The State of Technology Transfer in Canada:

Assuming Failure and Assessing Blame

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“Technology transfer in Canada is dead”. This sentiment has been casually thrown around quite a bit over the past few years.

Recently at a high-level meeting of technology transfer professionals and government officials, a representative of the Government of Canada expressed that intellectual property was no longer a priority of the federal government when it came to research.

In 2011 The Federal Government commissioned an expert panel that released a report entitled: Review of Federal Government Support to Research and Development. The report addressed the issue of academic technology transfer in Canada by stating:

With regard to IPRs…negotiations over IPRs seem to be impeded most often by divergent valuations of early-stage intellectual property…What inventors and institutions often see as an invaluable breakthrough, businesses may see as needing costly downstream development… the Panel is concerned that Canada is not benefiting as much as it should from the valuable IP being generated in this country…it is less adept at reaping the commercial benefits…there is a need to develop the skills and knowledge of Canadian entrepreneurs regarding the effective management of their IP.

This report further went on to state that barely 2% of businesses sponsored consider Universities as a primary source for new products. In essence the report was pleased with the research being conducted but believes the commercialization of intellectual property is not a success.

University administrations across the country have been moving to reorganize and reduce costs by eliminating technology transfer positions or closing offices altogether and have begun embracing an agenda of engagement with industry as opposed to the creation, protection and development of value in the form of University IP.

So if technology transfer is a failure surely there must be someone to blame. The consensus, unfortunately, is that it is the technology transfer offices themselves that have killed this sector through inefficiency, inadequacy and unsustainability. What this paper will show is that technology transfer as we have come to measure it has been dealt a near fatal blow but that the blame must be shared by governments, industry and senior university administrators alike.

This paper will examine the history of technology transfer in Canada including those efforts by federal and provincial governments like to stimulate the transfer of technology from academic research to the marketplace.  It will look at the modalities of the transfer of research discovery to the marketplace at various Canadian universities and hospitals. It will look at the wide variety of intellectual property policies and the perceived implication that the variation and policies has created a historical, and persistent, problem with driving technologies into the marketplace.

This paper will look at the various actors in the Canadian technology transfer system including academic technology transfer offices or TTO's, University administration, Provincial and Federal government granting organizations and lastly the broad amalgamation of all business partners that we refer to as “Industry”.

Background:

Canada is a Confederation of individual Provinces (10) and territories (3) which shares legislative power and responsibility with the Federal, or national, government. Provinces have broad responsibility for property, health care, education, the administration of the criminal and civil courts and regional economic impact while the federal government maintains responsibility for the military, foreign affairs, telecommunications, intellectual property and criminal law (legislatively).

Canada’s population is approximately thirty-five million (35,000,000) with ¾ of that population being concentrated in the three largest Provinces by population (Ontario, Quebec and British Columbia). Fully eighty-one percent (81%) of Canadians live in urban centres. Canadians are well educated with fifty percent (50%) reporting a post-secondary degree or diploma and that number rises to fifty-three (53%) if one adds trade or professional certifications to the category. Canada’s economy ranks 12th in the world in nominal GDP and that economy is spread across agriculture (1.8%), industry (28.6%) and services (69.6%). The Canadian economy has evolved from being primarily resource sector dependent to being more diversified through innovation and high technology companies such as Nortel, Blackberry and Bombardier.

Higher Education in Canada is comprised of two broad categories of institutions: universities and colleges. Universities are those granting degree programs and offering under-graduate, masters and doctoral programs while colleges generally are diploma granting. Both colleges and universities participate in research but the majority of basic research is conducted at universities while colleges provide more applied and trade specific research.

Canada has ninety-three (93) recognized public and private universities (including theological schools) and 183 recognized public colleges and institutes, including those granting applied and bachelor's degrees. In addition to the recognized institutions, there are 68 university-level institutions and 51 college-level ones operating as authorized institutions, at which only selected programs are approved under provincially established quality assurance programs. Tuition costs at universities averaged $4,524 in 2007–08, with international student fees for an undergraduate program averaging about $14,000 annually. At colleges and institutes (in the nine provinces outside Quebec), the average tuition was about $2,400 (Quebec residents do not pay college tuition). Education is also funded through the money that governments transfer to individual students through loans, grants, and education tax credits.

Participation in post-secondary education has grown significantly in the past few years, whether measured by numbers of enrolments or by the proportion of the population in any given age group who are attending college or university. While women continue to make up the majority of students on both university and college campuses, they are still in the minority in the skilled trades. University Attendance and Graduation According to the Association of Universities and Colleges of Canada, in 2005, there were 806,000 full-time university students (an increase of nearly 150,000 in the previous four years), as well as 273,000 part-time students. In 2005, Canadian universities awarded an estimated 175,700 bachelor's degrees, 33,000 master's degrees, and 4,200 doctoral degrees. There are more than 10,000 undergraduate and graduate degree programs offered in Canadian universities, as well as professional degree programs and certificates. Most institutions provide instruction in either English or French; others offer instruction in both official languages.

Degree-granting institutions in Canada focus on teaching and research. In 2013 thirty-seven (37) universities reported a total of $5.6 billion worth of research and development. There is a considerable range of research expenditures across the Canadian landscape. According to Research Infosource only the University of Toronto had research expenditures in excess of $1B while the second place institution, the University of British Columbia was almost $500M behind ($1,038M and $585M respectively) while at the opposite end of the spectrum three smaller, less research intensive universities, reported research expenditures less than $10M and one disclosed expenditures of less than $2M.

The Federal Government, through Industry Canada, funds research at Universities and hospitals in the Provinces under three (3) national granting programs that are administered under Industry Canada. These agencies include Natural Sciences Engineering Research Council (NSERC), Canadian Institutes for Health Research (CIHR) and the Social Sciences and Humanities Research Council (SSHRC). In addition, large infrastructure programs for the development of research capacity at research institutions are administered by the Canadian Foundation for Innovation. The University sector continues to rank second in research expenditures after private sector research in Canada. In the period between 2002 and 2012 higher education spending on research has increased by approximately 55% while real spending on research by the private sector has declined since the economic downturn of 2008. The Federal governments expenditures in support of basic research have, by contrast, remained essentially the same, in real terms, since 2007 and have recently began to shrink.

Provincial support of research and development varies widely from province to province. The majority of funding from provincial sources is concentrated in Quebec, Ontario, British Columbia and, Alberta.

Canada has no national policy on the ownership of intellectual property (“IP”) arising from federally funded research. In contrast to the Bayh-Dole system in the United States, IP derived from public research dollars is owned in accordance with the policies of the University where the research was conducted. The lack of a coherent policy on arising intellectual property has precluded Canada from developing the type of systematic structure for the commercialization of IP by Universities. Across Canada there are three broad categories of IP policies governing federally funded as well as other research expenditures: (a) Institution owned; (b) Creator owned; and (c) Hybrid.

Within the diverse landscape of IP policies at Universities across Canada there has arisen a number of different models of technology transfer offices that are tasked with the commercialization of arising IP. These models would include internal offices, external not-for-profit corporations, integrated university/industry liaison offices and offices that are consolidated with other aspects of the research enterprise (such as sponsored research). Clusters of offices have been created through both federal and provincial funding and support in order to share best practices and to augment skill sets in smaller offices.

Institutional Support for Technology Transfer Offices

Not all Universities in Canada have technology transfer offices. Some, where the intellectual property is owned by the creator, have chosen to defund internally supported commercialization activities (Carleton University) while some that own the IP are members of agencies that provide the commercialization services to multiple institutions (TecEdmonton, Springboard Atlantic). There are almost as many labels that could be put upon offices as there are offices across Canada but this paper will employ a convenient framework for the purposes of coverage as opposed to completeness. Broadly speaking technology transfer offices in Canada can be categorized as:

Research Services (Ad Hoc):

In Canada this is where most mature (>10 years) began and where many remain. At Universities that are limited in the amount of research expenditures and expected commercialization are limited the technology transfer function will typically be appended to the diverse operations of a research services offices including grants management, ethics approval and post award management as well as sponsored research. These offices will typically have less than one (1) FTE dedicated to licensing and licensing will be an infrequent activity. Should the level of annual research expenditures grow beyond $100 million the technology transfer function may be transferred to a discrete office. These offices will typically have more ad hoc approach to commercialization an will receive invention disclosures, review technologies, utilize external patent agents for preparation and filing of patent applications and may use external legal counsel for negotiation of licensing deals with third parties. Given that these officers are typically called upon for grant support, research administration and general administration there is often constraints upon the commercialization outputs that can be generated and commercialization activity is often lead by faculty inventors.

Traditional licensing office (US Model)

Offices that are charged with the sole task of receiving invention disclosures, protection intellectual property and licensing same to third parties or spin off companies are declining in number in Canada. These offices can be located within the University administration of can be an external, not for profit, corporation (Parteq Innovations/Queen’s University). These offices will often employ both technology transfer officers as well as internal patent counsel. With a mandate to maximize licensing revenue these offices are primarily focused on securing exclusive licenses and thereafter protecting those revenues through litigation. These offices will not be involved in industrially sponsored research, applied research, collaborations or non-revenue generating intellectual property agreements such as material transfer agreements (MTA’s).

Industry Liaison Office (Full Service)

Through design (University of British Columbia) or through mission creep these offices are meant to provide the full range of services that involve engagement with industry that is based on IP or research collaboration and will typically negotiate, draft and administers industry-sponsored research with industry partners and does the same for government and non-profit contracts and agreements. In addition to working on collaborative and sponsored research, ILO’s also work with researchers to assess the potential impacts of their research outputs, and to find suitable partners, licensees, stakeholders or investors to implement, develop, commercialize or otherwise advance these outputs and maximize their academic, societal, economic and financial impacts. These types of offices also work to facilitate and foster the creation of spin-off companies based on IP developed at the University and supports entrepreneurial activities of a wide range of student, staff, faculty and recent alumni. The University of Ottawa developed this type of office in 2002 with a view of expanding both the research enterprise of the University and its affiliated hospitals but also the outcomes from that research.

Integrated (Community Based)

The most recent model found in Canada this type of office may operated by a provincial agency (Springboard Atlantic) to provide the technology transfer services for multiple organizations based regionally and to alleviate the need for the development of comprehensive ILO structures (Springboard serves: Acadia University, Cape Breton University, Collège Communautaire Du Nouveau-Brunswick, College Of The North Atlantic, Dalhousie University, Holland College, Mount Allison University, Mount Saint Vincent University, New Brunswick Community College, Nova Scotia Community College, Nscad University, St. Francis Xavier University, Saint Mary’s University, St. Thomas University, Université De Moncton, University Of New Brunswick, University Of Prince Edward Island). These organizations can be part of municipal economic development activities whereby the local effort to generally increase business opportunities is enhanced to include the capacity to provide academic technology transfer services within an environment that is more aligned with industrial participants (Innovate Calgary serves University of Calgary and University of Alberta). The key differentiator for these types of organizations is that they are not part of the institutions that they serve and as such the organizations bear neither the cost nor the risk of non-performance of the research derived intellectual assets at first instance.

Staffing levels in technology transfer offices had continued to rise between 2001 and 2008 but have since begun to decline according the AUTM Survey of Licensing Activity licensing professionals from reporting institutions more than doubled from 89 full time equivalents (FTE) to 187 and non-licensing support staff in those offices rose from 94 to 167. However the disparity in office staffing levels continues to be evident from 2011 data from the same source which showed 22% of offices had one, or fewer, full time equivalent staff dedicated to licensing while the same number of offices reported nine (9) or more staff dedicated to licensing.

Stimulating Technology Transfer

In 2002 the Canadian Government delivered an innovation policy that included significant effort to increase the innovative capacity of Canada broadly and within the University technology transfer space specifically. In exchange for a commitment to increase indirect costs payable by the Federal granting council (overhead) the Association of Universities’ and Colleges Canada committed to tripling the output of research commercialization within ten years. As can be seen from the AUTM data table below, this has not occurred.

That same year, 2002, the NSERC Intellectual Property Mobilization (IPM) program was modified to provide individual grants to institutions to increase the size and level of training of technology transfer professionals. Under such program the number of FTE grew steadily as such positions were directly funded. In larger institutions the impact of the funding was less significant while at smaller universities these grants were essential to the creation of the first full time positions dedicated to technology commercialization. These grants lasted for three years and were thereafter terminated in favour of multi-institution grants that were intended to fund research projects and share best practices amongst offices. The IPM program was discontinued in 2007 in favour of the creation of newly funded Federal government initiatives (see below). The corresponding withdrawal of IPM funding for positions resulted in the almost immediate decline in licensing FTE’s in 2008, a trend that has continued to this day.

In 2007 AUTM published its Annual Licensing Survey (Canada) wherein a change was made to the reporting of the annual research expenditures and the annual licensing income. Prior to 2007 these items were presented in such a way as to create the impression of an immediate relationship between the suvey year research expenditures and the resulting commercialization impact as measured by the licensing income. The publication further characterized this gap as being between five and seven years from the research expenditure to when commercialization income may reasonably be expected. A more recent examination of commercialization trends at Columbia University demonstrated that over a 29 year period the time lag from disclosure of an invention (necessarily after the expenditure of the research dollar) showed that five years after disclosure approximately 50% of disclosed inventions were licensed. It can therefore be reasonably expected that the gap between research expenditure and commercialization revenues in the form of reportable licensing income may take upwards of nine years as shown below.

In the period of the growth of technology transfer offices in Canada there was a corresponding increase in the number of inventions disclosed and the eventual execution of licenses. This growth was accelerated in the IPM funding period. But when one takes into consideration the short duration of dedicated resources for the hiring of technology transfer (2003 – 2008) and the immediate decline in licensing professionals after the termination of such funding it is easy to suggest that the impact has been negligible as the number of disclosures and agreements have not fallen off as rapidly but one need only look at these figures in light of the aforementioned lag to understand that the 2013 drop in licensing income back to 2010 levels, despite the continued increase in the number of disclosed inventions, is likely indicative of a reduced capacity for Universities to efficiently move discoveries to the marketplace due the decline in licensing professionals.

Diversification

When the Federal government stopped funding positions at Universities in 2008 it did not stop funding commercialization activities completely, instead it shifted the focus. The new focal point of Federal commercialization spending has been Centres of Excellence for Commercialization and Research (“CECRs”). A CECR is a not-for-profit corporation created by a university, college, not-for-profit research organization, firm or other interested non-government party that matches clusters of research expertise with the business community. Each Centre shares knowledge, expertise and resources to bring new technologies to market faster. These cost-shared centres stimulate new commercialization activities that would likely have never taken place without the CECR program.

Examples of these centres include the Centres for Drug Research and Discovery in British Columbia, the Centre for Regenerative Medicine in Toronto, Ontario and Green Chemistry Centre in Kingston, Ontario. Each of these centres applied for, and won in a competitive process, up to $15 million of federal government funding over a five year period. The centres are unique public/private partnerships in that they are operated with participation from companies as well as academia to receive invention disclosures, analyze same with a view to determining if the CECR can provide resources to better translate that discovery to market and thereafter the centre itself will either conduct the development work to take the product to the next logical staging (Greencentre) or provide the inventor with funding to allow the researcher to conduct translational research within their own lab (CDRD). The goal of the CECR program is to: “*matche(s) clusters of research expertise with the business community to share the knowledge and resources that bring innovations to market faster. Centres advance research and facilitate commercialization within four priority areas: the environment; natural resources and energy; health and life sciences; and information and communications technologies.”*

Through the centres the federal government has sought to bring sectoral focus to limited dollars while mandating engagement with industrial partners from the outset (design, management, governance) to ensure that the centres are best able to achieve their objects and purposes. While the centres are mandated to become self-sufficient (through the development of non-grant based and recurring revenues), they are open to seek a renewal of their funding from the federal government which, may or may not be an indicator of the success to date of a relatively new program.

These centres, affiliated or housed at sponsoring university campuses or research parks, are specific to a sector or industry and most are amenable to receiving invention disclosures within that sector or industry from Universities across the country. The Federal government has committed more than $400M to more than twenty centres including the following active centres since the program was launched: Accel-Rx Health Sciences Accelerator ($14,500,000 for 2014-19); Advanced Applied Physics Solutions Inc. ($14,955,575 for 2008-17); Bioindustrial Innovation Centre ($14,955,575 for 2008-15); Canadian Digital Media Network ($19,471,136 for 2009-19); Centre for Commercialization of Regenerative Medicine ($15,000,000 for 2011-16); Centre for Drug Research and Development ($22,955,575 for 2008-18); Centre for Imaging Technology Commercialization ($13,310,785 for 2011-16); Centre for Probe Development and Commercialization ($28,755,575 for 2008-18); Centre for Surgical Invention and Innovation ($14,805,000 for 2009-17);Centre for the Commercialization of Antibodies and Biologics ($14,957,408 for 2014-19); Centre of Excellence in Energy Efficiency ($9,623,000 for 2009-15); Centre of Excellence in Next Generation Networks ($11,700,000 for 2014-19);GreenCentre Canada ($18,190,000 for 2009-19); Leading Operational Observations and Knowledge for the North ($7,107,000 for 2011-16); MaRS Innovation ($29,911,150 for 2008-16); MedDev Commercialization Centre ($14,900,000 for 2014-19); MiQro Innovation Collaborative Centre ($14,078,965 for 2011-16); NEOMED ($12,000,000 for 2014-18); Ocean Networks Canada Innovation Centre ($10,973,559 for 2009-18); Pan-Provincial Vaccine Enterprise ($14,955,575 for 2008-17); Tecterra ($11,685,000 for 2009-16); The Prostate Centre's Translational Research Initiative for Accelerated Discovery and Development ($26,283,575 for 2008-18); Wavefront($11,593,000 million for 2011-16).

Notwithstanding the significant investments made, and to be made, a 2012 Ekos Research Associates review of the program found limited available data regarding commercialization outcomes.

The Impact of Mission Creep:

Over the past five years there has been a noticeable shift in government funding objects to either support local businesses or create new ones. The most common metric amongst recent government programs has been “net new jobs” created. The shift away from innovation as an objective to job creation has had a noticeable and challenging impact on technology transfer offices who have primarily been the recipients of these new mandates on campus.

Startup Support

As with many jurisdictions around the world there is an ever increasing focus, particularly by government, on the creation of startups for the purposes of creating new employment. Traditional definitions of “University Spin Off” as set forth in the AUTM annual survey has specifically referred to those companies created for the exclusive purpose of commercializing, as their primary business purpose, IP created at a University. As the role of technology transfer offices have changed, however, Canadian TTO’s have become more involved in other early stage ventures which would not meet the spin-off definition. These activities have created great confusion in the reporting and comparing new venture metrics. As an example, Carleton University where creators own all IP, the University reports it has created more than 400 startup companies. In Canada it has been suggested that a more inclusive lexicon be developed such that spin-offs would remain as a distinct term but other startups, such as those created by undergraduate, recent graduates or not being directly tied to IP created with research funding could be known by a different term such as affiliated or associated startups. Regardless of the terminology there is likely to be a continued focus upon new, university based, technology startups and the desire to support same through technology transfer offices and other vehicles.

Incubators are very popular in the Canadian system for the promotion of early stage technology companies. Some incubators are phycially located on campuses of Universities (Waterloo) while others employ a “hub” feature to concentrate startup activity from many sources in a single location (MaRS and MaRS Innovation). Economic development agencies (Communitech in Waterloo) offer startup incubators that are targeted at non-university based companies while others are focused on particular aspects of the university ecosystem such as [www.startupgarage.ca](http://www.startupgarage.ca) which is a term limited incubator for undergraduate student enterprises. Most incubators (also termed accelerators) provide space, mentoring and networking services to their tenants.

SME Support

Support for small and medium sized businesses (under Industry Canada definition, less than 1000 employees) also varies from region to region, province to province and even within individual provinces. The Atlantic Canada Opportunities Agency, a federally funded program to assist small businesses in the Maritime Provinces has traditionally been focused on the fisheries and related businesses but has increasingly been working with agencies such as Springboard Atlantic in order to utilize the resources of colleges and university research to diversify those economies. In the southern half of Ontario, Canada’s largest province, there is a new initiative under the Federal Economic Development Zone – Southern Ontario to provide resources such as the Applied Research and Development Incentive (ARCI) to assist SMEs in increasing sales through new product launches, technical development or other activities that can be undertaken on University of College campuses. Programs such as ARCI are administered typically by ILO offices or, if no ILO office exists they are handled through research services. Where an ILO manages the program there is additional opportunity to work with the company to seek to achieve new outcomes which may include licenses or sponsored research. For an example of an ILO supported ARCI program see [www.sme4sme.ca](http://www.sme4sme.ca).

In an environment where funding for positions continues to be challenging and the aforementioned mandates have been added to the TTO mission, the traditional work of the TTO, or that which its success or failure is measured is sacrificed to unrelated metrics and potentially incalculable returns for the administrations investments.

The Role of Business

If it is accepted that each of government, academia and business have a role to play in the commercialization of research then an examination must be had of the role of industry in Canada in shaping conclusions regarding the success of technology transfer.

Examination of OECD data reporting the contribution of industrial research over the past ten years (below) yields two notable trends. Firstly, compared to the US, UK, Germany and France only in Canada has the relative contribution declined consistently over the past twelve years. The second point would have to be that since 2009 industrial research and development has been less than one percent of GDP.

Collaborative reseach with the academy is necessarily a subset of the total expenditures of industry on research and development. The 2013 AUTM Licensing and Related Activities Survey reported industrially sponsored research in Canada of approximately $600M. Over the twenty years that AUTM has been collecting this data this figure represents a more than a ten-fold increase in the commitment of industry to supporting collaborative research. It is also to be noted that after 2001, when overall business expenditures began a steady decline, the contribution of industry to overall academic research continued to rise until 2009 and has been falling since. During this period of rapid academic research (1993 forward) the rate of growth of industrially sponsored research was much slower than federal government funding or “other” sources of research funding.

When one looks at the total number of licenses that are executed by commercialization partners since 1999 (AUTM data) there was a somewhat consistent increase in transactions from 1999 to 2009 but the reported transactions have fallen off dramatically since that time. In addition to the reduction in the number of technology transfer professionals that were available to seek such licenses, the fact that industry was becoming less engaged with Universities each year would also contribute to the decline in transactional outcomes.

Conclusion

If technology transfer is dead in Canada then it never stood a chance of surviving. In order for technology transfer to have been judged a success in Canada it would have to have achieved the trebling of commercialization returns that were promised by University Presidents in 2002. That measurement would have been an increase in licensing revenue to more than $120M annually by 2012 but these results were not realized. Had the Federal government continued to support technology transfer professionals on campus beyond 2007, licensing revenue could have continued to rise. Accounting for the lag associated with bringing University technologies to market the all time record high licensing revenue of 2012 would have continued to grow were it not for the fact that there were fewer and fewer people in TTO’s to negotiate and conclude those licenses. University administration cannot be blamed for not stepping into the funding breach for they had no incentive to maintain staff levels when no legislative framework (such as Bayh-Dole in the US) would compel the recipients of Federal research dollars (the Universities and Hospitals) to commercialize regardless of financial aid from governments. Had funding for positions in TTO’s come with a Bayh-Dole type requirement of commercialization the situation might have been even more advantageous than in the US where Bayh-Dole came to Universities as an unfunded mandate. If, as implied by the Federal Governments expert panel, increased training might have made those TTO’s that remained more effective and efficient it would not alleviate the hasty and marked retreat from all research and development that Canadian Industry has been making since 2001. When this retreat began to impact the amount of collaborative research, despite overall research remaining strong, TTO’s lost many more of the customers that might previously been open to licensing a new technology or optioning research results for further investigation. Finally, if the people working in TTO’s had not been repurposed to develop applied research programs or create new jobs through entrepreneurship training and skills development training they might have been working on patents to be filed and licenses to be concluded.

Technology transfer is not dead in Canada it simply has evolved into something that reflects the reality of the Canadian experience. What was at one time conceived as being a licensing office for the results of basic research has grown in complexity and relevance to the broader community that the typical (whatever that means) TTO must now serve.

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The opinions expressed herein are those of the author and do not necessarily reflect the opinions of the University of Ottawa or the Association of University Technology Managers. [↑](#footnote-ref-1)