property, technology transfer and commercialization of intellectual property for Dalhousie and the Nova Scotia Agricultural College. NU-TECH provides the upfront work and costs of selected intellectual property protection, marketing and licensing in return for a vested interest based upon the intellectual property policy of the member institution, or as negotiated with non-member institutions or individuals. The focus of NU-TECH is currently evolving from protecting and licensing intellectual property, to covering the full spectrum of commercialization activity, industrial liaison, patenting and marketing of intellectual property and development of spin-off companies. Activities at NU-TECH over the past five years resulted in 128 patent disclosures with 38 allowed and 60 pending. Eight licences are in

effect and six spin-off companies have been created. Revenues are distributed between the Inventor, NU-TECH and the University.

The Business Development Office in the Faculty of Medicine is a second vehicle for commercialization of intellectual property from medical research. The office provides researchers, entrepreneurs and investors with on-site support in technology transfer, particularly in the creation and management of start-up companies. Two spin-off companies have been created.

Major coordinated initiatives are underway in Halifax involving the University, the National Research Council, affiliated teaching hospitals, the Greater Halifax Partnership and federal and provincial agencies to promote company development and greater receptor capacity for new intellectual property from research at the University. Dalhousie has helped in the development of spin-off companies, through protection of intellectual property, assistance with finding venture capital, and provision of incubation space. Some examples of spin-off companies are: Fusogenix which is exploiting the Small Transmembrane (FAST) proteins as part of drug carrier systems; ImmunoVaccine Technologies, which has created a unique and effective vaccine for controlling domestic animal and wildlife populations; NovaNeuron which has made discoveries that could help develop treatment of Parkinson's Disease, Huntington's Disease, and several other neurodegenerative diseases; and the Global Information Networking Institute which is designed to provide both faculty and students the opportunity to work cooperatively with industrial partners on projects of mutual interest and benefit. Examples of licensing arrangements facilitated by NU-TECH are: development of synthetic plastic fibres as an effective reinforcement of cement, and a new topical formulation of treatment of neuropathic pain.

A small incubator in the Computer Science building is focused on undergraduates creating spin-off companies. 15 companies have been started by these students and the faulty holds $2.0M of equity in them.

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