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ICUR International Conference on Innovation and Commercialization of University Research
Edmonton Alberta Canada - 2002 February 7-9

A Wrap-Around Summary and Introduction to Presentations

Prepared by Robert Armit of Corewest International for the Canada Foundation for Innovation

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Introduction

Canadian universities are in the midst of an important and now clearly discernible change. They are becoming more entrepreneurial, more innovative and more dynamically interconnected to the regional economies in which they are set. For some universities, and they are joined by colleges, hospitals and other institutions in this analysis, the change is not entirely new. But the overall movement to active and successful technology transfer programs is current and significant.

As head of the Canada Foundation for Innovation, I could not be more pleased with this development. A lot of what is happening is captured in the phrase "commercialization of university research". The trend to more activity in this field is exciting and meaningful. We are starting to experience real financial benefits of this work. These financial rewards are being seen and felt in the universities and other institutions themselves and in regional economies.

Canada is not unique in this regard. Many countries are home to universities committed to commercialization of university research. All of us can learn a great deal from one another. This is one reason why I endorsed ICUR as strongly as I did. I then asked Bob Armit to step back from ICUR and write twenty pages of what ICUR was all about with particular attention to Canada. This is his report.

For those of you who are involved in university-based research and ICUR, I commend this document to your attention. It lays out valuable information and perspectives. The report may and probably does understate the excitement a lot of us share for the new entrepreneurial university in our communities. So allow me in this introduction to applaud Canada's universities and the colleges, hospitals and other institutions that are taking a leadership position in commercialization of their research and technology transfer possibilities. I invite all Canadians to join me in recognizing this work. It is worth getting excited about. Canada benefits from these efforts. And all institutions will gain wisdom by focusing on these stories of success as they unfold. I am delighted to be a part of it.

David W.Strangway
Canada Foundation for Innovation

ICUR International Conference on Innovation and Commercialization of University Research
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A Wrap–Around Summary and Introduction to Presentations

Report Summary

ICUR was held in February 2002 in Edmonton, Alberta and had 32 speakers, 21 from Canada and 11 from other countries. The focus was on commercialization of university-based research. Canada as a country wants to do well in the commercialization of its university research. The activities are associated with the rising importance in Canada, in industrialized countries and in regions within countries to technology-led economic development, the knowledge-based economy and research-based innovation.

The Association of Universities and Colleges of Canada has said that with government and private sector support, the universities of Canada could triple commercialization of university research by the year 2010. This goal is placed in context. The federal government has set as a target that Canada should move from 15th to be among the top 5 countries in research and development expenditures as a percentage of GDP by 2010.

The Canada Foundation for Innovation survey of institutions regarding approaches to benefits to Canada clearly shows at least two major developments in university commercialization today: much is happening in university commercialization of research across universities, and the differences among institutions stand out as much as do the similarities. The future is now for people involved in the commercialization of university research.

ICUR brought out much of the complexity of commercialization of university-based research and contributed in its own way to a better understanding of current conditions. The conference presentations fell into four subject theme areas; government and university policies and practice, industry liaison and technology transfer offices, spin-off company creation and development and industry interfaces and networks. Five points are presented in this report in terms of Canadian discussion on commercialization that surfaced at ICUR and in dialogue around ICUR.

These five points are *stretch goals and the tripling of commercialization by 2010, universities and economic development, ownership of intellectual property, Canadian dialogue and responsibility for the Canadian agenda.* There are issues to discuss and a need for decision-making and action.

For Americans, commercialization of university-based research increased sharply with the US Bayh-Dole Act in 1980. Canada while working under different rules has its initial major broadly based work in this field in the same period. The two countries have evolved differently. Spin-off companies are more important in Canada, traced often to Canada having fewer receptors for technology. Licensing revenues are far higher in the US university system. Canada's debate on innovation strategy points to license revenue in discussing differences between Canada and the US. It was fitting that ICUR included papers and discussion on ownership of intellectual property, needs in industry for research, Canada's

receptor capacity, the structure and role of the university technology transfer office and regional economic clusters. International papers indicated similarity of experience and also the need for regional models to address regional needs. Reports from various countries indicate the high expectations that people feel for doing more with university research and technology-led economic development.

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A Wrap-Around Summary and Introduction to Presentations

A. The Commercialization of University Research and ICUR

The new demands being experienced in universities worldwide are captured well in the commercialization of university-based research. Expectations are high that universities can contribute more to their respective economies and to innovation. Commercialization of research is relatively new for universities, it is current, it is sensitive to many influences and it is growing fast. The activities are associated with the rising importance in industrialized countries and regions within countries to technology-led economic development, the knowledge-based economy and research-based innovation.

Canada as a country wants to do well in the commercialization of its university research. This activity tends to be regionally based and regions across Canada vary considerably on methods and resources involved in commercialization of university research. Canada itself varies from other countries. In this context, a group of far-sighted leaders perceived value in a conference on innovation and commercialization of university research. It would be held in Canada with contributions from Canada and several additional countries. The International Conference on Innovation and Commercialization of University Research (ICUR) was born. The event was supported jointly by the University of Alberta, which is acknowledged as a front-runner in university technology transfer in Canada, and by the International Association of University Presidents (IAUP).

ICUR was held in February 2002 in Edmonton, Alberta and had 32 speakers, 21 from Canada and 11 from other countries **(see Exhibit 1)**. The conference presentations fell into four subject theme areas. These are government and university policies and practice, industry liaison and technology transfer offices, spin-off company creation and development and industry interfaces and networks. This report provides a perspective on aspects of university commercialization that surfaced at the conference and a perspective on university commercialization of research in Canada circa 2002. Attention is accorded to the benefits that organizations see as accruing to them and to their respective countries from university research commercialization. The report is seen as a wrap-around summary to introduce the presentations, drawing on the conference itself and related sources of information in order to embellish certain issues. A further qualification is noted. ICUR is largely about universities. In matters of institutional involvement in the economy and research, there is a role for colleges, hospitals and related institutions. References to non-university institutions were made at ICUR and some reports cut across all institutions in some way. The primary focus of ICUR was the universities and university research and ties to colleges and hospitals through affiliation or common reported activities.

B. Canada's Universities, Innovation Strategy and Commercialization of University Research

Canada's universities are important to the country. There are more universities than ever, now numbering 93. Many are large with full-time student enrollment the size of small cities, extensive part-time enrollment and research budgets in multiple millions of dollars. Others are relatively small. Today's universities are more dynamic institutions than in previous periods, much closer to their various constituencies and the regions in which they are located. Universities and their communities including industry often move in real time on issues and opportunities. Research commercialization relates to advancing the university research forward in terms of its possibilities in product and process development in industry and the economy. Attention is in goods with links to research conducted in universities and that are as diverse as pharmaceuticals, biotechnology, medical devices, electronics, photonics, new plant varieties, animal science, industrial chemicals, and telecommunications by way of example.

Innovation in the economy is equally important in Canada. The country has set a bold target for itself in its innovation strategy. The federal government has determined as a target that Canada should move from 15th to be among the top 5 countries in research and development expenditures as a percentage of GDP by 2010. This represents one goal in advancing innovation and technology, seen increasingly as a structural pillar of the Canadian economy. University research on a relative basis represents 21% of Canada's total research effort and plays a big role in the innovation strategy. The Association of Universities and Colleges of Canada (AUCC) has said that with government and private sector support, the universities of Canada could triple their commercialization of university research by the year 2010. The future is now for people involved in the commercialization of university research. Robert Lacroix, Rector, Université de Montréal, and Chair of AUCC, gave a presentation at ICUR regarding four important preconditions that will allow this target to be met and a four-part strategy that AUCC is recommending.

According to AUCC, here are four preconditions that Canada must attain in setting the stage for enhancing university research and increasing commercialization of university research:

- Attract and retain world-class researchers and graduate students
- Ensure that universities can support healthy research environments
- Recognize the importance of academic freedom
- Build upon the diversity of approaches to commercialization

A four-part strategy for university commercialization is recommended by AUCC:

- Ensure the compulsory disclosure of federally sponsored innovations
- Give a right of first refusal to universities' commercialization services
- Favor more accountability to document the benefits of commercialization
- Adopt a 'Canada first' attitude wherever feasible

There is a question of measurement that is presented in following this goal. Here are selected commercialization statistics from Statistics Canada presented by AUCC for Canadian universities for 1999:

- $22,665,000 in intellectual property revenues
- 829 reported and 509 protected inventions
- 616 new patent applications, 325 new patent awards (for a total of 1826 patents still held)
- 218 new license awards (for a total of 1109 still held)
- 454 active spin-off companies in existence

The year 1999 is indicated as the base year for the measurement of the trebling of university research commercialization by the target year of 2010. The measurement is in terms of these university technology transfer data compiled by Statistics Canada for university commercialization.

These data are significant measures for each university to use and for the regions and country as a whole to monitor. Actual objectives can vary in terms of these measures and associated target situations. In opening the conference, Dr. Rod Fraser of the University of Alberta departed from these measures to address another aspect of economic growth. Fraser reiterated the commitment of the University of Alberta to commercialization of research. As part of a discussion about goals in commercialization, he pointed to the prospect or desirability of the formation of a super successful company connected to the intellectual property base of the university and having a continuous two-way flow of activity between the company and the university. This is a popular objective in a country that has few technology companies that attain super size status. It raises the question of setting imaginative objectives and working to meet them. Nortel Networks is a super size company. Many universities have ongoing relationships with Nortel. Fraser seems to be asking if we can focus on more companies like Nortel in Canada's midst. It is a good goal.

One phrase that captures attention in discussions of research commercialization is the term **"benefits to Canada".** The issue for funders and particularly government granting agencies is that a link be formed between dollars spent on research and its benefits to Canadians, the taxpayers and citizens. For universities as recipients of research dollars, the issue is accounting for the funding support in terms of the benefits of the research including benefits to Canada. Clearly commercialization of research involving Canadian industry and Canadians can be a leading candidate for realizing benefits to Canada. David Strangway, President of the Canada Foundation for Innovation, conducted a survey of institutions in the country on their approaches to benefits to Canada in the context of their research planning. The report is a unique document with a summary section and contributions from 84 institutions (largely universities, hospitals and university colleges). It clearly shows for perhaps the first time in anecdotes and in summary form at least two major developments in university commercialization:

1. A great deal is happening in university commercialization of research across all institutions in the country. As Strangway observes, the organizations have moved beyond seeing research in terms of funding levels, publications and patents. Universities are now seeing research in terms of economic contributions and value-added activities set in new

products and processes, licenses with royalties and spin-off company creation. The stories are about university researchers and their interaction with economic situations and problem solving.

2. The differences among institutions stand out as much as do the similarities. These are regional situations that are connected to university strengths, goals, processes and local drivers. There are glowing reports from universities that vary on policies and approaches to commercialization. Reports of positive work emanate from large cities and some from mid-size cities. Contributions are made both by universities set in existing regional economic clusters and by universities set essentially in stand-alone situations. In all cases, the university commitment is to work with what exists, to build things up and to bring benefit to Canada.

Strangway describes the overall picture from the survey as **"one of encouragement".** It certainly is valuable to have a running start with field experience when there is a goal to treble commercialization efforts in a decade.

C. Ownership of University Intellectual Property

One of the subjects that draws close attention is ownership of university intellectual property. There are two positions that are highlighted within the discussion: either the university owns the intellectual property or the individual researcher owns his or her intellectual property. This is complicated by some situations of joint ownership and other instances where either the university or the institution can own contingent on a due process of ownership working its way through a system of selection and determination. Ownership came up often at ICUR in various ways. It is an important subject.

The Canadian discussion is affected by preferences and goal setting in Canada. It is also affected by the American system where ownership of federally funded research rests with the universities. The history in the USA is pertinent. Americans harboured developments around university research commercialization going back many decades. Outstanding examples include the Stanford Research Park that was formed in the early 1950's, Research Triangle Park that was formed in the 1960's around three universities in North Carolina and the growth over time of Route 128 in Boston with indirect ties to the many universities in the greater Boston region. While these efforts were important, there was a problem in the system overall. Through to the late 1970s in the US, ownership of intellectual property lay with the federal government whenever federal funds were involved. This ownership position was not working well. Much of the intellectual property lay dormant. The US Senate led by Senators Bayh and Dole argued that the value in this property could be unleashed by allowing universities to retain the rights on their intellectual property rather that assigning it to the federal funders. The resulting Bayh-Dole Act in 1980 accelerated commercialization of university research (see OCRI).

The success of Bayh-Dole has resulted in many Canadians asking why universities do not take ownership of intellectual property in Canada. It is an open question. The Report of the Expert Panel on the Commercialization of University Research (1999) argued for a national policy of **"institution owns".** The Panel advanced a hypothesis to the Prime Minister's Advisory Council on Science and Technology (ACST) that reflected their beliefs on **"institution owns"** as a policy:

> Does empirical evidence confirm the propositions put forth in this report (e.g. that universities generate higher returns on investment with lower litigation costs when they own IP or require that IP be assigned to them, require full disclosure, and provide above average resources to their commercialization offices)?" (Statistics Canada p A5)

At ICUR, Bruce Clayman from Simon Fraser Univeristy observed that his data indicate ownership is not the key issue in financial success. There appear to be three variables that are emerging in the discussion of ownership of intellectual property (IP) and its commercialization at universities. These three variables are the following: who owns the IP, who shares in its revenues and who commercializes the IP. On the first two variables, Clayman points out that three categories of universities seem to be common:

- The institution owns the IP and shares revenues with the inventor
- The inventor owns the IP, is required to disclose it to the institution and may or may not be required to share revenues with the institution
- The inventor owns the IP with no obligation to share revenues, but works with the university industry liaison office or office of technology transfer on a negotiated basis

Clayman's interpretation of the Canadian situation is this: that commercialization success is not necessarily affected by who owns the intellectual property but it is affected by the level of commitment from the universities themselves to commercialization. Clayman further argues that the relationship between research and commercialization is direct and linear; that is, the more research there is, the more commercialization there is and the two move in tandem.

The movement in Canada to **"institution owns"** or a Canadian Bayh Dole has been tempered. There are at least two reasons why this has happened. The first reason is that Canada does not have the same problem that the US had in the late 1970s. The federal government granting agencies in Canada do not take ownership of intellectual property. Rather these agencies have always recognized policies of universities as prevailing in matters of ownership of intellectual property and technology transfer. Universities have responded with a commitment to doing more with their research and developed technology transfer programs in lock step with the US. Second, the Canadian system seems to be working well where universities determine their policies and apply them. The AUCC paper at ICUR makes the following point from those in government who felt an **"institution owns"** policy was best:

> " ... the federal government appears to have understood that a 'one-size-fits-all' approach that would seek to redress historical differences in the ownership of IP on campus is unnecessary, and ultimately counterproductive"

David Stewart-Patterson from the Canadian Council of Chief Executives provided the ICUR delegates with a summary statement on this matter of ownership. Stewart-Patterson argued that conditions around a 'Bayh Dole' are different in Canada, the federal government does not own the intellectual property, there is a great deal going on by universities with existing policies and this has to be understood. He further argued that the role of private sector capacity is an equally compelling subject to study. If Canada does not have the companies to accept the university research, this is a huge problem.

In this framework, AUCC is advancing a first rights recommendation. The university in this format is given first rights to commercialize a technology. This raises the matter of the third variable in ownership of IP, specifically who commercializes the IP. This position in AUCC is designed at least in part to strengthen the university commercialization programs.

D. Needs in Industry for Research and Canada's Receptor Capacity

For commercialization to occur, there must be industry uptake on research. In a simple case, there are two players: the research university and an industry partner. Universities represent their technologies in the market. This market place includes companies interested in working with universities and new firms spun-off by the universities to perform in the market place. The actual market has a plethora of additional operations and organizations involved including service firms that assist in making the process work. This includes consultants, licensing professionals, lawyers, financial offices, and research performers outside of the university. Dr. Tom Brzustowski, President of the Natural Sciences and Engineering Research Council has developed the reality of the Canadian research configuration in full expanse. This model was presented at ICUR. Salient observations on research in Canada include the following:

1. Canada according to Brzustowski is largely missing two key structural components in its research network: the first is corporate research laboratories where there are too few - in the US, 70% of researchers (750,000) work in 15,000 corporate labs (ref: Robert Buderi, Engines of Tomorrow); and the second is not-for-profit organizations that connect research with the market, e.g. organizations like Fraunhofer in Germany, Batelle in the US, and ITRI in Taiwan, where in Canada this is done by government laboratories and on too restricted a scale.

2. The Canadian dynamics have to change and be expanded in a way that more can be done with Canadian research. Aspects of the system that bear scrutiny include the Canadian contribution to world technology (4% could be higher?); most investment is foreign; brain drain and brain gain are both active and balancing (what does it take to have the benefit in Canada's favour?); economy is driven by commodities (where Canada is a price taker); in technology where research is important and prices can be set, Canada remains a net importer (how does the country become a major exporter of technology?).

3. There is an economic structure of virtuous circles and cycles that bears wider appreciation. The flow is essentially the following: grants support research in universities that yield knowledge and inventions, which are commercialized in existing and new firms that innovate and contribute new and improved goods and services within the economy

that yield taxes which provide the basis for the grants which start the cycle through again. This rudimentary model can be made complex and quite telling of strengths that make the system work well and weaknesses that cause breakdowns in making this work as it should. Clearly the cycle and its operations are tied to corporate research, middle organizations and economic change supporting research and technology.

Brian McCready of the Canadian Manufacturers and Exporters (CME) attended the meeting and made an important presentation to the assembly. McCready emphasized how manufacturers understand the importance of innovation and the university role in innovation. He commented on innovation and industry-university ties in several key ways. Here are selected comments.

"But Canadian companies seeking to innovate keep hitting brick walls. One is the disconnect that exists between university research and industry's needs. Another is the lack of an effective system to commercialize the results of knowledge created through university research…"

"Because industrial innovation depends on aligning the flow of knowledge—knowledge supply chains—behind the objective of enhancing customer value. Industry and universities are the key links in those chains…"

"The successful commercialization of knowledge depends on the quality and relevance of research to the technical problems facing industry, as well as on the ability of business to draw on new knowledge and expertise from academic and government research institutions in Canada and around the world…"

"This knowledge transfer must involve a two-way exchange—universities must be able to understand industry's needs and requirements, and vice versa. Those needs are not static, but can change over time, so ongoing, open communication is essential…"

"Universities must strengthen their partnerships with industry, develop more transparent protocols for the treatment of intellectual property issues, and support more research programs with practical application to the technical and business problems currently facing industry."

McCready pointed to at least two areas where Canada must improve to compete internationally at the industry-university interface: the first is in "first time" product development and the second is in the support given to small and medium sized enterprise. There is clearly a genuine effort from Canadian manufacturers and exporters to work with universities and to drive the innovation agenda through this cooperation. The example given by McCready is in manufacturing and materials work in Alberta.

One of the primary methods of transferring technology to industry is through spin-off companies or startups. The conference heard from a number of speakers who addressed the absence in Canada of a ready receptor in industry for much of the university-based research with commercial potential (Brzustowski, Robertson, Drouin). This may offer one reason why Canada has demonstrated a greater proclivity to form spin-off companies with technology as distinct from licensing the technology to industry (Clayman). Delegates learned details of the

InnoCentre model out of Montreal and now operating in Alberta (Miller, InnoCentre). Inno-Centre is a not-for-profit company that has formed a sophisticated incubation model for technology enterprise. The goal is to address the company creation gap in scaling up outstanding research through new company development. The spin-off enterprise is indeed central to the Canadian way of performing technology transfer.

E. The Evolution of the University in Commercialization of Research and in Innovation

The President of the International Association of University Presidents Dr. Sven Caspersen from Denmark was active throughout the conference and provided a perspective on the university and commercialization of university research. The framework involves knowledge transfer, something bigger and more encompassing than technology transfer itself. It involves north-south movements of knowledge, emerging partnerships throughout the world and new forms of networks. There is a role for research parks and science parks, changes in attitudes in communities for what the university is all about, and entrepreneurial growth in this new space. There is the concomitant need to provide the right tools to entrepreneurs and to acknowledge the new leaders in the new university supporting commercialization as these key persons do.

This is not simple. Delegates heard from Dr. Jose Sarukhan, past President of UNAM in Mexico and newly retired member of President Fox's cabinet in Mexico. This country has the 10^{th} largest economy in the world and has a record of excellent work in technology development through its Centre for Technological Innovation (CTI) at UNAM. Yet the country can make no headway in the research and technology sector. Essentially the country competes internationally on low wages and basic manufacturing capability. In Sarukhan's view, Mexican industry is protected and because of this protection, has no need to innovate. Most research is in government. Mexico is searching for ways to nurture its research and technology sector and develop an indigenous technology industry. The CTI efforts need reinforcement.

Delegates at the meeting from the university sector in many countries are indicating considerable success at expanding the technology base in universities and closing relationships with industry. ICUR's eleven speakers from outside of Canada made important contributions to an understanding of success in commercialization of university-based research. Several of the pertinent lessons are summarized on **exhibit 2**. Australia, for example, reported a commitment to technology and early success. The process was started with an Innovation Summit Implementation Group and a "Chance to Change" strategy. The focus was placed on research, commercialization of research and skills for Australia. Colin Melvin from Queensland University provided data on early success in pharmaceuticals and plant sciences. It was interesting that Mark Norris, the Minister of Economic Development for the Province of Alberta, spoke of a new program "Get Ready Alberta" focused on innovation and change. Some discussion centered on the notion of the three goals of a university "education, research and community service" being extended to include "innovation" as a fourth goal.

Minister Victor Doerksen also from the Government of Alberta spoke to delegates about the political acceptance of the commercialization of university research. While the benefits of this work may be evident to everyone involved in this effort at the universities, these same benefits may not be evident to many people in the community in which the universities are set. The story has to get out and be understood. This involves reducing key subjects to meaningful everyday language. Messages must be conveyed successfully in 15-second sound bites. This is reality. John McDougall of the Alberta Research Council reminded delegates that research in and of itself is a wealth consumer. Research costs money. It must gain credibility for its resource uptake to be maintained. This credibility is formed through the inherent value of research and its economic gain. The challenge is to establish this value and realize economic gain. Historically societies have not been good enough at commercialization of university research. Expectations are simply high and rising for more to happen.

Chris Tan from Singapore presented an algorithm for forming a Biomedical Sciences Hub in Singapore. The components of the algorithm are five in number:

(1) infrastructure + (2) intellectual property + (3) human capital + (4) industrial capital + (5) ethical framework = successful focus and programs to deliver on the focus

One of the areas to change in Singapore was the mind-set of young people in terms of choosing science as a career path. The marketing program that was formed to deliver this message was novel, attractive and successful. The story stood in ready contrast to a similar problem in Mexico with young people either choosing not to stay in school or staying in school but not going into science. In the Mexican discussion, there were no accompanying reports on a marketing solution to attract young people to science.

With more attention turning to commercialization, there is a need for better information and monitors. Delegates had insight into two major sources of information on technology transfer. The Statistics Canada survey was presented by AUCC. Prominent measures are shown on **exhibit 3, measures 2 to 11**. The second source is AUTM, the Association of University Technology Managers that has had an annual survey of technology transfer in the field for some ten years. Janet Scholz from the University of Manitoba reported on the survey to delegates at the conference as President-Elect of AUTM (Canada's first President of AUTM, a largely US organization). The data show interesting features of technology transfer, and can be seen as a form of the "virtuous circle " (cf. Brzustowski), going beyond the Stat Can measures.

- Total research reported for North America is US $29.5 billion in universities and hospitals
  in year 2000.
- There were 13, 032 invention disclosures or 1 per US$2.2 million. This figure is compared often between jurisdictions. It is one benchmark to use in answering the question "How many disclosures should we have at our university?" You can expect one for each 2.2 million US dollars research (and make allowance for the Canadian dollar and uniqueness of the university).
- There were 9,925 patent applications (6,375 were applications for US patent). There is 1 patent application per US$ 2.9 million. Not all disclosures are filed as patent applications.
- There were 4,362 new licenses and options, 347 new products and 454 new startup companies in 2000.

Dr. Bruce Clayman from Simon Fraser University reported on his study of how the Canadian universities compared to US universities in commercialization. Clayman normalized the data to account for differences in administrative practice on overhead between countries. His data indicate that Canada ranks quite well in comparison to the US. In spin-off company creation, Canadian universities are outpacing their US counterparts by quite a margin. This may well dispel conventional wisdom, which has Canada lagging the US on most measures of research and commercialization. When indirect cost differences are taken into account, the message is that Canada comes out well ahead in spin-off company formation but Canada is behind the US in licensing income. These two results can be explained at least in part by the absence of receptor capability for technology in Canada's private sector. Universities in Canada have adopted the practice of creating spin-off companies to act as receptors of technology. At least in the short term, there is little licensing revenue in the form of royalties from spin-off companies. This is so since product sales are low in early years. It is also true in many cases that university considerations in spin-off companies are taken out in the form of equity i.e. often the university takes equity in lieu of royalty arrangements, or has some combination of royalties and equity. Thus, royalty income on product sales is low in these cases where equity is involved.

F. The Office of Technology Transfer at a University

The responsibilities to conduct the technology transfer function falls on the Office of Technology Transfer, the University Industry Liaison Office or a sister university department that accepts these functions. What does an Office of Technology Transfer actually do? If you are President of a university, what type of office do you support in either forming or modifying an effort to commercialize research? These are good questions. Delegates to ICUR gained some information to help answer them **(see exhibit 4).**

1. Recommend and administer technology transfer policies.

The policies in technology transfer include subject matter related to the following areas: ownership of intellectual property, patents and copyright, licenses, revenue sharing, conflict of interest and confluence of commitment, contract research overhead, use of equipment,

student research involvement, publication of research results, disclosure and non-disclosure agreements, and university-industry relations. This list is representative only. Many universities view the issues and options differently in these subjects. The history at various universities is different.

2. **Separate company or university division.**

One distinction that came out at the conference was that universities had at least two models in forming an office of technology transfer. One model has a company incorporated by the university to handle technology transfer. A good example at the conference was Yissum, which is a wholly owned subsidiary of the Hebrew University of Jerusalem in Israel. In Canada UTI at the University of Calgary is separately incorporated in technology transfer. These companies accept invention disclosures, apply due diligence to the disclosure, and work to license the technology if it is accepted for commercialization. The company on behalf of the university frequently holds equity in spin-offs. Part of the royalties on licenses flows to the company. The second model is found when the university forms an office division in the university to handle technology transfer. Often this is an integral part of the Office of the Vice President Research or Dean of Graduate Studies and Research. This is the model at the University of Alberta.

3. **Focus on a Select Few Cases or on Volume.**

The mandate of the office is clearly in commercialization. However, there are a number of factors that have a major impact on the way the office operates and the way it is perceived within the university. One of these factors is in strategy. Some offices carefully select a few cases to work and essentially spend time on these cases. Other offices accept almost all cases coming into the office and accept the volume as part of the job. Robert Miller from Santa Cruz spoke at the conference of these two models in terms of "trying for the big winner" and "pushing through-put". Neither strategy is necessarily correct. Gerald Barnett from the University of Washington pointed out that volume affects policies. Barnett feels that the optimum case volume on one technology transfer officer is ten cases. Most officers are asked to handle thirty cases, seamlessly. High volume puts more pressure on each case. Resources are connected to results, rights and relationships.

4. **Tie to research parks and new business incubators.**

Canada now has at least fourteen research or science parks and incubators supporting technology transfer in related universities according to the AUCC paper. This figure is understating both the number of research parks where there are also several municipal projects for example and the incubators where there are over fifty projects of incubation evident in Canada, many independent of research parks. Delegates learned that Denmark has a science park at each university (Sinkjaer). Different regions, countries and universities have varying approaches to research parks or science parks and incubators. Bruce Clayman attributes the Discovery Parks system in British Columbia as one reason why both UBC and SFU are doing comparatively better than most universities in Canada in technology transfer. There certainly is growing attention to research parks or science parks and incubators nationally in Canada and internationally.

5. **Industrial Research.**

Universities vary on the relative amount of industrial research that is conducted on campus. Delegates heard David Litster of MIT explain how that university transformed a declining research base set around dwindling defense technology research dollars into an industrial contract research base, with individual corporate agreements at $20 million each and several agreements in place. The university believed that they would have to surrender patent rights to attract industry. This proved not the case. A commitment to a sound partnership arrangement and good license was satisfactory. Significantly MIT regards patents as a byproduct of research. At MIT, 60% of new patents are licensed within one year. The institution experienced a huge cash winner through sale of its equity in Akamai Technologies, a company that had the base technology for the Internet. These are impressive situations.

6. **Idea Flow.**

Universities are predominantly active in early stage research. There is considerable weight on new ideas and breakthrough technology. Somehow the university and its office of technology transfer must have a system of receiving ideas and screening them. Often this is captured in the disclosure procedures of the institution. Delegates at the conference learned about a Danish system of preseed idea screening. The system is an integral part of the science park and picking investments. There are three steps in preseed analysis and activity: the idea stage, the pre-examination stage and pre-project stage. In the idea stage, innovation consultants look at all ideas. A full two-thirds are screened out. The remaining one-third have a careful analysis in pre-examination stage involving patents, specialists and aspects of due diligence. Less than one third of these go on to the pre-project stage. These going on have involvement with angel funders, mentors, a steering board and project manager.

7. **Strategy and Patience.**

David Litster from MIT emphasizes that the university should not be greedy with its patents and also should be patient in its expectations of results from commercialization. John McDougall of the Alberta Research Council is not sure on this score. McDougall puts stock in strategy that makes the system work. He buys into the Brzustowski comment on the value of a Batelle type organization in Canada. McDougall argues that we are challenged and must work hard as a team to achieve our objectives.

8. **Professional Portfolio Management.**

Offices of technology transfer vary on their approach to portfolio management involving the cases being worked by the office and the professors involved in different ways with technology transfer. The conference had a look at a well-maintained portfolio in the presentation of Angus Livingstone of the University of British Columbia. This approach is finely tuned professional management. The areas of attention and record in technology transfer include invention disclosures, faculty research ties and areas of expertise, contracts, patents, licenses, spin-off company activity including equity management and related information. Some attention can also be given to activity in centres of excellence.

9. **Networking.**

Andre Oosterlinck from Belgium emphasized the importance of networking in technology transfer. In particular, Oosterlinck spoke about the necessity of strong internal networking within the university precinct. This cuts across various faculties and professors. Universities vary on how much ferreting activity is done with faculty on new technologies and how much training and debriefing work is undertaken in fields like patenting, recognizing a new technology worthy of disclosure, describing an invention, contract research procedures and their like. Oosterlinck also asked technology transfer professionals to visit their individual university presidents, gauge support levels for the technology transfer function and relate support to resources. This too varies among universities. Livingstone cited the New York consultant Henry Etzkowitz who distinguishes between thin and thick support networks for universities in their regions and communities and what becomes possible in thick networks.

10. **Financing.**

The original research from the Canada Foundation for Innovation provided delegates with valuable information on the financing of the Office of Technology Transfer. The path is similar. The offices lose money in their formative years and then "turn the corner" and become profit centers for the supporting university. This length of time is not clear from the outset. One report was 10 years. The financial gains once the corner is turned, however, can be substantial. Working capital and early seed funding is often provided by provincial governments, regional arms and the research granting agencies of the federal government, municipalities and the universities themselves. Business plans for specific operations can gain from experiences of other universities.

G. Regional Clusters and the Future

Canada's National Research Council is active in generating considerable drive behind their science in various regions of Canada. Their efforts are also geared to reinforce the work of universities in regions of Canada. Through the NRC, a number of IRAP grants are awarded to technology companies to move research closer to product. 42% (note: this program is outstanding) of companies from universities have IRAP (Industrial Research Assistance Program) assistance within 5 years of the time the universities create them. All regions of Canada have a university or college presence and many have an NRC presence. When industry too gets involved with government and university and service sectors like finance and legal also join, a cluster can form.

This can be in specific scientific disciplines or in more traditional resource sectors with technology connections. David Strangway argues that regional economic clustering is an excellent way for communities to move forward and points out that research universities invariably are central to regional economic clusters. In essence universities relate to the international world of science and ideas and to the regional economy in commercialization and political buy-in for legitimacy. Oryssia Lennie from Western Diversification supported growth of regional clusters involving universities and industry. Lennie sees this development as central to the new economy and a ready contrast in the resource-based economy.

Governments can play a big role in helping universities in technology transfer and in so doing, can help the economy as a whole. Universities publish. When the Quebec government closely studied their provincial universities, they found that the professors in Quebec published as well as professors anywhere. What they also found is that the commercialization activity was behind that done in other jurisdictions. The Quebec government asked what was needed for the universities to make a stronger economic contribution with their excellent university research base. The answer was a major funding program to commercialize research with the universities. The result is an impressive valorization program designed to reinforce existing technology transfer systems and kick start major projects in fields of outstanding science. Perhaps a super size company as brought forward by Alberta's Fraser might come out of the valorization program. The scale of thinking is similar.

For the future, delegates at this conference seemed to agree that the commercialization of university research rests in the first instance with the universities. Hin Yuen from Singapore pointed out how the various presentations at the ICUR reflected the fact that the universities shared many of the same problems, many of the same sorrows, and many of the same happy moments. In Canada, the support mechanisms are falling into place to allow the universities to rise to the challenge of doing more. David Strangway pointed to four areas in this respect:

- tools to do the research — e.g. Canada Foundation for Innovation
- faculty — e.g. Canada Chairs program
- ability to meet costs — e.g. Indirect cost proposals
- direct research costs — e.g. Granting councils

Both David Strangway and David Stewart-Patterson see the commercialization of research as a direct economic issue and as a societal issue. Canada's economic base is changing. The communities in which people live are changing with these economic shifts and with new regional clusters forming in many instances around major institutions like the universities and government groups like the NRC. Issues that affect this agenda seem to be reaching a decision point. People and organizations are anxious and want action to move forward.

H. Five Points in Focus for Canada

Commercialization of university-based research is a complex subject. ICUR brought out much of the complexity and contributed in its own way to a better understanding of current conditions. ICUR also brought out the opportunity and commitment in the field. It is evident that the country has a number of success stories in various fields of attention that bear on commercialization of university research. Some of these situations are provided as **exhibit 5**. For Canada, there are matters that are perhaps unique to this country that bear close attention. It is a good time for the difficult questions to be addressed. The debate on Innovation Strategy provides an excellent platform for the discussion and for answers to be derived. This concluding section sets out five points in focus in Canada.

1. Stretch Goals and a Tripling of Commercialization by 2010

AUCC has said in various meetings including ICUR that with government and private sector support, the universities of Canada could triple its commercialization of university-based research by the year 2010. The Innovation Strategy refers to this objective in the context of 'stretch goals'. Bruce Clayman told ICUR delegates that research volume is one factor driving commercialization. Since a tripling of research support in the next decade seems unlikely, the tripling of commercialization is going to have to come in part from efficient and effective university-based commercial activity. On this point, delegates heard from David Strangway regarding the university survey that revealed most universities are doing something now. Further indications of this are in the Statistics Canada data. Of Canada's 93 universities, 84 participated in the Statistics Canada survey and 52 reported managing IP. There appears to be an active community at this juncture.

The main challenge is in the universities themselves, in their researchers and research programs and in the ability of their systems to transfer ideas and early stage research into industry for application in products that are sold and yield revenues to the universities through royalties and equity participation. Many examples were provided at ICUR on how this is working and working well (Clayman, Robertson, Livingstone, Volker). Many suggestions for improvement were offered (McCready, McDougall, Brzustowski, Litster). It is a time of expansion, refinement, new goals and change.

2. Universities and Economic Development

Much of the interest is captured in the relationship of the university to the economy. This interest is evident for the country and for its regions. Western Diversification, the Province of Alberta and the City of Edmonton made this clear at ICUR. Different universities seem to take different perspectives on the relationship that they bear to the economy. One aspect of this relationship is the commercialization of research. Different universities go about commercialization in different ways. The differences become evident in specific aspects of commercialization like the size of the Office of Technology Transfer, monies available for patenting, obligations to intellectual property, time for industry liaison activities, work with incubation and research parks and their like.

The Innovation Strategy paper for Canada raises the issue of universities and public accountability. "The universities need to be held more accountable for reporting on the benefits that accrue to Canadians from the very substantial annual public investment in research." The feeling is that more can be done in an economic context with the university-based research in the country.

Who pays for this new activity, its refinement and expansion? How is it best undertaken? Currently the resources for commercialization of university-based research are made available by NSERC, NRC-IRAP through support to spin-offs, and the universities themselves joined by some provincial/municipal/federal help. Internally generated funds from technology transfer are increasingly important. With the benefit of twenty years of work at some universities now established, it appears that well run programs rely on external and university support in early years and then become net revenue generators. There are universities where technology transfer represents a significant revenue generator to the university. For many

universities and even for the expanding universities, the feeling at ICUR was that more resources are needed in this field. To make a difficult situation more dramatic, there is a problem with shortages of skilled people in technology transfer. Further, many universities seem reluctant to allocate funding to this field because it is interpreted as being outside of their mandates in education, research and community service. ICUR represented several important positions on this subject. IAUP through Sven Caspersen highlighted the new entrepreneurial universities with new leadership emerging around the globe. Innovation and enterprise are evident in mission statements of universities (Australia, Singapore). Clearly it is difficult to impose technology transfer into settings where the institutions do not wish marked involvement. Even if it is put in place, it probably would not happen without a culture change. Culture is important (Yuen). For all universities, the innovation debate is requiring that positions be taken. Discussion and fact-finding are important. Universities that want to know more about commercialization of research can look to ICUR for excellent papers and can find in Canada an emerging group of success stories in technology transfer **(exhibit 5).** To be close to how the commercialization systems are working, it is valuable to find the examples that are successful, focus on the factors of success and learn from the masters who are responsible for success. There are other possibilities to in-house programs, especially for small universities. For example, evidence of important university cross-overs surfaced in the CFI paper at ICUR. PARTEQ at Queen's is doing work with Saint Mary's in Nova Scotia and UTI at the University of Calgary is representing the University of Lethbridge in technology transfer. This option of universities working together has implications for the policies within individual universities. It may be a good way for many more to operate.

An associated issue is the value of information systems in commercialization of university-based research. For the virtuous circle to operate, there is a need for good information at all junctures of the circle (Strangway, Brzustowski). This requires people who relate to users' requirements for information, can work with the market conditions around information and are then able to compile and circulate the information. Here are three examples. It was evident at ICUR that the information system is working well for granting agencies and their relationship with university researchers. Second, the AUTM information and Statistics Canada survey are important sources of solid summary information in technology transfer. The point was made that one survey rather than two surveys is desirable, and that the two organizations could develop a common approach to data collection. Third, it was evident that the information linking new university-based technology with commercial operations seems to be lacking. The CME made this point in particular on behalf of Canadian industry. In the Internet age and the new economy with web sites, search engines and felt need to collaborate, how easy is it for researchers and manufacturers in similar fields to find each other and work together? The sense is that systems should be easier and better. Aspects of the national agenda must take information needs into account. There are benefits in having good information and using information well (Drouin).

3. **Ownership of Intellectual Property**

Abstracting from the ICUR presentations, there are at least three independent and related variables in the discussion of ownership of intellectual property: who owns, who shares in revenues and who commercializes the intellectual property. It is also clear that the goals of universities as a whole and of individual universities are key to success. The positioning of different organizations is affected by specific goals of the institutions themselves. Barnett put

one principle forward by arguing that ownership should reside where its objectives can be achieved. The reports in the Strangway paper indicate that different Canadian universities are taking different positions. Success is not associated with one model and results in commercialization appear to be independent of the ownership issue itself. Livingstone from UBC argues for an institution owns policy. He noted that without this policy in place, there can be many problems that come up after intellectual property is commercialized that could haunt all the parties involved. The University of Waterloo argues for the inventor owns. Quebec seems to be leaning to joint ownership. How is the issue of ownership of intellectual property playing out?

The Innovation Strategy paper for Canada calls for "clear intellectual property policies" in universities. It seems appropriate to lay boundaries around the structure of an intellectual property policy and to define options and seek clarity among institutions. The attention is directed in particular to sponsored research where federal granting funds are involved and where universities make a commitment in accepting research funding to demonstrate benefit of the research to Canada. This is a large part of the total research effort.

At ICUR there was a feeling that ownership matters in the commercialization of university-based research. It was recognized that specific models of ownership are not good predictors of commercialization success. Delegates learned that levels of commercialization are affected largely by the research volume itself and university commitment to commercialization. It also is affected by the way the community reinforces the work of the university in this area. Ownership matters in the way the university views its work in terms of intellectual property and the role of the university researcher in the institution. On the issue of commercialization of research and 'first rights' to the university commercial program, this is recommended by AUCC. The option is seen as valuable for reinforcing university offices where they exist. If this 'first rights' recommendation is accepted, individual universities may be given the ability to opt out of the arrangement. This then essentially retains the existing system where universities determine their own policies on ownership.

4. **Canadian dialogue.**

In a global economic context, Canada represents a small economy and small population. Canada's universities are impressive. A number are world class, and in research in the country, universities are a prominent force right across the country. The universities draw historically from Great Britain, France and the USA. In commercialization of research, the closest ties are with the USA, and these are strong ties. As a generalization, it seems fair to argue that Canadian technology transfer officers seek their association with peers through membership in large part through American organizations including Canadian chapters of American organizations. They are reflected in the associations that prevail in each aspect of commercialization. Here is a list:

Canadian Association of University Research Administrators (CAURA, Canadian)
US Society of Research Administrators (SRA and SRA Canada)
US Association of University Technology Managers (AUTM & AUTM Canada)
US Licensing Executives Society (LES, American and world-wide)
US National Business Incubation Association (NBIA, American)
Canadian Business Incubation Association (CABI, Canadian)
US Association of University Research Parks (AURP, American and world-wide)
International Association of Science Parks (IASP, European with world regions)
Canadian University Intellectual Property Group (CUIPG)
WestLink Innovation Network Ltd. (Canadian)

CAURA has a Canadian base and Canadian agenda. CABI in incubation is driven in recent years by government research incubators and community incubators and seems tangentially tied to the university sector. CUIPG has ten members, the large Canadian universities. WestLink was established to serve as catalyst in technology transfer in western based Canadian universities. It received seed funding from NSERC and Western Diversification. This is an important experiment in integration among technology transfer activities. The other organizations are US based associations including AUTM, SRA, LES, NBIA, and AURP and the European based IASP. There are benefits to this situation and some drawbacks that bear exploration. The US based groups recognize the involvement of Canadians in their organizations. Some Canadians have risen to the top. These include Janet Scholz in AUTM, Art Headlam in SRA and Glenn Mitchell in AURP. Some annual meetings have been held in Canada. These include NBIA in Toronto (2002), SRA in Vancouver, AURP in Montreal, and IASP in Quebec City (2002). Canadians certainly share much with the USA in particular and the association with Americans has a large educational value.

For universities in Canada, many connections are with regional and national players. When the association meetings are in the USA, the players involved at meetings are largely American. The agenda is packed with American cases, American companies and institutions and American situations. To the degree that Canada has similar cases, many US branch plants, miniature replicas of US organizations and valuable market situations, a great deal is gained from the American discussion. The Canadians in attendance often meet in a special session. Still, papers like the CME presentation at ICUR give pause to ask how good Canadians are at relating to Canadian situations.

5. Responsibility for the Canadian Agenda

At ICUR, there was a strong presence from a number of Canadian national organizations. These include the Canada Foundation for Innovation, Natural Sciences and Engineering Research Council, and the Association of Universities and Colleges of Canada. The three papers from each of these groups were excellent. There were also excellent contributions from a number of individual Canadian universities. Who should be responsible for the Canadian agenda?

The conference concluded with a sense it is Canada's 93 universities that are largely responsible for commercialization of university-based research. This may be the mood of the country. Realistically, much that has happened in such a favorable way is the result of

universities developing aggressive positions and realizing that they can benefit both the university and the country. It is clear that national leaders like David Strangway and Tom Brzustowski are also making progress through national programs and effective incentives. The national debate on innovation is changing the way things are done. The national agenda asks the question: what do the universities need to do themselves to be successful in achieving their stretch goals and how is this best addressed. Universities can and likely must do the primary commercialization work. They could well need some limited help. It might be time to ask if there should be a group or organization, existing or new, that is responsible to provide help where the universities deem common effort to be beneficial and efficient for the country. Activities would be developed in cooperation with all the players. There are various integrating mechanisms that can be explored in this type of situation. It is impossible to see the universities doing all of this work alone. It is equally difficult to see the government role set only as a support mechanism to universities. The provinces, industry associations and industrial organizations are involved. The national agenda needs subject matter and players.

A related question in the national agenda is this: how can the various players in Canada relate better to one another in commercialization of university-based research?

Perhaps what would help is the nurturing of various types of meetings, conferences, workshops, forums and platforms that address in whole or in part commercialization of university-based research. The focus in each instance is on communication, a Canada rich agenda, case analysis, problem solving, best practices and clear attention to relations involving the university, industry and government. The activity relates to all aspects of commercialization of university-based research, new business incubation and research parks or science parks activity. Attention is accorded to reaching the agendas of annual meetings of associations, societies and industrial groups that have an orientation to commercialization of university research. This activity may be encouraged by national organizations such as AUCC and CME. Concern is not only that Canadian meetings and broadly based communication occur. There is also a desire to ensure that the key target audiences be identified such as the Vice-Presidents (Research) in universities, Chief Scientists in industry and Presidents in SMEs and that the leaders come to the meetings. Many came to ICUR and this caught considerable attention.

Exhibit 1 - ICUR Presentations 2002 February 8 and 9

First Day Opening

Roderick Fraser	President Univ of Alberta
Sven Caspersen	Denmark President IAUP
Gary Kachanoski	Vice-President Univ of Alberta

Theme 1: Government and University Policies/Practice

Peter Robertson (Chair)	Assoc Vice-President Univ of Alberta
Robert Lacroix	Chair AUCC & Rector Univ de Montréal
David Litster	USA MIT
Tom Brzustowski	President NSERC
Jose Sarukhan	Mexico UNAM & Conabio

Dignitary Remarks

Hon. V. Doerksen	Alta Minister Science/ Innovation

Theme 2: Industry Liaison/ Technology Transfer Offices

Michael Volker (Chair)	Director UILO Simon Fraser Univ
Janet Scholz	Pres Elect AUTM
Bruce Clayman	Vice-President Simon Fraser Univ
Colin Melvin	Australia Queensland Univ of Technology
Peter Robertson	Assoc Vice-President Univ of Alberta
Gilbert Drouin	President Valorisation Québec
Robert Miller	USA Vice Chan Univ of California S. Cruz

Summary Comments

David Stewart-Patterson	CCEO

Dignitary Remarks

Mark Norris	Alta Minister of Economic Development
Oryssia Lennie	Deputy Minister WED

Second Day Opening

Arthur Carty	President NRC

Theme 3: Spin-Off Company Creation/ Development

Linda Humphreys (Chair)	Vice-President AHFMR
Thomas Sinkjaer	Denmark Director Aalborg Univ
Gerald Barnett	Director Univ of Washington
Susan Miller	President Inno-Centre Alberta
YH (Chris) Tan	Singapore Advisor Science Agency
Angus Livingstone	Director UILO Univ of British Columbia

Theme 4: Industry Interfaces & Networks

Allan Scott (Chair)	President Edmonton Economic Development
Brian McCready	Vice-President Alberta CME
Moshe Vigdor	Israel Vice-President Hebrew Univ of Jerusalem
John McDougall	CEO Alberta Research Council
Yeong Hin Yuen	Singapore Director TTO Nanyang Technological Univ
Andre Oosterlinck	Belgium Rector Katholieke Univ Leuven
David Strangway	President CFI

Closing Remarks

Exhibit 2 Lessons in International Situations of Success

1. International Association of University Presidents (IAUP) Dr Sven Caspersen	IAUP recognizes value of technology transfer and the larger function of knowledge transfer/ new leaders in new universities supporting commercialization
2. Massachusetts Institute of Technology (MIT) USA Dr. David Litster	Policies embrace principles of research/ the goal is new knowledge, patents are a by-product/ licenses make results available, revenue is secondary
3. Conabio José Sarukhán Universidad Nacional Autónoma de México (UNAM)	Centre of Technological Innovation created vehicles for commercialization & understanding of innovation/ need is for action technology agendas across sectors
4. Queensland University of Technology Australia Colin Melvin	"Chance to Change" summit/ commitment to Knowledge Commercialization Australasia agency
5. University of California-Santa Cruz USA Robert Miller	Importance of connecting the market to technology & patenting when market exists / writing good agreements between startups and the university
6. Aalborg University Denmark Dr. Thomas Sinkjaer	Creating bridges among universities, industry and government to span the 'valley of death' between university research and applications in industry
7. University of Washington USA Dr. Gerald Barnett	Finding new paradigms in intellectual property and relationship building/ facing the realities of programs and finances & the value of new ways of doing things
8. Singapore Institute of Molecular and Cell Biology Singapore Dr. Yin Hwee Tan	Forming a biomedical sciences hub in Singapore, bold business plan, international connections, taking science to the economy, marketing approaches
9. Hebrew University of Jerusalem Yissum Israel Dr. Moshe Vigdor	University goal is excellence, industry goal is immediate results, form independent organization to handle all technology transfer
10. Nanyang Technological University Singapore Dr. Hin Yuen Yeong	Impressive history in forming office of technology transfer and technopreneurship centre, holistic approaches to strategy
11. Katholieke University Leuven Belgium Dr. Andre Oosterlinck Rector	Professional management in commercialization and strong relationship building both inside the university and externally with industry

Exhibit 3 Measurement of Commercialization of University Research

1. Sponsored Research	Research volume drives commercialization directly
2. Revenues from IP management	Revenues in current year arise from current and prior research / ratio of revenues to research is often termed 'return on research'
3. Inventions Disclosed	Dollar research per disclosure is closely followed e.g. 1 disclosure for every 3 (Can) million $ research
4. Inventions protected	Stat Can measure, cumulative
5. New patent applications	May be related to US patent filings only (AUTM) or to first filings
6. Patents issued	Normal period from patent filing to award is 2 years
7. Total patents held	Patent life varies and patents can be abandoned and reassigned overtime
8. New licenses	May include number and % exclusive and number of licenses to start-up firms (AUTM) / the ratio of licenses to disclosures is followed and has wide range / the ratio of licenses to $ research is compiled
9. Total active licenses	Cumulative
10. Spin-off companies	May cover all start-ups (AUTM)
11. Research parks and incubators	Research parks & incubators are university related &/or government projects
12. New companies still operating	AUTM / WestLink follows spin-off status
13. New products	AUTM
14. Product sales	AUTM estimated on royalty income as a % of sales
15. Job creation	AUTM estimated on average sales per job
16. Tax revenue	AUTM estimated on tax rates on activity

Exhibit 4 Structure and Role of the Office of Technology Transfer

1. Recommend and administer technology transfer policies	Examples include ownership of intellectual property, patent policy, copyright policy, revenue sharing, conflict of interest, industrial contract research and overhead, publication requirements
2. Separate company or university division	Two basic models to choose between: having a university owned company or a division of the university managing technology transfer
3. Focus on a select few cases or on volume	To the degree that it is possible, there are two approaches to workload: carefully select potential winners and concentrate on them or work volume in the office as a strategy
4. Tie to research parks and incubators	Where available research parks and incubators provide reinforcement for spin-off companies and industry-university relations
5. Industrial research	Industrial contract research is a vector for university research expertise being available to industry with benefits for all parties
6. Idea flow	Offices vary on the structure of activities at steps along the continuum from idea to product and manage the processes including stages of idea flow and invention disclosure
7. Strategy and patience	Some see commercialization as an exercise in patience, not easy for many, and others emphasize strategy, structure and hard work, which are not opposites and are different
8. Professional portfolio management	The strategy and records in an office can vary, and professional management has information for keeping track of key information and for problem solving
9. Networking	There are at least two key networks, which are to be addressed: the internal university network across faculties and the external environment that can vary between regions
10. Financing	With small initial pump priming these offices can become self-financing in a reasonable period of time.

Exhibit 5 Selected Examples of Canadian Success Stories

1. University of Toronto and University of British Columbia	Levels of sponsored research, excellence in research and activity with centres of excellence
2. Université de Montréal	Commitment to commercialization of research and disclosures of new inventions among faculty
3. Parteq at Queen's University	Patent program and licenses with industry
4. McGill, Université Laval, UTI at the University of Calgary and NuTech at Dalhousie	Programs in technology transfer and innovative ways of going about commercialization of research
5. Simon Fraser University and University of Alberta	Growth in spin-off companies set up around university intellectual property and academic entrepreneurs
6. Université de Sherbrooke	Financial success in technology transfer
7. Research park incubators in Calgary and Edmonton	Technology business incubators
8. Hamilton and Halifax incubators	Stand alone new business incubators
9. Discovery Parks Inc.	Land assembly supporting university & technical institute/industry interaction in British Columbia
10. Saskatoon's Innovation Place and Guelph Research Park	Agri-business innovation with University of Saskatchewan and University of Guelph and with industry
11. C-CORE in St. Johns	Advancing niche research and its commercialization
12. Laval Technopole in Laval	Attraction of international enterprise and liaison with regional universities
13. London as an economic region	Hospitals, research park, industry like 3M and University of Western Ontario
14. Valorisation Québec	Support for new technology enterprise
15. Waterloo and University of New Brunswick	Support for technology entrepreneurship and new ventures

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