An Industry Perspective Of Licensing

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A discussion of issues relating to technology transfer between companies and with universities

Before embarking on a discussion of technology transfer from an industry perspective, we should have a clear understanding of what we mean by the term "technology transfer." In its broadest sense, technology transfer includes any transaction involving some or all of the following features: the disclosure of information (teaching), the receipt of information (learning), the granting of rights to allow the recipient to do what is envisaged by the transaction (this could include evaluation of the information, using the information to conduct research or to employ the information as a means to make or use a device or implement a process, and the acceptance of obligations (like the payment of royalties). Finally, technology transfer culminates in an implementation of the information in the contemplated manner (growth).

The information may be confidential in whole or in part, bringing with it the obligation on the recipient of maintaining the confidence of those aspects of the information that are confidential. The right to use information may include rights under patents covering various aspects of the information.

There are any number of transactions in which transfers of technology take place. Let's look at some examples and see if they contain the components noted above.

Consider a student at a university in Canada. This is one of the purest examples of a technology transaction. It combines the elements of teaching and learning in a public forum so there are no confidentiality restrictions on the student and virtually unlimited use rights are granted to the student. Growth continues through the student's university career and is transferred to the place of employment after graduation.

Consider a university professor setting up a spin-off business, based on inventions or developments the professor has made while at the university. There is disclosure from the professor to the employees of the spin-off company who in turn learn from the professor in order to implement the developments and there is the granting of rights and acceptance of obligations between the professor and the university.

Consider a contract between a company and a university in which there are variously disclosures and receipts of information, granting or cross-granting of rights to prior and developing technology, and, ideally, implementation of successful results.

Finally, consider a license between two contracting parties; one that owns technology and one that seeks to implement it. Such a transaction likewise includes the essential ingredients of technology transfer transactions, and it is on licensing that our comments will focus. We will, however, make reference to other types of technology transfer transactions, all of which will be viewed from an industry perspective and supported by real life examples to illustrate the points being made.

Licensing is a complex but fascinating topic because it brings together so many diverse disciplines. It combines the technical and legal, the art of legal drafting and negotiation, and the business of making a profit from exploiting technology.

Before exploring specific technology transfer problems and issues associated with negotiating and implementing licenses, it may help to look briefly at the company for which I work and the industry it represents so that you may better understand the industry perspective.

◄ Company History ►

Shell Canada Limited is an independent Canadian company in the oil, gas and petrochemicals business. It is an operating company in what is known as the Royal Dutch/Shell Group of companies. The majority shareholding in Shell Canada can be traced back to two European-based companies. Besides operating companies, the Shell Group is characterized by a number of service companies established to provide commercial and technical advice and services, including research services to various operating companies around the world.

Major Shell research establishments conduct research in Canada, Japan, the United States, and Europe. Most international outward-licensing activity is conducted from service companies based in London and the Hague. All other technology transfer transactions affecting Shell Canada are conducted in Canada.

I want to refer briefly to the type of activity in which Shell Canada is involved and I want you to retain the images of these activities. We will be referring back to them to illustrate the issues we will discuss. A big part of Shell Canada's business has to do with finding hydrocarbons. For this part of the busi-

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ness. Shell develops, buys and sells technology in an effort to make the discovery of hydrocarbons easier and more predictable. These technologies relate to improved seismic and tomography applications and better interpretation of seismic and tomography data. When commercially exploitable reserves of hydrocarbons are located, Shell needs the technology required to produce them (get them out of the ground), in a safe, economic and environmentally acceptable manner, whether they be in the form of gases, liquids or viscous fluids like bitumen. Finally, once the hydrocarbons have been produced, technology needs to be employed to refine the hydrocarbons into various products such as natural gas, sulphur, petroleum and petrochemical products.

INDUSTRY'S PERSPECTIVE ON ESTABLISHING AND CONDUCTING PRELIMINARY CONTACTS

How does a multinational energy company establish and conduct preliminary contacts with a view to acquiring or selling technology? It must be recognized that the energy industry is capital-intensive and long-standing relationships have been built up over decades of activity with equipment suppliers, contractors (such as drilling contractors, seismic contractors and engineering contractors), and even with competitors with whom technology may be transferred. The relationships between these various entities are usually clearly defined and well understood by all of the parties involved.

Technology transfer with universities has changed over the last two decades in Canada and is improving, in large measure because of the establishment of technology transfer offices at most Canadian universities. This is heightening awareness of technology transfer issues and promoting discussions such as are occurring at this conference. It is generally standardizing the approach and easing the manner in which industry can establish and conduct its preliminary contacts with universities on technology transfer matters.

As a backdrop to this discussion it should be emphasized that industry often exhibits a basic conservation or caution in dealing with third parties in technology transfer matters. Industry, after all, is profit oriented. A company is only able to stay in business if it provides a satisfactory return to investors. For this to happen the company must establish a successful track record of comparing costs and risks of given projects and the associated benefits.

Consider the development of the Bearberry Reservoir. During the 1960s when Shell was exploring northwest of Calgary it drilled a well that revealed the presence of the Bearberry gas reserves, containing 90% hydrogen sulphide (H_2S) content and significant amounts of dissolved elemental sulphur. Alberta has been blessed, or cursed, depending on how you look at it, with sour gas reserves. Shell Canada has developed expertise in exploring these reserves. One example is Waterton, where natural gas containing up to 15% H_2S is produced. Elsewhere in the Shell Group, natural gas reservoirs containing up to around 30% H_2S have been produced. Never in the world, however, has any natural gas reservoir containing 90% H_2S been commercially produced. Bearberry is called an ultrasour natural gas reservoir of, by some, a sulphur mine. The technical problems are great.

During production a safe system must be used that will prevent sulphur from precipitating and plugging the production means. The technique that will likely be demonstrated at Bearberry involves pumping hot oil down-hole to dissolve the precipitating sulphur and then regenerate the oil at the surface (stripping the sulphur out) so that the oil can be pumped down-hole again.

Consider the costs and risks associated with the development of technology for this project. Teams of researchers have worked out the theoretical manner in which the reserves can be produced at a cost of millions of dollars. Will the scheme work? Those involved in the project believe it will. What is the risk then? The risk is in determining how long the reservoir can be produced and how economically. In order to get better information on these unknowns and in order to put the technology to the test, a demonstration plant is required in the field at a size that is less than commercial size. Its main purpose is to demonstrate the technical and economic feasibility of the technology proposed. The demonstration plant is not expected to be a profitable operation: it will produce 100 tons of sulphur a day at a capital and operating cost over five years of approximately $115 million. If the demonstration plant proves the commercial and technical viability of full-scale exploitation, the risks of progressing to a commercial plant move away from being mainly technical risks and toward being mainly economic risks. For example, will the long-range sulphur demand stay sufficiently bouyant to support a commercial plant of the scale contemplated at Bearberry (3,500 tons of sulphur a day)?

◄ Opportunities ►

Once the technology is proven, licensing out opportunities exist, because ultrasour reserves exist elsewhere in the world. If, by licensing technology from Shell Canada, others can develop their ultra-sour gas reserves safely and predictably, without needing to spend the millions of dollars and time on research and demonstration, there should be demand for licenses. If development of competitors' ultrasour gas reserves does not adversely affect the sulphur market on which Shell Canada relies, then we are looking at a viable technology transfer opportunity.

Certain entities with which companies deal, such as entrepreneurs, have the perception that industry has deep pockets, making at least some of the larger players even more cautious than normal in establishing initial contacts. Large companies often go to great lengths to act in a legally correct and ethical way in transacting with universities, governments, and third parties in general. But most large companies have to beware of a third party, whose technology was evaluated and rejected (and maybe alternative technology developed or acquired), who might claim, sometimes years after the fact, that its technology had been misappropirated and misused (usually in some vague and undefined way). This type of allegation is extremely difficult to defend against and victories are often Pyrrhic.

A case in point involved a $200,000 piece of equipment for use at a production facility. The equipment was of the sort that had previously been the subject of an article in an oil and gas trade journal. The article described equipment that solved a problem being faced by engineers operating the production facility. There were preliminary discussions with the equipment company, who demonstrated the workability of their equipment, but the cost of providing the equipment was too high. So the engineers developed their own design. It cost many times the purchase price of the original equipment to subsequently defend against a law suit brought by the equipment supplier alleging its trade secrets had been misappropriated and misused. A Pyrrhic victory indeed.

That is not an isolated example. It is small wonder that companies have adopted, as a security measure, the expedient of having third parties sign a letter making it clear that preliminary discussions are to be conducted on a nonconfidential basis and that the company is free to use in any way and to disclose any information received in such discussions, subject only to patent rights. It is too risky to always rely on custom in the industry and good-faith among the participants.

A final comment on industry perspective on establishing and conducting contacts for the purposes of technology transfer. Most companies that have in-house research capabilities realize they cannot be technology leaders in all areas all the time. As technology becomes more important and more pervasive, and as changes in technology have become more quickly paced, companies have been forced to accept that in-house reseach must focus on areas where cost effectiveness is demonstrated and to access technology from third parties or develop it through consortia or with third parties like universities. Shell Canada, for example, is involved in making research consortia work in areas like robotics, artificial intelligence, and hydrogen.

TYPE AND SCOPE OF AGREEMENTS

There are many different types of agreements that contain technology transfer transactions. When personnel are welcomed into a company there is normally an employee contract that addresses personnel matters. Some have to do with technology. Obligations to the company to keep technical information in confidence and to apply one's experience and knowledge for the benefit of the company are often set out in such contracts. When personnel are being hired from a company's competitor, then such additional issues as abiding by obligations to hold the competitor's information in confidence are also usually addressed. One of the more effective ways to transfer technology from universities is to exchange personnel on sabbaticals or otherwise between industry and the university. This is happening more frequently. And contracts between the individual, the company and the university frequently deal with such issues as ownership of the developments of the seconded personnel, rights to use such developments, and obligations restricting disclosure and perhaps use rights to prior-developed information. In areas where pioneering research has been contemplated in a university, the results of which are not likely to be commercially exploitable but will benefit industry as a whole, companies and often governments will provide grant money on a "no-strings-attached" basis. Where research is being conducted with the object of generating results that might provide a commercial edge to a sponsor, then the sponsor and the university will likely negotiate a contract for the conduct of the research, addressing such things as limitations on the disclosure of the results and ensuring that the sponsor's freedom of action and some degree of exclusivity is obtained. In contracts or purchase orders for the purchase of equipment, there is frequently a technology transfer element. Standard forms for such contracts are usually designed to protect companies by obliging vendors to keep secret company confidential information and by providing patent indemnity and other assurances so that the company has the freedom to use the equipment being purchased. Similar propositions are also found in agreements with engineering contractors relating to the engineering procurement and/or construction of projects. When entities enter into agreements for joint ventures or collaboration there are usually provisions directed to the manner in which technology is to be acquired, developed or handled in the joint venture or collaborative effort.

LICENSE AGREEMENTS

The main vehicle for the transfer of technology is of course the license agreement. So it is appropriate to concentrate our efforts on them. License agreements are vehicles in which owners of proprietary rights to technology, most often patent rights and/or rights to know-how (or more restrictively, trade secrets) extend those rights, enabling the licensee to exploit the technology.

The extension of rights for the technology, to the licensee, can be on a nonexclusive, exclusive or sole basis. Nonexclusive means the grantor can extend similar rights to other parties at its discretion. An exclusive grant means that the licensee is guaranteed that no competitor (including the licensor) will be permitted to practice the licensed subject matter. A sole grant means that, other than the licensee, only the licensor will be entitled to practice the license subject matter. A license may be granted on a site or plant basis, so that the licensee is authorized to practice the licensed technology at a defined location or plant site or a licensee can be authorized to practice the licensed technology in a geographical area, be it national or international in scope.

The technology must be defined clearly in the license. A licensor normally prefers to have a restricted definition of the technology whereas the licensee prefers as broad a definition as possible. The license contains clauses directed to the grant of rights, royalties payable, performance guarantees and warrantees, and other clauses necessary to enable the parties to address all the factors that might, but for the license agreement provision, impede the future successful technology transfer relationship that grows out of the license.

The licensee, for example, wants to ensure that it will be taught the technology and the best and most cost-effective methods for implementing the technology. It will want assurances that the technology will work, that third parties will not attack its freedom to exploit the technology, and that if difficulties arise in implementing or exploiting the technology that the licensor will stand by it in a joint effort to solve the difficulties. The licensor has a different set of, albeit interlocking, concerns.

A licensor wants to ensure that fair consideration in the form of royalties is obtained for the grant of rights to its technology. If the license is exclusive or sole, the licensor will want to ensure that the technology is exploited optimally by the licensee. If nonexclusive, the licensor may want to ensure that improvements to the technology are available from a given licensee so that they may be shared with other licensees. In any event, the licensor will probably want the licensee's exploitation of the technology to be a success so that the licensor's reputation is enhanced, which may attract other licensees to the licensor's technology. If there are third-party attacks on the technology in future, the licensor will not want to be bothered by trivial questions such as non-commercial competing usage of the technology or by third parties accusing licensees of patent infringement for activity not directly covered by the license.

We will look in greater detail at some of the provisions in a license agreement that most affect the wants and needs of the respective parties as described above. It is essential to remember that a license is only really successful if the wants and needs of both parties are satisfactorily addressed for the present and future.

GRANT CLAUSES

Consider the grant clause in a license agreement. The purpose of a grant clause is to clearly define that which the licensee is free to do with the technology. It defines the rights required to use the licensor's technical information and the appropriate licenses under patent rights directed to the manufacture of an apparatus or the practice of a process, the right to use a device or product, the right to sell the apparatus, device or product manufactured using the process, and the right to sub-license others. All of these rights should be circumscribed by location where the licensee is entitled to practice the rights. The grant clause should also set out those things that the licensee must do (such as meeting any minimum quotas, reporting improvements and granting back rights to these improvements and under any patents covering them).

ROYALTIES

Royalties are among the most important and most written about part of the license. Just what is the "right" royalty for a given technology transaction? Obviously, royalties are not always the only consideration under a license agreement. Consideration might be received in the form of a cross-license arrangement or as part of the settlement of a dispute over technology ownership. There are other possible benefits to a license, such as the grant back of rights to improvements previously mentioned.

There are a number of rules of thumb that can be used to arrive a "ball park" royalty. For example, running royalties can be based on a percentage of gross sales (normally in the 2-10% range), depending on the profitability of the product being manufactured. Additionally, one can seek to ensure that the licensor shares in the anticipated profit of the licensee, attributable to the implementation of the technology, (typically 25-35%). If the technology being licensed is similar to that commonly available elsewhere, or that has been licensed in the past, there may be a tendency to expect royalty payments to stay close to these "established industry norms." Finally, one successful negotiator has been heard to remark that the only limitation on the size of royalty payable to his client licensor is the size of the wheelbarrow his client has with which to wheel away the royalties.

In my experience, rules of thumb cannot be followed slavishly. Every set of facts must be examined on its own, keeping in mind some basic principles. First, consider the cost to the licensor of developing or acquiring the technology being licensed. Hark back to the Bearberry example. The developer of the technology who has spent $115 million developing a body of technology will be loath to pass on rights to a competitor who is not willing to pay, as a royalty, a significant proportion of those R&D costs.

Second, one must also consider the options facing a given licensee and licensor. If a licensee is being pursued by several prospective licensors offering comparable technologies in terms of quality, reputation, technical support capabilities and the like, the licensor is not likely to pay more for one than the other simply because the development costs of one is greater than the other. Consider also the licensor's options. If a given licensor has developed a given technology, but is unable to exploit it itself due to limitations of capital or the nature of its business or whatever, it is much more likely to be willing to negotiate a lower royalty rate with a prospective licensee than is a licensor who has the intention and capability of exploiting the technology itself.

A given company's profit motive may only be served by licensing a technology at inflated royalty rates. This brings us to a third consideration: the profit made by a licensee from exploiting a given technology ought to be shared with the licensor in a proportion commensurate with the risks accepted by the licensee, capital expenditure required to implement the technology and any other factors that affect profitability in a given case. It is important not to lose sight of the fact that a license is not a static or mechanical thing that automatically generates royalty payments. A license is an organic or evolving thing that only works well if the parties believe and continue to believe that it is serving their respective interests. We need a "win-win situation" for a license agreement to really work well. If a licensee ends up paying all of its profits to its licensor, how can it be expected to stay in business? No business means no royalties. A licensor that does not think it is receiving a fair share of the profits being generated for a licensee through implementation of its technology will be unwilling to invest time, effort and money in assisting the licensee to solve any problems that might arise during implementation of the technology or if the licensee is attacked by third parties for patent infringement or the like, or is faced with unlicensed competition.

◄ Relationship ►

Finally, the relationship of the parties must be considered. Are the licensor and licensee competitors? Is the licensor an engineering contractor that makes a living not only through licensing its technology but also by providing engineering services, design, and procurement and construction expertise associated with given projects. The latter kind of licensor may be much more flexible in license negotiations than the former, knowing that its bread and butter can be earned under an engineering, procurement, construction contract that is connected to the project for which the technology is licensed.

Royalties can be sought on a running basis or on a lump-sum or a prepayment-of-running-royalties basis. A prepayment or lump-sum payment is often calculated by looking at the present value of the running royalties contemplated over 5-7 years of a license period. A licensee may prefer to have royalties couched in terms of running royalties with an option to prepay. A lump-sum payment made as an optional prepayment of running royalty may be treated as an expense rather than a capital expenditure, which may receive preferable tax treatment. Conversely, a licensor may prefer to receive royalties in such a way that they can be characterized as capital receipts. Royalties are normally based on revenue streams or on capacities or quantities of production of the licensor. If a license envisages sub-licensing, then royalty payments back to the licensor are usually calculated as a percentage of royalties received by the licensee from sub-licensees. If royalties are to be paid over a period of time, it is common to apply an inflationary factor to them, normally based on such things as the Consumer Price Index or the Producer Price Index. Information on the Consumer Price Index is found in catalogues published periodically by Statistics Canada or by phoning Stats Can at (613) 951-8116 (information is often also available through local federal government offices). Information on the Producer Price Index can be obtained from the U.S. Division of Industrial Prices and Price Indexes at (202) 272-5118.

Some other housekeeping matters. One must ensure in discussions around a royalty rate that there is agreement on the currencies being used. There is nothing more embarrassing than to conclude a deal on the basis of profitability and economics calculated using Canadian dollars only to find out that the party opposite has been rubbing its hands in glee on the basis of receipts in American dollars. Licenses that are exclusive or sole normally have minimum royalty requirements to encourage the exploitation of technology. In this case where minimums are not met, the licensee normally has the option of meeting minimum royalty payments to retain its exclusive license or to suffer some defined penalty. The penalty normally ranges between termination of the agreement and having the license default to a nonexclusive status. Finally, a licensee is normally obliged to make periodic reports of its licensed activity and the licensor often wants to be able to inspect the licensee's records to ensure that the reporting has been done accurately. The licensee would prefer to have such an inspection conducted by its normal outside accountants retained for such things as annual reporting or at least by an important third-party firm of chartered accountants.

ENFORCEABILITY

Licenses are no more and no less than contracted arrangements between parties, and they are enforceable as such. Courts of civil jurisdiction or boards of arbitration, depending on the nature of the dispute and the presence or absence of dispute resolution mechanisms in the contract, can be enlisted to review disputes and implement the intention of the parties, usually constructed from the contract. It is important that the intention of the parties be clearly expressed in the language of the license. It is equally important for the parties to contemplate the various scenarios possible over time and express the course of action to be followed for each. Some particularly important clauses in this regard are the performance guarantee, warranty, and hold-harmless clauses.

Consider first the performance guarantee. In negotiating a license, a licensor would very much like the licensee to accept at face value that its technology will work as well as advertised. A given licensee, of course, is likely unwilling to risk what can be a large investment in capital and royalties merely on the licensor's claim that its technology will work. So the licensee will normally insist that the licensor guarantee the level of performance of its technology to a minimum that is in line with acceptable economies for the licensed unit. The licensee would like the licensor to accept the responsibility of ensuring the licensed unit will operate at that minimum acceptable level, and if it does not, to take whatever steps are necessary, at its cost, to make the unit perform at that level. These are the two extremes.

Normally a compromise is reached, and a performance guarantee is provided by the licensor where, subject to certain safe guards such as adequate detailed design and construction, review by the licensor, presence of licensor staff and adequately trained and experienced personnel by the licensee, and all the necessary materials and feedstocks to perform test runs, etc., that the licensed unit will operate in a defined test run mode at a defined level. If the test run is failed, for reasons attributable to the licensor, such as an error in the design of the licensed unit, then the licensor will expend effort to assist in modifying the design so that a test run can be satisfactorily passed or alternatively pay liquidated damages up to a specified minimum, normally 50% of the royalties. This standard approach to performance guarantees has limitations.

Consider a process licensed from a third party contractor for a royalty payable over eight years on a running basis. The license has standard performance guarantee provisions, generally as described above. After the licensed unit starts up, there is a series of events that postpone the test run. Some months later, immediately before a scheduled test run of the unit, an essential piece of major equipment fails catastrophically. It is impossible to conduct the test run or run the plant. If this is a plant that cost over half a billion dollars to build, that was designed to manufacture a thousand tons of product a day, selling at over a thousand dollars a ton, you are looking at lost revenues of over a million dollars a day.

If this sort of scenario is actually played out before your eyes, performance guarantees take on a whole new meaning. The licensor and licensee of course will seldom agree on the cause of the failure. For example, the licensee may claim that a design error caused the catastrophic failure. The licensor may claim that the failure was attributable to faulty operation of the unit. If the parties want to continue to do business with each other they will try to resolve their differences and agree to a resolution that includes combinations of such things as a lump-sum payment under the performance guarantees, a redesign of the failed equipment, and a waiver of the need to pass a test run.

◄ Warranty Clause ►

Warranty clauses are directed to the licensor's right to license the technology, to the identity of other licensees, or in an exclusive license that there are no other licensees, to the fact that the subject patents are valid and to layout the course of action that will be followed if third parties bring action against the licensee for patent infringement, etc. Normally, the licensor will limit its exposure to indemnifying the licensee against third-party patent infringement by putting a cumulative ceiling on the amounts payable equal to 50% of the royalties. A licensee will want to ensure that a licensor will defend against such third party patent infringement actions and perhaps will want to require the licensor to obtain rights under the third-party patents or to modify the licensed technology so that it avoids infringement. Patent warranties and indemnities are common in licenses. However, the pedigree of trade secrets and know-how is often equally important, and it is worth considering whether a license should explicitly deal with the possibility that third parties might attack a licensee on the basis that the licensed technology is or contains elements that were misappropriated from a third party. It is important to note that in Canada a licensee is estopped from challenging the validity of patents under which it has taken a license. This is opposite to the law in the United States. If there are any reservations on the point, then, it is important to be explicit and have the licensor state that it warrants that the patents under which a license is granted are valid, that the licensee is not estopped from challenging the validity of any patents being licensed, and to establish the consequences of invalidity of any or all of the licensed patents.

Finally, the parties should put their minds to the matter of unlicensed competition. The licensee's competitors will be gaining an unfair advantage if they are allowed to exploit the licensed technology without paying royalties to the licensor and the licensor, of course is foregoing revenue and perhaps other consideration. A common approach to this problem is for the parties to agree that any unlicensed competition, above a defined minimum level of activity, will cause the royalty payment requirements to cease or will trigger a royalty repayment, unless and until the offending competition is attended to by the licensor either by way of putting in place the appropriate license agreement(s) or by arranging that the offending competitor's activity is terminated.

UNIVERSITY/INDUSTRY CO-OPERATION

As mentioned earlier, a progressively more favorable climate for cooperation between industry and universities has been evolving over the last two decades. There is still much yet to do. The historical difficulties that have hindered cooperations between industries and university have stemmed from the respective differences in the needs and wants of the parties.

Universities have, of course, traditionally been governed by the prime directive of disseminating knowledge through teaching and publication. Traditionalists often see universities as serving societal needs on almost a philanthropic basis. The thinking has been that universities should endeavor to stimulate creative and intellectual activity and to increase the general level of knowledge available to the public. This traditional view has been tested by a number of changing economic, political and philosophical factors in the world. Governments have become less generous in their funding of universities. Industry has recognized that universities represent a potential source of highly educated and specialized skills that can be steered to conduct work in areas of interest and potential commercialization at reasonable cost. Various levels of government have established funding schemes that encourage industry/university cooperation by, for example, agreeing to match industry funding for certain industry sponsored research projects at universities. In response to the evolving climate of cooperation between universities and industry, universities have developed and modified technology transfer policies, to clarify the respective rights and obligations of university staff, students and the university itself. Technology transfer organizations have been developed at or in association with universities to assist staff and students in technology transfer matters. The main purpose of the establishment of technology transfer offices at universities appears, to an outsider, to be to seek to ensure that the universities' traditional roles of publication and teaching are not unreasonably restricted, that appropriate compensation is received for the time and effort provided by university personnel and the monies worth attributable to the universities facilities resources, and the background developments or know-how brought to a given project by university personnel. These are reasonable endeavors, generally supported by industry. Technology transfer offices that allow industry to discuss industry/university technology transfer issues with fellow technology transfer professionals.

Conversely, industry have their share of identifiable needs. For example, they need to be certain that their confidential information, if disclosed to university personnel, will not find its way into a thesis or some other university publication that is made public. Industry sensitivity to this issue is heightened every time a university person proclaims that they must publish or perish. Companies, being the practical and profit-seeking entities that they are, are loathe to invest significant amounts of money in a research cooperation with a university unless they have some assurance that the results of the effort will be implementable or will lead to further development that will give an implementable result. By implementable we mean not only that the results are capable of being reduced to practice in a commercial sense, but also that the necessary rights to exploit the results are either obtained or can be obtained at a known price. As previously described, the cost of development of research results is often an order of magnitude greater than the cost of basic research and the cost of commercialization is often several orders of magnitude greater. Industry loathe to risk the ever increasing expenditures necessary to commercialize technology if there is no guarantee of freedom of action at the end of the day.

Industry and university have come together in recent years and have, in my view, shown increased willingness to compromise, so that cooperations can proceed for the general good and the good of the respective parties. More recently, it has been recognized that with the ever-increasing pace of technology development, coupled with the increasing specialization and sophistication and breadth of application of new technologies, collaborations are required to fund a broad base of work in areas of general relevance. This is leading to the development of research associations or collaborations that conduct research, such as C-FER here in Edmonton, and collaborations that direct and administer research conducted at other establishments such as universities, research laboratories and offices, like PRECARN for articial intelligence and robotics related research and the Hydrogen Industry Council for hydrogen-related research. The approach being adopted by these associations, which appears to be highly supportable, is that they should be government and industry supported, industry driven, and sufficiently flexible to recognize the respective needs of industry and university. Time will tell how well these various efforts succeed, but the foundation has been laid and it is hoped that they will generate the means to assist in improving Canada's international competitiveness and growth.