REPORT TO:

EXPERT PANEL ON THE COMMERCIALIZATION
OF UNIVERSITY RESEARCH

OF THE

PRIME MINISTER'S ADVISORY COUNCIL
ON SCIENCE AND TECHNOLOGY

"BEST NORTH AMERICAN PRACTICES IN TECHNOLOGY TRANSFER"

BY: NIELS REIMERS
TECHNOLOGY MANAGEMENT ASSOCIATES

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Background

The Expert Panel was established in September of 1998 by the Prime Minister's Advisory Council on Science and Technology with the charge of formulating a vision and an implementation strategy to guide commercialization undertaking of Canadian universities over the next five years. The Expert Panel engaged the author to survey and report on best North American practices in commercialization of university research.

The author was founder and directed Stanford University's technology commercialization program for 22 years. On loan from Stanford, he reformed and directed the technology, commercialization office of MT in 1985-86 and founded directed the University of California Berkeley's technology commercialization office in 1989-90. After taking early retirement from Stanford in 1991 to engage in consulting, he was engaged to found and direct the technology commercialization office at the University of California San Francisco on a two-year assignment that he completed in February 1998. He has consulted with numerous research institutions in North America, Europe, Asia.

The report draws upon October 1998 discussions with technology commercialization professionals at 6 Canadian universities, members of the Expert Panel, and officers of Canadian government research organizations and Industry Canada. The author in addition draws upon his knowledge and experience, past studies, and the literature.

NORTH AMERICAN BEST PRACTICES STUDY
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REPORT TO THE EXPERT PANEL ON THE COMMERCIALIZATION OF UNIVERSITY RESEARCH

"BEST NORTH AMERICAN PRACTICES IN TECHNOLOGY TRANSFER"

by Niels Reimers, Technology Management Associates

1.0 SUMMARY

The technology commercialization professionals at Canadian universities with significant research programs are at the highest level worldwide. Innovation organizational structures and methods have been employed because of the lack of industry receptors of technology, lack of experienced managers of high technology startups, and lack of experienced investors in nascent technology. Canadian university technology commercialization is also effected because of limited research funding, geography (in some cases), a huge competitor across the southern border, cultural factors, as well as governmental and university policies. Recommendations are made for Expert Panel consideration.

2.0 INTRODUCTION

2.1 The Knowledge Economy

The world has moved rapidly from the information economy to the knowledge economy. The key factors to succeed in the industrial economy of scale and capital have been superceded by the factors of technology and knowledge workers. Companies must be agile, interdependent, and international to compete successfully.

Agility by management is necessary to rapidly change directions in response to changing market and technology conditions. Given the speed at which products/services must be introduced, internationally, today's technology based startups quickly enter into alliances %worldwide for research, product development, distribution, marketing and capital. The world is becoming interlaced with alliances. The information from the infrastructure established in the information economy is available at everyones fingertips. Instant global communication has led to intense global competition.

A company can no longer introduce a technology-based product or service locally, earn capital, and then decide to market across international borders. Early international market share is critical to survival.

2.2 Knowledge Workers

Knowledge workers are tending to become more loyal to their profession or self interest than their employer or region and the extreme mobility of the knowledge worker, a technology-based company's principal asset, requires great management and government attention. The competition for such workers is fierce and companies establish incentive plans and working conditions to attract and retain knowledge workers. The competitive situation has also directed great attention to management of intellectual property, also an important asset of industrial competitiveness today.

2.3 Research Universities

In this perhaps fearsome world of rapid change, there are special opportunities that can be grasped by individuals and nations. The principal contribution of a university to society and to national competitiveness today is the graduated student and, secondarily, research results that can be commercialized. This has put research universities in a position of special importance and policies and practices of universities, governments, and industries worldwide are being directed to shortening the time from the research finding in a university laboratory to its commercialization.

2.4 Best North American Practices

Of Canadian universities that have significant research programs, their technology commercialization managers are full participants in the Association of University Technology Managers (AUTM), wherein best professional practices are shared among members of this primarily North American organization. Recently, universities in other parts of the globe are initiating technology commercialization programs and have joined AUTM to learn from expert Canadian and U.S. technology managers.

There tends to be a greater emphasis by these Canadian university technology managers than U.S. technology managers toward company startups, in view of fewer potential licensee receptors in Canada and the desire to retain technology commercialization benefits in Canada.

In terms of deals struck and outcomes realized, Canadian university technology managers compare well with U.S. universities of similar research budgets.

Hence, this report to the Expert Panel will not cover best practices in topics such as royalty setting, agreement drafting, technology marketing, and the like as Canadian university technology managers are professionals in these normal aspects of university technology commercialization.

However, there are best practices in government and internal university policies and structures that impact success in university technology commercialization and these are covered for the Expert Panel in this report. This report will also touch on cultural and other barriers for Expert Panel discussion.

2.5 Agility

Canada is in a unique position as an advanced nation, with the world's most competitive and largest economy a next door neighbor. This requires agility as a nation in terms of policies and practices to prevent both a brain drain of knowledge workers and technology to the south ... as well as to attract knowledge workers and technology to the north. Or to at least have the "balance of technology transfer" in this arena near equal. Given Canada's relatively small size, close and quick communication and cooperation among key players in government, university, and industry is possible and can provide an important competitive advantage.

2.6 Recommendation

The Expert Panel is encouraged to deliberate upon whether the assertion of 2.5 above has practical validity and, if so, how to effect such communication and cooperation.

3.0 OWNERSHIP OF INTELLECTUAL PROPERTY RIGHTS

3.1 Background

The key element of a transaction to commercialize a university technology is the intellectual property(IP) covering the technology. IP includes the intangible research property (IRP) rights of patents, copyrights, trademarks, and maskworks. IRP rights give the owner the legal right to exclude others from use of the IP involved.

IP can also be tangible research property (TRP) rights, often termed know-how (or "trade secret" rights in industry), and will include items such as software source code, a biological organism, and the like. In licensing TRP, the owner must guarantee to the licensee that no unlicenced parties will have access to the TRP.

To license IRP, the university must have an assignment from the inventor (s) if a patent,

and, in most cases, an assignment from the author (s) if a copyright or maskwork is involved. In some cases, the copyright will be deemed a "work for hire" and owned by the university and an assignment not necessary.

To license TRP, the university must have ownership or control of the TRP. If the TRP is a research result such as a biological organism, the creating scientist will typically have control, if technically not ownership. Hence, the licensing office must enter into an agreement with the creating scientist before licensing.

To be complete, we should not overlook "showhow" the access to which may either be included in a license agreement or provided via a personal consulting agreement or employment agreement. As implied, "showhow," such as hands on demonstration of technique, is the personal expertise that is not readily codifiable into knowhow.

IP technology transfer is managed by a university Technology Commercialization Office (TCO). In the context of this report a TCO may be an office internal to the university or a separate legal entity, profit or non-profit, which manages technology commercialization for a university.

3.2 University and Government Policies on Ownership of IP

At most Canadian universities, ownership of UP is with the inventor or author and a university TCO must secure their agreement via an assignment to permit the university to license the technology involved. This situation also often applies to TRP. The complete IP management situation in a university is more complex, well known to university licensing professionals and will not be covered in depth here. For example, a university faculty member or student can "destroy" an item of IRP or TRP by unrestricted publication. At the same time, a university will not want to restrict a scientist from publication of the patent able invention or sharing an item of TRP with research colleagues. This apparent dilemma can be resolved by licensing professionals without compromising the ability to license.

Canadian government granting agencies have no policy with respect to ownership of IP. Hence, unless a university has implemented a policy of university ownership, such as UBC, the IP rights belong to their creator, whether faculty member, graduate student, or post-doctoral fellow. In the U.S., by contrast, Public Law 96-517 (the "Bayh-Dole Act") requires that the university must have ownership of IP in order to receive government research funding. It also can be noted few companies will support research at a university unless it can guarantee the ability to deliver license rights to IP resulting from their funding.

The matter of ownership of IP at some Canadian universities falls under provisions of a University-Faculty Union agreement. In general, such agreements provide the faculty own the IP but must disclose any IP created to the university. There is no obligation to assign to, or cooperate with, the university TCO. It is noted University-Faculty Union agreements do not apply to graduate or postdoctoral students.

3.3 The Problem

It can be seen that there is potential for technology to be lost by the university, Canadian industry, and Canadian citizens in terms of lost 'obs. For example, consider that a faculty member or graduate student or post-doctoral fellow, develops a technology of great commercial potential under MRC support. The individual involved maybe contacted by a major non-Canadian manufacturing company or venture capital firm and made an offer of a significant royalty as well as high paid employment in return for assignment of IP rights. Canada would lose the creative individual and the technology. The public and press would be heard from and explanations sought from the government and the university in respect of a policy that was not in place for benefit of Canada.

This is not an abstract concern. Case History 2 in Section 12.0 to this report describes a software licensing situation, which, inter alia, illustrates what can occur because of the lack of a government or university policy on IP ownership. Most Canadian TCOs are put in a position where they must cajole inventors and authors to cooperate.

But if a policy is in place where ownership of IP is with the university or its TCO, the inventor/author must have recourse to have IP rights promptly released to him if a TCO chooses not to exploit the technology or is not successful in exploiting the technology.

3.4 Recommendations

3.4.1 It is recommended that a government policy be established whereby a university recipient of government funding must have a policy in place whereby ownership of all IP that arises from government grants or contracts vests in the university.

3.4.2 It is recommended that universities establish a policy that ownership of all IP created with external funding support, industry and government, vest in the university.

3.4.3 It is recommended that universities establish a policy that will permit an expeditious waiver of IP ownership rights to its creator under certain conditions upon petition. A condition may be that the university, after evaluation, has determined not to pursue IP rights or licensing. Or that the university has been unsuccessful in licensing the technology.

4.0 TCO ORGANIZATIONAL STRUCTURES

4.1 North American Practice

In general, more university technology commercialization programs in North America are internal to a university, typically organizationally located within the office of a Vice President Research or equivalent position. Others are external to a university, in a legally separate non-profit or for-profit structure. External TCO's are more prevalent in Canada.

Some North American universities do not have TCOs at all and have their technology managed by a technology management firm such as British Technology Group (which has a North American office) or Research Corporation of the U.S.
In Canada, university technology commercialization had been managed by Canadian Patents and Development Limited (CPDL).
CPDL was a government funded organization and was discontinued around 1980. A viable option for a university continues to be to have its technology managed by a technology management firm. An technology management firm can have economies of scale to provide more expertise and resources than a campus office. However, most universities today that have a reasonable level of research have established their own TCOS, internal or external. A technology management firm is less likely to achieve the "collateral benefits," discussed in 4.3 below, than a TCO.

An anomaly may be the University of California, which has an "Office of Technology Transfer" that managed technology commercialization of all 9 campuses, including UC Berkeley, UCLA and UC San Diego. Dissatisfaction with a central TCO, and desire to have an on campus TCO, led UC in 1990 to permit campuses to establish their own programs, which the 3 campuses named above and others have done. The OTT still functions and either the OTT or the campus TCO will manage an item of technology from the same university, sometimes confusing for a company as well as the faculty.

There are various factors that influence a university to use an external or internal TCO. There also are advantages and disadvantages with either alternative.

4.2 Trends in University Technology Management

Universities worldwide have been seeking to forge closer links with industry. North American universities are very much in the vanguard and universities elsewhere seek to study and emulate best practices of North American universities. The primary objective of a university understandably has been to obtain funding from industry to support graduate student research and secondarily income from technology commercialization.

However, universities have come to realize a university is often confusing to approach and responsibility and authority diffuse. This has led, in the past few years, for universities to establish "one stop shopping" (OSS) for companies. A single OSS office handles all industry interactions, including technology licensing and industry research agreements. After the negotiation and agreement signing, the accounting and other administrative aspects of research agreements may be turned over to a research administration office or handled within the OSS office. But in either case, the interface with industry is only with the OSS office. The OSS office is, in a sense, the industry marketing office of a university and actively assists faculty to obtain industry research support as well as to manage technology commercialization. The competition among universities to obtain industry research funding has been increasing and how a university is organized to manage the process has become critical to success. However, it goes without saying the people involved are more important than the organizational structure. And the quality of the faculty and the technology produced are of course very critical to economic success of the organization.

4.3 Internal TCOs

Examples of successful single campus internal university TCOs in North America include MIT, Stanford, the University of Alberta and the University of British Columbia. The latter 3 have become one stop shopping offices as well. An internal TCO tends to have closer coordination with the faculty, students, and other administrative units of the university than an external TCO. But an external TCO can have a close coordination as well, depending on the charter of the TCO and its physical location.

The interaction of a TCO with companies will often lead to benefits to the university beyond simply royalty income. A company may choose not to license a proffered technology, but may provide a gift such as an item of equipment it manufactures to the laboratory, having seen the laboratory has an older model or one of its competitor's. Or, the company may be encouraged to support research in the laboratory. Or hire the graduated student. Or engage the faculty member as a consultant. Let us call these "collateral benefits" to a university from a TCO.

The interaction with industry importantly also leads to a better understanding of what industry really needs and practical knowledge to feed back to the educational process.

4.4 External TCOs

External TCOs are established for various reasons. Some state universities in the U.S. have managed their research administration activity in external organizations only because of state laws that did not permit the university to engage in such commerce. It was a natural progression for such organizations to handle technology commercialization. An example is the Iowa State University Research Foundation. Such organizations are non-profit.

An external TCO can help insulate a university and its faculty from conflict situations. It also can enable more innovative compensation systems for its staff than can be done within a university administrative structure. However, depending on its focus and factors noted in 4.2 above, it may not bring about the collateral benefits of gifts, research support, student hiring, and consulting opportunities as effectively as an internal TCO.

The more innovative external TCOs tend to be in Canada and four different forms of an external TCO will be covered in succeeding sections.

4.5 An External TCO: Parteq of Queen's University

Parteq is a non-profit TCO, wholly owned by Queen's University, that manages only technology of Queen's and is operated for benefit of Queen's. The President of Queen's selects the Board of Directors of Parteq. The Board members select their president, direct the activities of Parteq, including hiring of its president, and make other typical Board decisions without involvement, review, or approval by the President. However, the Chairman of the Board is a Queen's Vice President. This acts to diminish an arms length relationship that would provide greater insulation of the university from conflict matters, real or perceived, that come with the territory of technology commercialization.

However, whether or not university officers are members of the Board, it is recommended that all potential conflict situations must involve the VPR of Queen's, wearing his university "hat" and not a Parteq hat, and the conflict situations managed as will be presented in Section 9.0 herein.

Should Queen's become unhappy in some regard with Parteq, its sole remedy is for the President to replace some or all of the Board members.

The physical location of Parteq is on the Queen's campus. This removes a portion of its "Insulation" from Queen's, but also enables it to be more effective in bringing about the collateral benefits noted in 4.3.

Parteq has an incentive compensation system for its President and may extend that to its other technology marketing professionals, termed Commercial Development Managers. The Parteq Commercial Development Manager for Case History 3 joined the company he helped create. This was a loss in one sense to Parteq but it also can be seen that the potential of creating and joining startup can provide a significant lure for hiring new professionals.

4.6 An External TCO: UTI of the University of Calgary

University Technologies International (UTI) is a for-profit TCO that, while wholly owned by the University of Calgary, also manages technology of other entities, profit or non-profit.

UTI is located at a distance from the campus of the University of Calgary. This reduces its effectiveness to bring the collateral benefits to the university noted above.

The for-profit structure has the potential to reduce the motivation and incentive to divert effort to bring about the collateral benefits or to direct more than minimal effort to the majority of university technologies (See Section 8.2 Economics of a TCO) which have modest, if any, income potential.

However, the management by UTI of technology of other entities can be seen to have the potential of greater income to UTI/Calgary in the long term, and the UTI Board can set a course for UTI to place emphasis on collateral benefits and modest income potential Calgary inventions.

It can be observed that it is not just whether a TCO is for-profit or non-profit, or internal or external, that will encourage attention toward achieving collateral benefits or directing more than minimal effort to low income potential inventions. If the VPR responsible for the internal TCO or Board of Directors of the external TCO, or the charter of either form of TCO, measures performance of the TCO only by the amount of income or equity received, that will have a greater influence on priorities.

4.7 An External TCO: NU TECH of Nova Scotia

NU TECH is a non-profit TCO founded to manage technology of Maritime universities that have chosen to have their technology managed by NU TECH. NU TECH is located directly adjacent to Dalhousie University, which makes achievement of collateral benefits for Dalhousie easier. The staff must make extra effort to visit other client universities on a regular basis.

The NU TECH board includes representatives from each member institution and from industry. The Chair, selected by other board members is the Associate Vice President-Research of Dalhousie. The management structures of Parteq and NU TECH are similar.

A NU TECH-type organization is an excellent technology commercialization alternative for universities with small research programs that do not have economies of scale to establish a campus office. It also has greater potential to achieve collateral benefits for its client universities than a remote technology management organization discussed in 4.1 above.

A catalyst to establishment of NU TECH was support from the Natural Sciences and Engineering Research Council, which led to NU TECH's founding in 1996. NSERC support ends in September of 1999 and a proposal for extended support will be submitted. The relatively small base of research, even with multiple universities included, may make financial success a longer term proposition. However, Case History 5 illustrates what a NU TECH can do for local benefit, although cash return to NU TECH's budget may be small. This case history also is another example of the difficulty arising from lack of policy about technology ownership.

4.8 A European Example - Forskningsparken (FP) of the University of Oslo

Some universities in Europe, primarily Scandinavian, which are more remote from major markets, have established compact structures adjacent to the university such as Forskningsparken ("The Research Park," in Norwegian), which is on the campus of the University of Oslo. It is an organizational structure worth knowing about by the Expert Panel.

FP is located in a large architecturally interesting single building designed for ease of interaction among its inhabitants. There is a 5-story atrium in its center with an open elevator, walkways, and stairs. A cafeteria reaches out into the second floor. Friday afternoon informal get-togethers with refreshments and snacks are hosted for inhabitants. (Such Friday afternoon functions are common in Silicon Valley companies) Central facilities are available such as secretarial support, copy machines, meeting rooms, and the like. The facility was a quick success, with rental and service income covering central staff salaries and other expenses. Its original size has been expanded by 50%.

Large (for Norway) companies (including subsidiaries of foreign companies) that conduct research were encouraged to locate research laboratories in FP, where there would be the advantages of close access to faculty consultants, university libraries, and prospective research staff- the graduate students. The composition of FP has evolved too about 1/3 startups/ 1/3 research labs of companies, and 1/3 university project space. This latter segment is explained in the next two paragraphs.

It appears by definition that a university never has available research space. When research space is allocated to a faculty member, it is carefully guarded. Research space is only reluctantly ceded to a new faculty member and internecine difficulties often arise as a faculty member approaches retirement or no longer attracts a high level of research funding as in his prime, but doesn't want to relinquish research space. A faculty member often cannot compete for a research project that may not fit in her allotted research space or will require special facilities.

FP fills a need for extra research space for a typically time-limited project need of a research investigator. The typical FP laboratory of a university research investigator is occupied full time by one to three graduate students or post doctoral research fellows. The research investigator allocates a portion of her research time to mentoring the research at FP, which is convenient to visit.

An objective has been for the startups to grow and leave FP. This has not always been easy for FP management, as the environment is one difficult to leave.

The management of FP is small, largely directed to providing services and as landlord. It has a TCO function but it was just getting started when I last visited.

4.9 Recommendation

That the Expert Panel recommend to Canadian universities that they, if not already so organized, investigate their interface with industry and consider a one stop shopping organizational structure, whether internal or external. A university must ensure such a structure is provided adequate staffing and resources, particularly at the onset.

5.0 TAX ON UNREALIZED GAINS

5.1 Background

Given the objective of commercialization of university technology through startup companies formed to exploit the technology, Canadian university technology managers were concerned with any tax policy perceived to inhibit success of such companies. The tax policy of concern is that dealing with options to purchase stock, which are granted to employees.

There are two principal forms of options granted to employees. One form can be termed benefit stock options, granted primarily as a benefit to all employees, who are permitted to purchase company stock at a discount to the fair market value. The other form is termed incentive stock options, granted primarily to encourage key employees to perform and remain with the company. Incentive stock options are typically set to purchase stock at greater than present fair market value.

The focus of concern is with incentive tax options. Such options are especially important in Canada to provide incentives for the best people to stay and grow their company in Canada. Canadian tax law provides that a taxable event occurs at the time that an employee exercises her option. This tax arises even though there is no gain realized until the stock is sold. Therefore, to cover the employee's tax bill, the stock may be sold rather than held, defeating the purpose of the incentive. This tax policy is contrasted to that in the U.S., where the benefits are not taxed until the disposition of the stock and any gain is realized.

In today's knowledge economy, the key ingredient of success in a technology based company is the skilled employee, rather than capital or scale, as in the industrial economy. Today's employee tends to have greater dedication to his profession than to his employer and is extremely mobile. Incentive stock option schemes are important to retain critical employees.

Other elements of the U.S. policy on not taxing stock options that should not be overlooked in a Canadian policy are that (a) incentive stock options are nontransferable (except by death), (b) acquired stock must be held at least one year and (c) the option must be exercised within three months of departure from a firm. It can be seen this latter proviso is an especially significant incentive for an employee to stay in a company that is ascending in value.

5.2 Recommendations

5.2.1 It is recommended the Expert Panel engage a business tax expert (a) to obtain confirmation that the above problem is presented correctly, and (b) to identify any other tax issues inhibiting commercialization of university technology.

5.2.2 If the Expert Panel supports tax changes, it is recommended the Expert Panel encourage university support. University (and company) officials can effectively present the case to their regional legislators as beneficial to industrial competitiveness rather than a narrow benefit to universities.

6.0 INDIRECT COSTS

6.1 Indirect costs of research-U.S. experience

Beginning in the late 1940's, government support of University research expanded significantly in the United States. It was believed the results of such support would yield benefit to military but more to commercial competitiveness. This was in regard both to research results that could be applied and in the supply of graduates trained in cutting edge research to the economy. Funding decisions were to be made primarily on the quality of the research primarily and secondarily to its potential for practical application. The full costs of research, including indirect costs, would be funded.

Universities welcomed the prospect of such research funding but were concerned that they were not structured for cost accounting. Direct costs of a research project such as salaries, supplies, and travel could be accounted for but not the indirect, but very real costs such as research administration, portions of library expenses and the like. A system of accounting was established whereby percentages of the total of cost elements such as libraries, research administration and even physical education that supported the researchers would be negotiated.

Indirect costs in the U.S. are determined by "uniform cost principles" and are negotiated with the government and the indirect cost rate may change from year to year. The indirect cost rate varies from university to university depending on their research infrastructure, probably averaging about 50%, although I have no exact figures on that. State universities tend to have a lower rate, with less incentive to obtain full recovery, as the taxpayer will make up the difference. A private university typically has a higher rate: Stanford has an IDC rate of around 70% and the University of Southern California around 62%.

6.2 Industry IDC

GE conducted a study of the IDC of performing research using the direct cost base of research only. Normally, industry lumps in research with the much larger cost base of manufacturing, marketing, and administration. This typical practice will yield an indirect cost rate ranging around 100%. However, a company's indirect cost rate when offset only against direct research salaries and benefits, supplies, and other direct allocable costs, will exceed 200%. GE's study showed a 265% IDC for their Medical Division.

GE then determined to outsource its research in computerized axial tomography at universities where not only was the IDC rate lower than theirs, but it was calculated on a low base. Graduate students and post-doctoral fellows receive very low compensation in comparison to industry research scientists. GE selected Wisconsin, Mayo Clinic, Stanford, and Duke.

6.3 IDC at Canadian Universities

In Canada, an arbitrary IDC rate of 40% is generally used by universities for industry funded research. There is the perception some universities will agree to a lower IDC rate if believed necessary to attract company research funds. One university has a clear written policy that local and small companies will receive a lower IDC rate.

It is somewhat of a good news, bad news, IDC situation at universities in Canada. The bad news is that without a full understanding or accounting of actual costs of doing research, the incentive to manage costs or to be entrepreneurial is likely reduced. The good news is that the accounting doesn't have to be done and the IDC can be "priced" by comparison to U.S. universities next door.

Such "pricing" can give a competitive advantage to Canadian universities in terms of receiving industry research funds and appears to be the current policy that is already in place. However, if such pricing in fact results in an under-recovery of the full costs of research, a university should be consciously aware it has made that decision. Of course, if a financial situation is difficult, it may make sense to take in any research funding, as long as it makes at least some contribution to IDC.

Given the perceived policy regarding pricing, a university still can make allocations of the IDC to encourage entrepreneurial behavior and efficient management, as presented in the recommendations below. These practices are not followed by many, if not most, U.S. universities; however, they are practices which the author believes have the indicated merit.

6.4 Recommendations

6.4.1 It is recommended that a set percentage of IDC collected from research income be allocated to the department of the researchers.

Comment on recommendation:

By receiving the portion of their budget that is concerned with the management of research directly from the IDC, the department of a researcher will be motivated to seek research funding and efficiently manage their expenses for research management and administration. For example, if research volume is trending lower than forecast, the department will need to economize. Or if research volume is trending higher, it will have a surplus from the IDC and can get that network computing project going, provide startup research funds to that young new faculty member, etc. Management is "pushed down" to the basic university unit of the academic department, resulting in enhanced entrepreneurial activity at that level.

6.4.2 It is similarly recommended, and for similar reasons, that a set percentage of the IDC collected from industry research income be allocated to the TCO.

Comment on recommendation:

An element of the indirect cost of university research will be the portion of a TCO budget that is directed toward marketing and administering of industry research. By having a portion of its budget tied to industry research income, a TCO will have the motivation to not only seek industry research but best manage the industry research component of its budget.

7.0 INCOME AND EQUITY DISTRIBUTION

7.1 North American Policies-Inventor Distribution

A study some years ago by the Association of University Technology Managers (AUTM), an association to which most Canadian and U.S. university licensing professionals belong, showed an average distribution of 33% of license income to inventors at U.S. and Canadian universities. Judging from my limited survey of a few Canadian institutions, distribution to inventors in Canada may approach an average 50%. Such a high distribution percentage may be necessary to "cajole" cooperation, as noted in 3.3 above. Some universities have a sliding scale, paying a higher percentage initially and lowering the percentage as cumulative income levels are passed.

From my experience, it will be difficult for a university licensing program to show a bottom line net profit ("surplus" may be a better term at a non-profit institution) with a distribution to inventors of greater than 35% or so to inventors unless a "major" invention arises. The world today is awash in technology and the contribution of professional management by a university licensing office to successful commercialization, including negotiation of favorable license terms, can be overlooked by inventors/authors and university management. Few inventions sell themselves.

As covered in Section 3. O, most Canadian university TCOs do not have automatic rights to IP, putting the TCO in a position of negotiating inventor's share on a case by case basis. This is not a desirable situation from either an administrative or fairness standpoint. It also impacts predictability of income distribution to other contributors and stake holders.

Equity distribution tends to follow cash distribution percentages. MIT has an informal policy with respect to equity that is worth noting here. If an MIT inventor receives significant equity directly from the startup company to which her technology is being licensed, she is asked (not required) to waive to NET her personal share of equity that would arise from application of MIT's royalty distribution policy to payments from the licensee. This would apply when the equity from the company would be much greater than that received through MIT.

7.2 North American Policies- Distribution to Other Than Inventors

Universities generally have clear policies regarding the percentage distribution to inventors but not always with respect to distribution of remaining income (and expenses).

The importance of an allocation to the TCO is discussed in following Section 8.0. An allocation to the TCO budget of 15% of gross income is common in North America. After deduction of the 15% and out of pocket expenses for a case, one arrives at Net Income.

For similar reasons to those presented in preceding Section 6.0, a portion of Net Income should be to the academic department of the inventor. It is the case at many North American universities, including Stanford and MIT, that the department receives the same percentage of Net Income as their inventor. Differing from an allocation of IDC, the royalty funds received by a department should be supplemental to the normal department budget.

A researcher will be less concerned about diversion of time to cooperate in technology transfer if his department also receives royalty income that can benefit the entire department.

The remaining Net Income is typically distributed to the "stake holder." This is the entity that "finances" the TCO and bears the risk of loss. At MIT, the Net Income is distributed 1/3 to the inventor, 1/3 to the inventor's department, and 1/3 to MIT. At Stanford, the stake holder is the academic school of the inventor.

Policies regarding income (and loss) distribution range widely in North America. One relatively common distribution formula for what remains of Net Income after the inventor share is distributed is 50/50 with the academic department and the risk taker. For example, if 50% of Net Income is distributed to the inventor, the department and stakeholder receive equal distributions of 25%. Recall, Net Income is after a deduction from Gross income of a percentage to the TCO, followed by deduction of out of pocket expenses on that case.

7.3 Recommendation

Given that a royalty distribution policy has a significant impact on the overall financial performance of a licensing organization, recommendations regarding

royalty distribution are included in following Section 8.0 TCO Financial Structure.

8.0 TCO FINANCIAL STRUCTURE

8.1. Background

Any financial structure should provide appropriate incentives to encourage entrepreneurial activity and efficient management by the involved parties as well as reward for performance. The key parties are the potential inventors, their academic departments, and the TCO, whether an internal or external to the university.

In respect of the inventors or their departments, their incentive will come from a share of royalty income. Section 8.3.2 below will include a best practice recommendation for royalty distribution of net income.

For the TCO itself, a university can make a policy decision that the TCO business focus is on the "bottom line" or that the TCO is to be considered primarily an inventor benefit program or a public service to regional economic activity. There is not consistency on this point in North American universities, U.S. or Canadian. The author will recommend a business focus that he believes will lead to the best result in public service and financial benefit to the inventors. A business focus also will enable better performance measurement by university management (and other interested parties such as the government and public).

8.2 Economics of a TCO

A few words are in order about the basic economics of a university licensing office before providing recommendations. A study at one university showed that of 100 technology disclosures, about 1/4 to 1/3 will survive evaluation and, of that be licensed and produce income. Of that remainder of about 12 to 17, only about I to 3 will provide enough net income to financially justify establishing a TCO. The skill of the licensing office professionals is of critical importance, but there is a strong component of luck ... the licensing office has no control over the technology disclosed to it.

It should be noted that a TCO would have a normal university budget for its salaries and other administrative costs. It should also have separate funds allocated to cover direct out of pocket costs, incurred by the TCO on a case by case basis.

Comment is also in order as to recommendations concerning a distribution of portions of the indirect costs (IDC) and net royalty income to departments of the researchers and inventors. The department is the key academic unit of a university and where the allocation (perhaps "awareness" Is a better word) is best known of a faculty member's classroom teaching loads, number of graduate students/post-docs, student counseling hours, departmental/university services, and other professional commitments. The department also directly manages its faculty's research grants/contracts and provides the infrastructure for that purpose. The topic of IDC has been covered in Section 6.0.

Please refer to the diagram following this section entitled "TCO End of Year Accounting" and the description of the diagram in 8.5 as an aid to following the recommendations below.

8.3 Recommendations

8.3.1 TCO

Conduct accounting of income and expenses on a fiscal year basis, only distribute income after close of the fiscal year. Account for all direct licensing expenses (primarily patent attorney/patent office fees) on a case by case basis. Establish a Reserve account for "bad inventory." An annual review of case inventory will establish certain cases as not marketable. The expenses on those cases will be "written off" as bad inventory against the Reserve account. Allocate a percentage (15% is common) of gross income on each case to the TCO university budget and allocate to the TCO budget a portion of the TDC of industry contract funding expended in that year for which the licensing office was responsible for garnering. If the 15% plus the IDC allocation should in some year more than cover theTCO budget, allocate the surplus toward restoring the Reserve account to the appropriate level. Any surplus, after the Reserve is restored, can be allocated to a "TCO Research Incentive Fund", to be administered by the Dean of Research or equivalent position.

8.3.2 Royalty distribution

After the 15% deduction of gross income on a case discussed above, deduct any remaining "inventory" expenses on that case to arrive at net income. Allocate the net income of a case to the inventor, the inventor's department, and the "stake holder." The "stake holder" is typically the university "general fund", which provides funds (at risk of loss) for the TCO budget and for case expenditures.

8.4 Comment on recommendations

From a management perspective, the above recommendations plus a royalty income forecast will enable assessment of performance by the TCO. The data provided to management will be total royalty income, income allocations, the net TCO budget after credits from allocations to it of IDC and royalty income, the size of the remaining Reserve, the size of the Case Inventory (out of pocket expenses not yet credited against case income or written off against the Reserve), and the forecast of royalty income and all other categories. This management review may lead to an increase or reduction in the size of the Reserve. University management must also of course take into account the contributions of service to the faculty and community, companies founded, jobs created, etc.

The recommendations will provide motivation to the TCO to manage their inventory and budget, to seek increasing license income industry research income, all toward the objective of contributing to the TCO Research Incentive Fund of which a great measure of pride will result. University inventors can also take pride in their contribution and all faculty can see the net gain of having a successful TCO.

The academic departments also become stakeholders in the technology commercialization process by dint of their receipt of a distribution of net income. The diversion of a portion of a faculty member's time to the commercialization process will not be looked upon unfavorably as it is in departments that do not receive a distribution. Further, the consciousness of the entire department is raised with respect to technology commercialization. Often, the one closest to the technology does not recognize that she has made an important invention and it will take a colleague to call her attention to contacting the TCO.

Individual department policies with respect to use of royalty income will vary. Some may choose to allocate the income to a research account of the inventor. Some will use it for general department benefit, to provide research funds for that new faculty member until he can secure external funding, etc.

8.5 TCO End of Year Accounting Diagram

The following diagram illustrates the workings of the recommended financial structure at the end of the TCO's fiscal year. To the left are individual Case Financial. Accounts, which constitutes the TCO Inventory. Each case account will include (a) uncredited expenditures incurred for that account and (b) any income received in that fiscal year for the case.

The end of year review of all unlicenced inventory will lead to a decision to "write off" the expenditures on certain cases, such as Case Financial Account B in the diagram. The funds to write off cases come from the Reserve.

Case Financial Account A illustrates the flow of funds on a case that has produced income. Step I is the allocation of 15% to the Reserve, Step 2 the deduction of out of pocket expenditures on the case, and Step 3 the distribution of Net Income to the Inventor, his Department, and the "Risk Taker", typically the university General Fund.

To the right are 3 stages of a TCO end of fiscal year accounting:

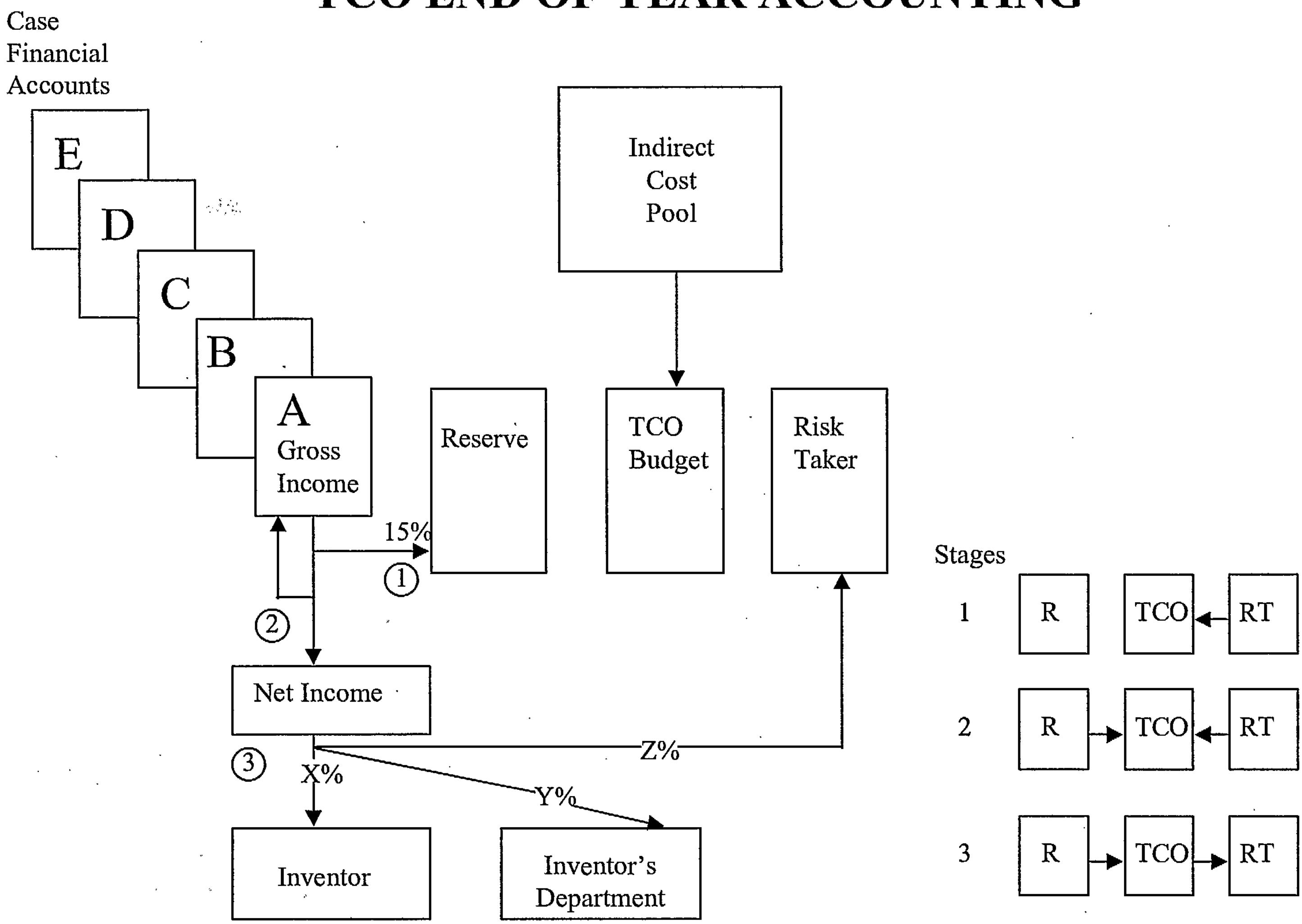
Stage 1. The Risk Taker provides funding to zero out the TCO budget. The Risk Taker also may choose to increase the Reserve account.

Stage 2. The Reserve has reached a comfortable level whereby some funds can be transferred to the TCO budget. Again, the Risk Taker provides enough funds to zero out the TCO budget.

Stage 3. The Reserve funds transfer to the TCO budget plus the transfer from the Indirect Cost Pool exceed the TCO budget and the surplus is transferred to the Risk Taker.

It should not be overlooked that the Risk Taker has been receiving Z% of Net Income, which Net Income is a source for zeroing out the TCO budget before Stage 3 is achieved. The Risk Taker also provides risk funds for "acquiring inventory". The expenditures by the TCO to acquire case inventory are unbudgeted, with each expenditure of funds (acquiring inventory) on a case the result of a considered decision by a licensing professional that the investment has potential of yielding greater income than the expenditure.

TCO END OF YEAR ACCOUNTING



8.6 Balancing Financial and Regional/National Benefits

While it is very important that a TCO have a financial structure that enables measurement of financial performance, the total focus on financial returns of a TCO has the potential to be adverse to regional or national interests. Maybe that large royalty payment from a foreign multinational should be ignored in favor of a regional company, even though its development plan is deficient. At the same time, a focus on purely regional or national interests may be a short ten-n benefit but not a long term benefit. Maybe that large multinational will agree to establish a manufacturing site in Canada to serve the North American market. It is a balancing act by the TCO and will be discussed further in Section 11.0

9.0 CONFLICTS OF INTEREST AND COMMITMENT

9.1 Background-Conflict of Interest

A university and its inventors have a public trust and have a duty to carefully deal with situations where a real or perceived conflict of interest may exist. Generally, a potential conflict will exist where the university or its inventor will be in a position to influence or benefit from both sides of a transaction or a relationship, to the detriment of one side. An example of such a potential conflict situation could be if a faculty member has significant equity ownership in a company and his research might benefit that company. Another example might be if the university has the choice of licensing an invention to a company in which it holds equity or licensing another qualified company.

The "potential" of conflict exists in almost every human endeavor. Such as a doctor prescribing more doctor visits, a lawyer recommending expensive legal action, a salesman describing a product, etc. The key is "managing" such potential conflicts, which is covered below. Often, the public interest may not be served if an overly rigid conflict policy is enforced.

But a university must set certain clear standards of what actions, on their face, are potential conflicts of interest. For example:

> A faculty member's academic obligations of prompt and full publication of research results and objectivity in research must take precedence over any obligations to a company.
>
> A faculty member shall have only one interface with his graduate student, that of academic mentor; a student shall not be employed by or be a consultant to a company in which the faculty member has an ownership interest or will direct the student's work at the company.

All potential conflicts cannot be listed. The university licensing professionals are typically best positioned to identify potential for conflict in connection with technology development activities and to bring those forward pursuant to 9.3 and 9.4 below.

9.2 Background-Conflict of Commitment

Conflict of commitment refers to an individual having professional obligations in time or direction of effort to more than one party. While a faculty member is permitted to consult, his primary obligation must be to the university. It Is typical U.S. university policy that a faculty member cannot have a line position at a company while an active faculty member. The commitment of a faculty member must be 100+% to her academic responsibilities. For a start-up to succeed, each entrepreneur must have 100+% commitment to the company.

This is not to say that exceptions are not possible, if carefully managed, as discussed in 9.3 and 9.4 below.

9.3 Managing Conflict - Administration

A senior university officer, typically a Vice-President for Research (VPR) Is assigned to advise, review and resolve academic and other issues that may arise from a technology commercialization activity. These issues are not only conflict issues but also matters of ownership, royalty distribution and the like. The cornerstones of any conflict policy are openness, trust in integrity of the faculty, and public benefit: Openness: The activities of a faculty member should be completely open to his colleagues, students, and others. A faculty member must be required to disclose in writing any activities such as consulting, industry gifts, participation in founding a company, or the like to his department chair and that information will be made available to colleagues and students. In scientific papers, the fact of such potential influences such as corporate funding of the research or a consulting or license relationship with a company whose product was used in a research study must be clearly indicated in the paper.

Trust in integrity: The fact that a faculty member may be in a position for potential conflict to occur should not result in the assumption the faculty member will act in conflict.

Public benefit: While this is the responsibility of all university personnel involved in dealings with industry, the key individual will be the director of the TCO. For example, the decision of whether a startup company in which the inventor holds equity should be licensed vs. another company should be made on the objective criteria of which choice will be in the best public interest. That is, criteria such as which company will be most likely to commercialize the technology for public use in the most rapid and adequate manner, which will offer the best terms, etc.

9.4 Managing Conflict - Implementation

In general, in any situation where the TCO director sees a potential for conflict of interest or commitment, it will be discussed with the faculty member involved and then brought to the VPR by the TCO director and the faculty member. In some cases the VPR may simply caution the faculty member and receive assurances the potential conflict will not become an actual conflict. In another situation, the VPR may require the faculty member take a leave of absence from the university, subject to approval of his academic department. Such leave is on a time-limited basis, usually not more than one year, during the period of involvement with the company.

The faculty member's department chair will be consulted by the VPR in all potential conflict of commitment situations and many potential conflict of interest situations. The chair will be aware of the classes taught, the number of graduate students mentored, office hours kept, and departmental and university responsibilities of the particular faculty member. What may be condoned for one faculty member may not be condoned for another

In another example situation, it may be that only the student is in position to provide the hands on "showhow" of how to consistently perform a complex laboratory process. The VPR will determine with the faculty mentor that the showhow transfer will take, say, one month. Considering the public interest that the technology is transferred, the VPR can authorize an exception to policy and allow the faculty member to permit the student to spend the month of, say, October to transfer the technology. The VPR will require that the company separately pays for the services of the student, and that such funds will be credited to the grant or other source of income from which the student stipend has come.

In another situation, a post doctoral fellow may be a short period away from leaving the university, wishes to join the startup, but has key experiments to conclude and include in a research paper. The VPR may choose to authorize an exception to policy and permit the faculty member to authorize her fellow to spend 50% of his time with the company for, say, four months, after which time the fellow's relationship with the university will end. The VPR will also require the research account that covered the fellow's salary only be charged at 50% of his salary.

9.5 Canadian Universities

The foregoing elaboration of conflict and its management is not unfamiliar to Canadian universities. The University of Alberta conflict policy is excellent. Any Canadian university that is active in technology commercialization and has not established such a policy and the accompanying administrative and implementation procedures should do so promptly.

But there may be more potential for conflict in technology commercialization at most

Canadian universities and the management of conflict must be rigorous. A Stanford or MIT can take a harder line in keeping their inventors focused on their academic duties. There is an infrastructure and supply of venture capital and entrepreneurs in Silicon Valley and the Boston area so there is much less need for the faculty member to "cross the line" to launch the venture. Similarly, where a Stanford or MIT TCO would be deterred by policy from aggressive recruiting of faculty to start companies, many Canadian university TCOs must take initiatives in the public interest-to establish the venture, raise capital and the like.

Given the limited infrastructure in some locations of venture capitalists and entrepreneurs, Canadian TCOs and their faculty, and sometimes graduate students and post-docs, must on occasion step "over the line", at least for a period, and under set limitations and oversight by the university, to get a new venture launched. But authorization to step over the line must be received as noted earlier.

The public can applaud entrepreneurial activity, but it also can attack an individual or university for, for example, its perception that fruits of public research funds or public facilities for are being directed or utilized for private and not public benefit.

9.6 Recommendation

> **It is recommended that universities not only have clear conflict policies in place but also clear and transparent procedures to managing conflicts.**

Comment:

As somewhat of an aside, it is my belief a "Conflict of Interest Committee" is neither the most efficient, or most effective, or even consistent means to deal with conflict management. A senior official such as the VP Research should have authority to manage conflicts, depending of course on consultation and input as needed from the Department Chair, TCO Director and involved faculty member. And by "transparent" is meant the determinations and rationales are open for colleagues, students, and, when requested, the public.

10.0 BARRIERS

10.1 Culture - Individualism

An understood problem to entrepreneurial activity in many countries is reluctance to stand out. Australia calls it the "tall poppy syndrome" (stick your head up and it will be mowed down). In Scandinavia, it is called "Jantelov" (the rule of Jante). Jante is a fictional town in a Scandinavian book where the muffling of individualism (no one is better than the next person) that is common in Scandinavia was satirized. A Scandinavian will readily agree this is a key barrier to company founding and growth.

In Europe overall and in Japan, if a person/company goes bankrupt, it is very much a cultural negative. Rather than take risk of failure, one doesn't take risk.

While not a sociologist, I did not sense in Canada that Jantelov or going bankrupt were cultural barriers to entrepreneurial activity.

However, Conrad Black observed in speaking of Canada: "We could change this country by being reasonably respectful of those who are successful and not being destructive of them". He goes on to say "That tendency is the bane of Canada .... Americans admire success, which is one of the reasons the U.S. is the most successful country in the history of the world".

One can observe the U.S. may carry individualism to the extreme. We can also think Conrad Black off base.

Recommendation

It is recommended the Expert Panel discuss and consider if the assertion of Conrad Black is on target or not. And if on target, consider by what means the achievements of entrepreneurs can be as celebrated as sports heroes.

10.2 Culture - Confidence

There is a vague sense I gathered, and not from Canadian university technology licensing professionals, that there is not confidence Canadian university technology management (or perhaps indeed other Canadian endeavors) are world class. If there is a lack of confidence, it is possibly engendered, certainly at least in part, by a huge neighbor to the south which arguably shows too much confidence that all of its endeavors are the best. This feeling may be quite wrong, but it leads to the following recommendation.

Recommendation

If the Expert Panel concludes that the technology management of its leading research universities is world class, despite the many barriers, that it prominently presents that conclusion as one of its findings.

10.3 Lack of Industry Receptors

A technology commercialization barrier that is more pronounced in some regions of Canada than others is the lack of industry receptors for technology created at the regional university. Or there may be industry technology receptors in one field and not another. For this reason, Canadian TCOs with the goal of technology commercialization and job creation in their region, often will endeavor to create a startup.

But even if the startup is launched, such as Neurochem (Case History 3.), which was successfully created by the TCO of Queen's University (Parteq), a company may find it necessary to relocate in order to grow for lack of a pool of future qualified employees, necessary infrastructure, or the like. In the case of Neurochem, it chose to move from Kingston to Montreal.

While companies in many of today's business fields such as the Internet, software, and even biotech, can in theory be located virtually anywhere, there is still the pull to be located near peers. This will partly be to access a larger pool of future employees, but also to have that personal interchange vital to professional growth. A company will also prefer to be near its financial backers and customers.

Removing this barrier is not easy. A region might choose to focus on a specific business field, establishing/encouraging the infrastructure/incentives/business climate to attract companies in the selected business field(s).

10.4 Geography, Experienced Venture Capital, Experienced Venture Managers

A sparsely populated region will have both the industry receptor gap as well as distance from markets. And even a populated region will have the lack of venture capitalists with the experience of supporting the growth of high technology ventures. And even Silicon Valley considers a large impediment now is the scarce supply of experienced managers of high growth ventures.

A natural collaboration direction in many regions will be North-South (Western Canada, Western U.S., for example) rather than East-West (Alberta-Montreal, for example). But this should not imply the direction of technology is only to the south. Canadian industry can take advantage the large base of university technology created in the U.S. and pull that technology north.

Recommendation

Discuss the barriers of 10.3 and 10.4 and options for dealing with them. Perhaps, for example, young technology companies from the crowded Boston area can be enticed to the Halifax region, where regional universities produce technology and trained graduates in their field, where housing costs are less, and the like. Perhaps certain Silicon Valley VCs can be encouraged to invest and assist guiding the growth of Simon Fraser or UBC startups in collaboration with Vancouver area VCs.

10.5 Research Funding

It has been suggested that research funding to Canadian universities is at a lesser level than many other developed countries. Clearly, to have technology available to be commercialized, and trained graduates to staff technology companies, university research funding is critical. Industry worldwide is beginning to realize the advantages of research agreements with universities and universities are organizing to better manage the interfaces with industry and market their research capabilities. And Canadian universities are in the forefront. But the primary source of the research funding to a university to support thesis quality research will remain government funding. Research funding is the feedstock for technology creation and trained knowledge workers.

Recommendation

It is recommended that the Expert Panel assess the comparative data available covering government research support to Canadian and U.S. universities. If research support is less on an apples to apples comparison, present the need to provide greater research support to Canadian universities to increase the supply of trained graduates and to yield new technologies for commercialization.

10.6 Development Gap

Much has been made of "the gap" between the research discovery and its application. It is argued that the technology needs to be advanced before industry will take it on, and a research investigator will make a case for allocation of scarce university funds to his research program to further develop the technology. It has been my feeling, as a technology commercialization professional, that if I have properly presented the technology to a company and the company, which understands the market, does not see the potential to invest its risk capital in closing that gap, then how can the researcher or I make a valid case for such added funding?

On the other hand, at least two Canadian universities (UBC and UA) have set up "prototype development programs", which have been successful. These are neither business incubators nor generally are allocations of research funding to researchers. As indicated in the Report on the UBC Prototype Development Progam, The First Six Years: 1989-1995 , the PDP is intended to provide "the management and financial resources necessary to develop prototypes of early stage technologies in order to improve their commercial potential". Case History 6. covers a situation where successful technology commercialization was enabled by the LTBC prototype development program.

Over ten years ago, the U.S. National Science Foundation established a program of support to university business incubators, wherein a company would be wrapped around a research discovery. The gap would be closed and a company to commercialize the technology created at the same time. This initiative was unsuccessful. This has generally been true of other university-based business incubators that have been created.

Recommendation

It is recommended the Expert Panel suggest other Canadian universities study and consider implementing the prototype development program models at UBC and UA, if applicable to their situation.

11.0 INTERNATIONAL TECHNOLOGY TRANSFER AND BENEFIT TO CANADA

11.1 International Technology Transfer

We have observed that university-industry technology alliances are increasing worldwide. Such alliances are often with a university in one national territory and a company in another national territory. And many companies today, not simply the giants, have multinational operations, which blur the distinction of being a French company, a Dutch company, a U.S. company or a Canadian company. Companies in Canada will obtain technology relevant to their business, whether from a source in Canada or elsewhere.

When drafting the U.S. University-Industry Act, known as Bayh-Dole, the drafters struggled with how to best benefit the taxpayers that funded university research. It was concluded that U.S. universities should license their technology worldwide and that there be no restriction on the "nationality" of a company licensed. However, an exclusive licensee of a U.S. patent, whether a U.S. or nonU.S. company, would be subject to clause requiring it to manufacture in the U.S., but only in respect of sales in the U.S.

But whether such a legislative restriction existed or not, U.S. university TCOs typically follow an informal practice to consider the U.S. taxpayer as best they can. Canadian university TCOs similarly follow such a practice for the Canadian taxpayer. It can be seen to be a matter of good sense as well as patriotism. At the same time, however, a TCO must use good business sense. For example, in some cases, there may not be a qualified domestic licensee, or only a non-domestic licensee will agree to diligently develop the technology.

A Canadian university has a more difficult chore than a U.S. university to find qualified domestic licensees In view of the disparity in the size of the respective industrial economies. A requirement to manufacture in Canada in order to receive a license to the Canadian patent may not make sense if prospective sales in Canada are too low.

In terms of the balance in technology trade, it is likely that Canadian industry receives more technology from U.S. universities than U.S. companies receive from Canadian universities.

11.2 Recommendation

It is recommended that the Expert Panel acknowledge that Canadian university TCOs consider "benefit to Canada" in their licensing of technology and commend and support that practice.

11.3 Comment on Recommendation

There are many ways that a TCO can take "benefit to Canada" into account in licensing, but hard to legislate. The court of public opinion may be more effective than legislation in a situation where, for example, a strong and willing domestic company was ignored by a university in favor of its German competitor. There is the potential for "gameplaying" by the domestic company that, for example, decides only after the license is granted to a foreign company that it really was interested after all and complains to the press. But a professional TCO will have documented their decision process and can provide that evidence to the court of public opinion as well.

If the Expert Panel sees fit to make a recommendation for legislation similar to the U.S. Bayh-Dole Act, there should at the same time be put in place a process for expeditious handling of exception requests by an official with practical knowledge in university technology transfer.

12.0 STRATEGIC COMMERCIALIZATION PLANS

12.1 Planning, Professionalism, and Luck

North American universities, including the best-known technology commercialization programs in the U.S., have not always set up strategic plans, with objectives and metrics. As a TCO has no control over the technology that may be disclosed to it tomorrow, it is argued such plans are not useful. Achieving an objective of $X million in royalties, or Y startups, has a large measure of luck (or good fortune) when that newly disclosed item of technology is found to have the attributes that can be the basis for a startup or produce significant royalty dollars.

However, it also is true that the potential of that new item of technology has to be recognized and the astute technology commercialization professional will make more of it than the less astute, no matter how lucky either is.

12.2 Vision and Objectives

Hence, there is merit to establishing a vision and objectives for a TCO that will be tailored to each university's situation. Is there a regional strength in a technology field and what steps can the university take to strengthen its research and technology commercialization capability in that field? An objective to increase the level of technology disclosures by 25% must be accompanied by a plan to achieve that increase.....such as scheduled monthly presentations to each academic department. Going along with an increase in technology disclosures will be a projected staffing increase to deal with the increased business and increased level of patenting expenses.

While a vision and strategic plan will provide a better focus for a TCO, university management must at the same time realize that the factor of "luck" will influence meeting some targets, and that increased success of a TCO may often entail a greater commitment of resources.

Caution should be exercised in that some data may be of interest to collect, but not be useful in making management decisions. Also, setting a peripheral target such as an increase of 10% in the number of patents, for example, can encourage bad management decisions. A patent is very expensive to file and can be obtained for virtually any technology disclosure, but not be marketable. The best TCO performance may be a reduction in patents filed, if fewer marketable disclosures are received in the accounting period.

12.3 Recommendation

It is recommended the Expert Panel suggest that Canadian university TCOs develop a vision and strategic technology commercialization plan, with targets, which is appropriate for their university and region, if they have not already done so.

13.0 CASE HISTORIES

Case histories are presented in the following pages to provide the Expert Panel a greater understanding of the details of specific technology commercialization projects as well as to illustrate the applicability to certain recommendations made in this report. The case histories are all from Canadian TCOs, both internally and externally managed.

Case History Listing

1. **SemBioSys,** an agribusiness startup of UTI, based on licensed technology from the University of Calgary.

2. **A software license** from a Canadian university TCO. This case history illustrates the type of problem that can arise from the university not having a policy regarding ownership of IP.

3. **Neurochem,** a biotech startup from Parteq, based on licensed technology from Queen's university.

4. **Cellulose binding technology license** from the internal University Industry Liaison Office of the University of British Columbia.

5. **Reinforcing concrete technology** from NU TECH, the TCO of several Nova Scotia universities.

6. **Prototype Development Program** example from the UILO of LJBC based on elastomeric transducer technology.

CASE HISTORY 1
SEMBIOSYS GENETICS INC

This case history describes the formation of a start-up company based upon technology created at the University of Calgary and the role of UTI Inc. in the process. Professor Maurice Moloney of the Department of Biological Sciences discovered the technology. It enables the production by oil seeds of proteins for pharmaceuticals, vaccines, nutrition and many other uses. The process is less expensive than bioreactor or recombinant protein production processes.

A UTI executive was seconded to the company as managing director and a member of the UTI board was also instrumental in the formation of SemBioSys and in consummating an alliance with a major agribusiness company.

SemBioSys Genetics Inc. -
A Case Study on a Start-Up Company
from Canadian University Research

In April 1991 Dr. Maurice Moloney of the Department of Biological Sciences at the University of Calgary's Faculty of Science approached University Technologies International Inc., the University's technology transfer company, with a unique research discovery - proteins called oleosins on the surface of seed oil bodies have the ability to facilitate simple production of other proteins.

Realizing the discovery held the promise of an entirely new agri-business industry, UTI patented the technology and then investigated a licensing option. Because of the uniqueness and very early stage of the technology, there was little initial industry interest outside of three small development contracts. Company creation was pursued as the best commercialization option. The creation of a new company is one of the more exciting commercialization routes available to research technology. If a technology is sufficiently unique and expandable or holds the potential of supporting multiple products, company creation can be a viable option. In October 1994 SemBioSys Genetics Inc. was launched.

In lieu of payment for the extensive staff hours and capital UTI put into the project for technology assessment, intellectual property protection, business planning, company creation, market assessment and investigation of investment partners (estimated at $900,000 in value,) UTI took equity in the new company. UTI aggressively marketed applications for the technology for three years. The UTI Board of Directors, particularly Richard Elenko who is now the SemBioSys' Chairman of the Board, added their expertise and support to SemBioSys' cause and were instrumental in identifying and making contact with DowElanco Canada, the agribusiness arm of the Dow corporation, as the most appropriate business partner for the young company. Spearheaded by Richard Elenko, UTI actively pursued the alliance of the two companies.

In 1994, Hugh Jones, UTI's Manager of Business Development, was seconded to SemBioSys as Managing Director responsible for the company's day-to-day business operations. That commitment on UTI's part ensured a continuity and business momentum for the young company. UTI, Jones and Richard Elenko then played a major part in negotiating a $4 million investment agreement between DowElanco and SemBioSys that year.

In December 1997, DowElanco and SemBioSys announced a strategic partnership. DowElanco will invest another $17 million over the next five years to allow SemBioSys to scale up its operation toward commercial production. Its corporate operation and laboratory facilities, currently employing 20 researchers will grow to 150 researchers, technicians and administration staff. The company has substantial potential for more high-end job creation as applications for its technology develop, an effective engine for economic development with local, regional, provincial, national and international impact.

The company is based on biotechnology which attaches target proteins to highly-specialized proteins called oleosins in the oil seed. As the oil seed grows, the target protein is manufactured and can be easily extracted with the seed's oil. The process can be used to manufacture pharmaceuticals, vaccines, enzymes for industrial and food use, and nutritional proteins to improve animal feed meal. Through this technology, these products can be produced more quickly, more simply and less expensively than existing bioreactor or recombinant protein production methods.

SemBioSys is one of nine companies created around technology licensed from UTI Inc. in the past six years. Company creation, given the right set of technology qualifications and economic factors, can carry the most economic impact of any technology commercialization.

In 1989, when the University of Calgary created UTI Inc. and charged it with the University's technology transfer functions, it created a company which has since become the model for technology commercialization organizations across the continent. UTI has developed an industry-leading body of expertise in technology evaluation, intellectual property management, business development, technology transfer and company creation.

University Technologies International Inc. was uniquely positioned to bring SemBioSys to fruition. In the face of an initial lack of industry interest and support, UTI Inc. was able to protect and develop the technology beyond the stage where a traditional university-industry liaison office would have given up or spun out a company with an uncertain future. UTI was able to both carry and encourage SemBioSys to the point where it could prove itself to industry backers. The result is a Calgary-based, multi-million dollar biotechnology operation based on promising research from The University of Calgary. It is a case study that research from the U of C and other Alberta institutions can be nurtured and commercialized to generate considerable wealth and growth with regional, national and international impact.

CASE HISTORY 2
A SOFTWARE LICENSE

This case history covers the commercialization of a software program from a Canadian university, which university is not named. The problem that results from the lack of clear ownership to the technology is vividly illustrated. The university TCO broadly licensed the software program until a spin-off company was formed and existing licenses transfer the spin-off company. Growth of the company has been hampered by the uncertainty of rights to the software.

This story covers the commercialization of a software program over a 22 year period In the period 1976-1985, NSERC supported the research programs of two professors at the university which produced a sophisticated tool for expressing and solving symbolic mathematical computations. Success was measured by the positive response received from the nominal distribution of the software to academic colleagues by the university in the early 1980's. As the acceptance and interest grew, licensing through the university was formalized with assignments provided by the authors to the university to allow legal licensing. These assignments were necessary due to the university's policy of IP being owned by the inventors/authors unless co obligations to the contrary were attached to the finding. In this case, the funding was provided by the Federal Government's Natural Sciences and Engineering Research Council without IP strings

As the licensing income grew, the research group expanded with additional graduate students (in a 40 computer terminal laboratory) and the porting to various platforms was achieved. In 1988, a spin-off company was formed and the licenses administered by the university were to the new spin-off. The assignments and the obligations associated with the licenses (with one or two minor exceptions) were also transferred from the university to the company. Two of the licensees had concerns about the stability of the new spin-off and requested their licenses with the university. This introduced a qualification to the assignment from the university so that the two licensees who complained could continue to be licensed by the university. In any event, the new spin-off company assumed the administration and the commercial support of the licenses and set about collecting and purchasing complete ownership of all the authors rights (in addition to the assigned university rights) to ensure positive ownership of the software rights. This included all the graduate students and one of the two prime principal investigators. The other PI at that time was the CEO and Chairman of the BOD and provided only a royalty limited license to his rights versus the complete assignment provided by all the other authors. This special arrangement was concluded without BOD approval and continues to be the subject of a legal dispute.

The company enjoyed an international reputation for quality and achieved steady and profitable sales growth under professional management It also provided and an option for a minor equity participation, a significant annual research support contract and paid royalties on their software revenues to the university. This sales growth has unfortunately leveled recently due to the difficulty in attracting outside investment. An unstable shareholder community has also aggravated this situation and caused the BOD to have to avoid taking some of the drastic corrective actions required to rectify the situation.

The uncertainty surrounding the company's complete and unfettered rights to the software code has deferred the acquisition of the outside investment required to fulfil the growth demands of the market. This underlines the importance of the university being able to provide clear and unfettered rights to the software code it transfers to the private sector - either to a spin-off or existing company. It also speaks to the benefits of having professional management in place in the spin-off in the beginning and writing shareholder agreements that are flexible enough to deal with success.

CASE HISTORY 3

NEUROCHEMFNC

This case history describes the formation of a development stage pharmaceutical start-up company based upon amyloid research at Queen's University and the role of its TCO, Parteq, in managing the technology and enabling the company formation. While Neurochem has moved to Montreal from Kingston, it continues to support research at Queen's.

Neurochem Inc is a development-stage pharmaceutical company which was founded by Parteq Research and Development Innovations in late 1993. The company was created as a means to exploit key discoveries at Queen's, primarily in amyloid research.

Amyloid deposits are considered by many to be the root cause of a number of neurodegenerative diseases, the most common of which is Alzheimers disease. Amyloid can, however, also be found in tissues and organs other than the brain. A form of amyloid, AA Amyloid, for example can develop as a result of any kind of inflammatory reaction and can be a fatal consequence from such disorders as rheumatoid arthritis, kidney failure and Hodgkin's disease. There are at present more than 15 known types of amyloid protein. Once these amyloids have formed, there is no known therapy or treatment to dissolve the deposits in situ and a disease known as amyloidosis results.

Researchers at Queens University demonstrated in 1987 that all amyloid, including the beta amyloid in Alzheimer's, regardless of the underlying protein, have one, and only one, common component, namely highly sulfated glycosaminoglycans (GAGs). The research group also discovered that a specific GAG was codeposited with the amyloid protein in the building of the amyloid deposit It was then postulated that if one could interfere with the synthesis of this GAG or the binding of the GAG to the amyloid protein, that one could stop the formation or build-up of the amyloid deposit.

Such a compound was identified in 1993 and patent protection was filed by Parteq. After initial discussion with potential licensees, Parteq approached the principal investigators to determine whether they had an interest in participating in the formation of a new company to exploit their discovery. Parteq then identified other complementary intellectual property (IP) so as to build an IP portfolio which might attract investment capital. Parteq prepared the business plan and identified potential venture capital partners. A Toronto venture capital firm expressed strong interest but would only proceed if another knowledgeable investor or corporate partner became involved. Parteq then led the search for this other partner and eventually employed a consulting group to assist with the process. A venture capital firm from Boston then expressed interest and Parteq led the negotiation of the investment . All intellectual property was licensed from Parteq to Neurochem and an initial seed investment of $1 million was secured.

Neurochem was a virtual company during the early development phase and the company was incubated in an office immediately adjacent to the Parteq office. Parteq provided early administrative support and continued to provide management and IP protection support to the company. Development was contracted to the various Principal Investigators at Queen's. Eventually other investigators from other institutions around the world were recruited to support the research and development program.

Parteq then assisted with identifying and securing a second round of financing ($ 10 million) from a venture capital syndicate which included the two initial investors. Neurochem has since concluded a third round of financing ($8 million) and has now completed Phase I for its first clinical indication, a systemic form of amyloid. Neurochem is now located in Montreal in an independent laboratory facility and employs approximately 35 people. It has contributed a significant amount of research funding to Queen's and has been the largest industrial supporter of research at Queen's for the past four years.

Parteq and the principal investigators currently hold approximately 10% of the shares of Neurochem, which based on the latest round of financing were valued at $2.6 million. Parteq still maintains a position on the Board of Directors of the company. Parteq played a very proactive role in the formation and development of Neurochem and it is absolutely certain that this company would not have been formed without Parteq's leading contribution. Neurochcm has already contributed significant benefits to Queen's and the economy and we certainly hope that, in the near future, the company will contribute financial return to its shareholders.

CASE HISTORY 4

CELLLULOSE BINDING DOMAIN TECHNOLOGY LICENSE

This case history describes the saga of licensing cellulose binding domain technology created within the Department of Microbiology and Immunology at the University of British Columbia and the role of its University-Industry Licensing Office. And "saga" is an appropriate term to describe the path of management of the technology and the tenacity of UBC's UILO over many years to achieve success.

Note that the non-Canadian licensee is required under the license agreement to eventually set up a Canadian subsidiary in British Columbia.

Research Team

In 1983, Doug Kilburn, Tony Warren, and Bob Miller of the Department of Microbiology & Immunology received NSERC funding for research on cellulose-degrading enzymes from bacteria. The research team disclosed to the UILO a series of inventions in 1986 relating to novel cellulases from the bacterium *Cellulomonasfimi* and their industrial application to degrading cellulose waste material. After significant patenting expense and marketing effort, this technology ultimately went nowhere.

In 1988, after the discovery of the region of the enzyme that binds to the cellulose substrate, the team disclosed the invention entitled "Cellulose Binding Fusion Proteins". Charles Haynes, of the Biotechnology Lab and Department of Chemical Engineering, joined the group in 1995, and has contributed to the continual expansion of the areas of application for this platform technology.

The Technology

Cellulose binding domains (CBD's) are regions of enzymes that bind to cellulose but which do not have catalytic activity. CBD's can be removed from their protein of origin and retain their binding properties. They can also be genetically engineered into other proteins of interest to create fusion proteins that are able to bind to cellulose while maintaining their original functionality.

Applications

Protein purification
Calcitonin, Human Serum Albumin

Industrial Enzymes
detergents, textiles, baking, pulp & paper

Diagnostics

Biomedical
Immobilized growth factors, wound healing, cell proliferation, transplantation

Plant growth modulation

Patenting

The patenting process for a platform technology is complicated and expensive. Often, the Patent Examiner determines that an application discloses more than one invention and splits the claims into several groups for separate examination. This significantly increases the costs and effort required for patent prosecution.

The original CBD patent application filed in the U.S. eventually resulted in 6 separate U.S. applications, 4 of which have issued. This is the result of the Examiner dividing the original application and the addition of new material from further technology development. Two separation streams of international applications have also resulted from this first filing.
In 1995, when licensing discussions began with CBD Technologies, a new series of patent applications were filed on specific fields of application of the technology.. Currently, there are over 34 patents issued or in prosecution relating to UBC's cellulose binding domain technology.

Licensing

In 1994, the UILO was contacted by CBD Technologies Inc., a startup company interested in commercializing the cellulose binding domain technology. They had already licensed similar technology from the Hebrew University in Israel that potentially infringed the UBC patents. After a year and a half of due diligence and complex negotiations, a License Agreement was signed on March 29, 1996. Meanwhile, Novo Nordisk A/S, the world's largest industrial enzyme company, expressed interest in the technology, but were interested in only a narrow field of use. Since the negotiations with CBD Technologies were so complicated and lengthy, the UILO negotiated a License Agreement and Research Agreement with Novo for use of CBD's in detergents and textile processing, and this field was excluded from the CBD Technologies License.

The Novo License included milestone payments, royalties on sales and a two year extendable research contract. The CBD Technologies License was a combination of equity, royalties, maintenance fee and research funding. It also included a provision that upon reaching certain performance milestones, the Novo License would be terminated by UBC and become a sublicense. UBC receives a special royalty rate from this sublicense.

The Costs

By 1997, over $6 million (Cdn) in government grant funding had been spent on cellulose and cellulose binding domain technology at UBC. By the time the License Agreements were signed, the UILO had spent more than $200,000 for patent costs. The agreements were negotiated such that CBD Technologies was required to pay all patent costs from September 1, 1995 onward, which amounted to $75,568.61 on the date of execution. Novo Nordisk was required to pay an annual patent reimbursement of $1 0,000. The balance of UILO

accrued patent costs, amounting to over $100,000, were to be recovered through future milestone payments and royalties.

In December 1996, CBD Technologies began to run out of money and bills were no longer being paid. The patent firm turned to UBC to cover outstanding payments. The company also stopped making payments on UBC research agreement. Rather than terminate the License Agreement, UBC decided to trust in the company to raise the required financing. Almost a year later, the company paid all it outstanding debts to UBC, amounting to 180,000 for research agreement and $165,000 for patent expenses.

The Company

CBD Technologies, Inc. was formed in 1993 to commercialize cellulose binding domain technology developed by Oded Shoseyov at the Hebrew University in Israel. The company later identified the research team and intellectual property at UBC as being a critical component for the success of the company. Although the company has gone through difficult times and numerous management changes, it is now in a strong position to develop the cellulose binding domain technology on numerous fronts. In early 1998, the company raised $7.6 million U.S. including a $2 million investment from Dow Chemical Company. The company has negotiated two sublicense agreements and the UILO is in the process of transferring the Novo Nordisk license. CBD Technologies is well positioned to take an international approach to commercialization, having corporate offices in New Jersey and management and research facilities in Israel. In addition the company is required under the License Agreement to eventually set up a Canadian subsidiary in British Columbia.

CASE HISTORY 5

CONCRETE REINFORCING TECHNOLOGY LICENSE

This case history describes a unique collaboration of Dalhousie University, and an informal consortium of local companies that led to successful development of the technology and a license agreement in final negotiation. A university researcher discovered the technology, a new class of fiber with potential for reinforcing concrete, with assistance and support of a local synthetic fiber manufacturer.

Of especial note is the collaboration with local companies, unsophisticated in patents and their value in creating a market opportunity. The provincial government and federal basic research provided funding along with the local companies. The license provides fiber production to take place in Nova Scotia and the companies to fund a university chair in the technology area.

CASE HISTORY - NU TECH

The Technology

A researcher with the assistance and support of a local synthetic fiber manufacturer has discovered a new class of fiber that has great potential to prove 'de increased strength and flexural toughness in concrete, thus providing the potential for reducing the cost of primary tension reinforcement (rebar, steel fibers etc.) in many concrete applications.

The Disclosure

The research project was funded partly by an informal consortium oflocal companies, one a concrete producer, another a synthetic fiber manufacturer of fiber for other markets. Majority funding came from provincial sources tied to funding industry-needed research and federal basic science research. The research results obtained were very good and the researchers had a clear idea of the potential value on the world market. However the local industry players did not seem to have a vision of a) the market potential, and b) a view of the continuing role of research and university based expertise. The TCO was asked to encourage and mediate the continuing involvement of the companies to complete the required research.

Results To-date

The companies were persuaded to finish funding the required research, the results obtained were excellent, a patent was filed, and a license agreement is now in final negotiation. A world-wide distributor of building products is negotiating for marketing and sales rights with fiber production to be undertaken in Nova Scotia. The companies are also committing to fund a chair at the university in this technology area.

The TCO Perspective

A potentially successful commercialization effort which could realize considerable financial return for the researchers, the university and the local economy. The revenue sharing arrangement between researchers, university and commercialization agency had to be specially negotiated in order to obtain agreement of researchers to the university acting for them. A significant factor in the success has been the exceptional effort by the researcher in contacting and interacting with industry players.

The project resulted in pressure to generate an internal policy to share revenue between university, faculty and department (not yet agreed at our institution and a significant impediment to the support of commercialization efforts at the colleague, departmental and faculty levels).

There was initially little appreciation by small, local industry on the value of patents (national monopoly), the market opportunity represented by a technology leap, and some trepidation regarding the risk and investment required in development and production (better to be a big, safe fish in a small pond, than a little, at-risk fish in a big pond).

CASE HISTORY 6

PROTOTYPE DEVELOPMENT PROGRAM EXAMPLE

This case history illustrates the contribution that a Prototype Development Program can make to the commercialization of a technology that was not initially marketable to industry. The technology is a novel transducer that uses elastomeric materials. The PDP of UBC, managed by its University Industry Liaison Office, was a key element that led to the founding of a company and eventual commercialization of the technology in a flat audio speaker application.

THEN

The original invention disclosure was made by Dr. Lorne Whitehead and colleagues, department of Physics and Astronomy in February, 1986. The invention was a novel tranducer using elastomeric materials that appeared to offer unique benefits, such as mechanical impedance closely matching that of water. The UILO filed a US patent application in April, 1987 that issued in December 1989.

The UILO Protoype Development retained a MBA student to undertake a preliminary market assessment of the technology, which was unfortunately not at all positive. Subsequent interest by US and Canadian military in detecting landmines led to a series of experiments that identified the need for high voltage, variable frequency power supplies to operate the transducer. UILO PDP provided funds, matched by contributions from NRC-IRAP to hire undergraduate students to design and fabricate the power supplies. UILO-PDP also facilitated a meeting with a large number of faculty plus an angel investor to assess the technology and identify potential applications.

The outcome of this meeting was a financial commitment from the angel investor to explore an application in the aerospace industry. A graduate student, Mr. Brent Bolleman was identified who might be suitable to undertake some of the experiments as part of his M.A.Sc. thesis research. The interaction between Dr. Whitehead, the original inventor and the graduate student lead to a series of new inventions, including a greatly improved geometry for the elastomeric transducers.

NOW

GMW Aerospace Corp was formed June 1992 with Mr. Brent Bolleman as president. GMW exercised its option for a license in 1994 and shortly thereafter, demonstrated the first thin form speakers based on the UBC technology. This technology was the basis of the company until it acquired rights to planar magnetic technology for flat panel speakers in early 1997, Sonigistix Corp began shipping its first flat-panel multi-media speakers, under the Monsoon Brand, to customers at the beginning of September, 1998. The speakers are receiving outstanding reviews in industry trade publications.