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Special Issue: The Role And Contribution Of Multi-Institutional Technology Transfer Offices

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The Role And Contribution Of Multi-Institutional Technology Transfer Offices

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Introduction And Background To This Special Issue On The Role And Contribution Of Multi-Institutional Technology Transfer Offices

By John A. Fraser, Alexandre Navarre and Ashley J. Stevens

This special issue of *les Nouvelles* is devoted to Multi-Institutional Technology Transfer Offices (MiTTOs).

Our interest in this topic has its roots in a World Bank-RFP for a tech transfer capacity-building project in India. Two of us (John Fraser and Ashley Stevens) are part of a small team of consultants mentoring the seven biotech-focused regional tech transfer offices (RTTOs) covering India under the overall supervision of a leading Indian consulting company, Sathguru. Sathguru has contributed the article on this Indian network of RTTOs to this special issue.

Over tech transfer careers now approaching a collective 100 years, we were aware of many MiTTOs that had existed over the years, a term we use to include:

- National tech transfer offices (NTTOs), which carry out tech transfer for some or all the institutions in an entire country;
- National networks of multi-institutional TTOs (NMiTTOs), which perform the same function through a network of MiTTOs; and
- Regional technology transfer offices, which supply tech transfer services to institutions in a specific region.

These MiTTOs had different funding and business models. They had come and, sometimes, they had then gone away. Some had lasted for an extended period, while others had had fairly short lifespans, and some are still operating after more than 20 years. Some had left no trace behind, while others had morphed into substantial investment funds or operating companies.

So, as we started to mentor the Indian RTTOs, we started to think about the issues that arise in MiTTOs. Could we learn from the successes and identify the pitfalls and help future MiTTOs avoid some of the minefields?

We therefore set out to identify all the MiTTOs we could in all countries, drawing on our international networks of colleagues. We believe we have been successful and have identified most of the MiTTOs that have been established, but we certainly invite readers to contact us if they are aware of organizations that meet our criteria that we have overlooked.

Our criterion for including an organization in the special issue was that it had to have the primary transactional responsibility for transferring technologies to companies through legal agreements for multiple research institutions with **which it is not affiliated**. This definition excludes central offices for multi-campus universities and multi-institute governmental laboratories, and it also excluded regional organizations that provide support services for tech transfer but don't have actual transactional responsibility. We only consider formal, IP-based transfers through legal agreements and do not include traditional, informal transfer mechanisms, such as publications, lectures, and employment of students.

As noted above, we differentiated between NTTOs, which offer tech transfer services to an entire country, and RTTOs, which offer tech transfer services to institutions in a more tightly focused geographic region. A more recent approach has been coordinated national networks of multi-institutional TTOs (the NMiTTOs) covering an entire country. Germany and Norway pioneered this model and Chile, France and India are currently also following this model.

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One important initiative, ANVAR, the early French NTTO, does not have its own article but is covered in the early section of the article on the current French initiative, the national network of initially 14 Sociétés d'Accélération du Transfert de Technologies (SATTs).

We consulted with colleagues in other countries to determine if there were MiTTOs in their countries that should be included. Some that were suggested turned out to be collaborative organizations that provide resources to but didn't have transactional responsibility for other organizations, and they are not included in the study.

We identified 12 NTTOs, 5 NMiTTOs covering an entire country, and 16 RTTOs. These organizations are located in 16 countries and include most of the major countries with active tech transfer ecosystems.

For organizations that are still operational, we found someone within the organization or who was familiar enough with it to write about it. For organizations that have ceased to exist, we first attempted to identify a former employee of the RTTO or someone in the country who was familiar with it to write about it. Failing this, we researched and wrote an account ourselves drawing on literature sources, augmented where possible with discussions with former employees. Bulgaria is currently in the process of establishing an NTTO, and this organization is included in the total of 12 NTTOs, but is not the subject of an article.

For each organization, the authors were asked to cover within their articles:

- The organization's history;
- The institutions it served;
- Its original sources of funding;
- Its business model;
- The pluses and minuses of its model and the challenges it faced;
- A few of its biggest hits; and
- Its current status/ultimate fate.

Following first are accounts of 34 former and current NTTOs, NMiTTOs and RTTOs. After these individual accounts, we analyze their business models and their strengths and weaknesses to attempt to identify whether specific business models correlate with specific strengths and weaknesses, irrespective of country specifics.

One of the unanticipated outcomes of the project was the realization that frequently an MiTTO had been an integral part of the establishment of tech transfer in a specific country, and we found that several authors had explicitly included an account of how tech transfer originated and developed in their country. We therefore invited other authors to add a section on this broader topic to their contributions. We summarize these various accounts in an article.

This special issue therefore provides what we believe is the first account to have been written about the emergence and spread of tech transfer ecosystems around the world. The various accounts vividly illustrate that although the input to tech transfer—the results of academic research—and the objective of tech transfer—to see those results commercialized and used—are the same around the world, a standardized, one-size-fits-all approach to managing the tech transfer process has not emerged, but rather there are nuanced outcomes adapted to different countries' cultures, histories and needs.

The articles are presented in chronological order from when tech transfer started in a country and/or the organization was created.

We gratefully acknowledge the efforts and contributions of our magnificent group of 26 collaborating authors from 12 countries: José Manuel Pérez Arce, Carlos Báez, Jaci Barnett, Catalina Bay-Schmith Cortés, Tim Boyle, Brett Cusker, Anne-Christine Fiksdal, John Grace, David Gulley, David Henderson, Tom Hockaday, Kosuke Kato, Ignacio Merino, Lasse Olsen, Jorun Pedersen, Henric Rhedin, Santiago Romo, Anil Sadarangani, Andy Sierakowski, Adrian Sigrist, Christian Stein, Koichi Sumikura, Randi Elisabeth Taxt, M. Carme Verdaguer, Vijay Vijayaraghavan and Bram Wijlands.

The views expressed in all of the articles in this special issue are the personal views of the respective authors and do not express the views or opinions of their employers. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4253942*.

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Alexandre Navarre has had a career dedicated to innovation in industry with Dow Chemicals, with the Canadian Federal Government, and with university tech transfer offices as director (McGill and Western Ontario) and as founder and CEO of one of the French SATTs. He was also Quebec manager of the Canadian Science and Engineering Research Council of Canada (NSERC), a founding member of ACCT Canada and a long-time chair of the Development Committee of the Canadian AUTM section. Actively retired, he currently consults on innovation and IP policy issues and writes articles on innovation challenges.

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The Birth Of Organized Tech Transfer—Research Corporation/Research Corporation Technologies

By Ashley J. Stevens

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Origins

Research Corporation (and its 1986 reincarnation as Research Corporation Technologies [RCT]) is the oldest tech transfer organization in the world, dating back over one hundred years to 1912, though proactive technology commercialization activities (as opposed to management of existing patents) was not launched until 1937.

In 1906, when research was still a relatively new concept at U.S. universities, and sources of funding for research were non-existent, two members of the faculty of the University of California Berkeley discussed the possibility of using patent royalties to fund research projects:[1]

- Brailsford Robertson, a biochemist. In 1915, Robertson patented a growth-promoting substance named tethelin, extracted from the pituitary. He also proposed to donate his patent rights to the university, with the profits from licensing to be used to build an endowment which would then be used to support a medical research institute. The Regents were initially reluctant, but were finally persuaded and an agreement was signed in 1917. The university granted a five-year, exclusive license to H. K. Mulford Company in Pennsylvania. Unfortunately, tethelin did not prove useful, and no royalties to support research resulted.
- Frederick G. Cottrell, a chemist. In 1907, Cottrell patented a process for cleaning smokestack emissions. He offered the rights to the university, but the Regents declined on the grounds that the university should not be involved in commercial ventures. After much discussion and consultation with the Smithsonian Institution, to which he initially proposed assigning the patents, an offer which was rejected by its Trustees, Cottrell eventually assigned the patents to the newly formed Research Corporation (RC), which was incorporated in 1912 as only the second philanthropic foundation in the U.S. (Andrew Carnegie had established the Carnegie Foundation for the Advancement of Teaching in 1906). William Howard Taft helped draft its charter.[2]

The stated purposes of RC were to make inventions and patent rights "more available in the useful arts and manufactures" and to provide the means for "technical and scientific investigation, research and experimentation" by contributing the earnings of the corporation to scientific and educational institutions. The concept was so appealing that leaders of some of America's largest technology-based companies (including Arthur D. Little, T. Coleman du Pont, Elon Hooker, Elihu Thompson and James Storrow) agreed to be founding members of the board of directors, fund the fledgling organization, and serve without compensation to achieve its ends. The founders loaned RC $10,100 to start its operations.[3]

Exploiting the Precipitator Patents

RC's only assets initially were Cottrell's patents. It set out to license them to manufacturers and RC was able to repay the initial loan within two years and started making small investments in research by 1917. However, RC came to realize that licensing the patents wasn't that successful, since licensees lacked the skills to adapt the basic technology to their particular industry, and so in 1919 it set out to manufacture and sell precipitators itself. This business model was more successful, and by 1924 RC was able to start making more substantial grants.

The suspicion with which academia viewed patents in the pre-WWII years cannot be overstated:

- Robertson was forced to return to his native Australia;
- Frederick Banting at the University of Toronto only agreed to let his name be on the insulin patents (which the patent attorneys insisted on) after the University agreed to defend him against any accusations of unethical conduct;

1. "University Technology Transfer in the U.S. History, Status and Trends," J. Sandelin, available at *https://web.stanford.edu/group/OTL/documents/JSUSHistoryTrends.pdf.*

2. This article draws heavily on "Cottrell: Samaritan of Science," Frank Cameron, Reprint Edition published by *Research Corporation*, Tucson, AZ 1993.

3. *Research Corporation*, Annual Reports, 2002 and 2005, available at *https://rescorp.org/rcsa/annual-reports-financials*.

- George and Gladys Dick at the University of Chicago, the discoverers of an antitoxin treatment for scarlet fever, were investigated for antitrust;
- The University of Wisconsin was severely criticized for patenting vitamin D and was successfully sued for antitrust for refusing to license the patents to margarine manufacturers in an attempt to protect Wisconsin's dairy industry; and
- Harvard declined to patent a treatment for pernicious anemia invented by George Minot and William Murphy (Eli Lilly applied for and received a patent on the Harvard product). Harvard's Patent Policy prohibited the patenting of biomedical inventions until as late as 1976 when Monsanto made changing the policy a condition of a $40 million sponsored research agreement in biotechnology.

RC as a Funding Source for Research

RC was one of the few dependable sources of research funding available to universities in the U.S. and, prior to World War II, had funded over $1 million for academic research. RC's impact was significant and played a key role in areas as diverse as rocketry, pharmaceuticals, atomic structure, nuclear magnetic resonance, and molecular beam research. It both funded and patented Van der Graaf's development of his generator and some 40 scientists who received RC funding went on to win Nobel Prizes. In 1939 RC gave a grant of $5,330 to John Atanasoff at Iowa State University to build the first electronic digital computer. Atanasoff made the fatal mistake of spending four days showing his machine to the University of Pennsylvania's John Mauchly, who took his ideas and used them to build the ENIAC computer. In the confusion of wartime, Iowa State never completed filing the patents that Atanasoff had prepared, while Mauchly and his grad student Presper Eckert obtained patents that dominated the computer industry until 1973, when Honeywell, in a lawsuit that lasted over five years at the District Court level, succeeded in invalidating them for being derivative of Atanasoff's work.

The B1 Patents

From an early stage, RC accepted donations of patents from inventors and managed them. Its first big success in this area came in 1935 and provided a new source of income for RC when Robert Williams of the University of California and Robert Waterman and his associates at Columbia University gave RC their patents on the synthesis of vitamin B1. This occurred amid intense discussion of whether it was moral to patent vital discoveries related to making a vitamin. Patenting was later shown to have encouraged the capital investment necessary to reduce the cost of the vitamin severalfold, thus making it available to large populations of the world. RC successfully helped steer the patents through an interference. Twenty-five percent of the profits went to other RC research funding programs and the balance to a research program dedicated to combating dietary diseases. The Williams–Waterman Fund for the Combat of Dietary Diseases became the foundation's first organized grants program in 1940 and continued to be a cornerstone of its programs until 1978, with over $12 million in grants made. The program eliminated beriberi and pellagra as diseases in the United States.

The Nystatin Patents

In 1955, Rachel Brown and Elizabeth Hazen of the New York State Department of Health discovered the first anti-fungal agent, Nystatin (which, like Warfarin, was named after their employer). They donated the patents to RC and over the lifetime of the patents until their expiration in 1976, RC's income was $13.4 million, of which half went to RC's grant funding program and half to the Brown-Hazen Fund, which funded life sciences, including mycology.

The importance of RC's research funding started to change in the 1950s as Congress started to act on Vannevar Bush's 1945 Report to President Truman, "Science the Endless Frontier," and started appropriating large-scale funding of academic research, first through the National Science Foundation, then the National Institutes of Health and then the Defense agencies. RC's importance was diluted, and the Foundation restructured its programs to make them more strategic and impactful.

The Genesis of the Tech Transfer Program

In 1937, as the precipitator patents started to expire and the precipitator market started to decline, RC realized that the skills it had developed in patent management were of value to others, and it signed an Invention Administration agreement with MIT to manage its IP. By WWII, only four universities had set up their own TTOs—MIT, WARF, Iowa State, and Kansas State—and the other U.S. universities followed MIT's lead and utilized RC to manage their tech transfer activities.

If RC decided to take on an invention, the patents were assigned to it. RC paid all the costs of patenting and the gross income received was distributed 15 percent to the inventors and 42.5 percent each to RC and the university. When Bayh-Dole was passed, the prohibition of universities from assigning their patents without the funding agency's permission (which they never gave) included a carve-out to permit assignment to a patent management agency such as RC.

MIT's relationship with RC was terminated in 1960. In 1951, RC filed for a patent on a computer memory system using arrays of magnetic cores invented by Jay Forrester. RCA pursued an interference proceeding, claiming one of its researchers was an earlier inventor. Resolution of the interference took until 1964, when the Forrester patent was finally affirmed. During this process, MIT terminated its relationship with RC and MIT lawyers took over responsibility for licensing and enforcing the Forrester patent, generating several million dollars in royalties.

The Impact of Tax Law Changes

Changes in tax laws forced RC to restructure several times. The 1950 tax act forced RC to get out of the precipitator manufacturing business. Those assets were transferred to a wholly owned tax-paying corporation called Research-Cottrell in 1954, which went public in 1967, allowing RC to start selling its shares. By 1982 RC had sold the last of the stock and the proceeds allowed RC to considerably expand its grant program. In 1998, Research-Cottrell merged with Hamon Corporation.

RC's royalty income peaked in 1974 at $6.3 million, of which $2 million came from Nystatin, whose patents expired that year. From 1977 to 1981, the expenses of the Invention Administration program exceeded its revenues substantially and RC started to look for ways to stabilize its finances. It moved to Tucson to lower its occupancy costs. Simultaneously, the IRS started to challenge the compatibility of RC's tech transfer activities with its non-profit status.

RC had legislation sponsored in Congress to create Research Corporation Technologies as a not-for-profit, tax-paying entity. It was structured as a program-related investment that would carry out the technology transfer mandate of the foundation's charter. RC made a $35 million investment in RCT via a fully subordinated unsecured note from RCT due in 2017. RCT prepaid $10 million of the note in 1994 and the balance in 2010.

As a result, RC exited the tech transfer business completely and is now a purely philanthropic organization. Today it has total assets of around $200 million and makes grants totaling around $4 million annually.

Research Corporation Technologies

RCT started operations in 1987 and continued the invention administration program of RC. It had four regional offices with representatives that liaised with institutions in their area. It had agreements with over 300 institutions.

By 1987, seven years after passage of Bayh-Dole, most large universities had started to set up their own TTOs, and RCT's rights were non-exclusive. If an institution submitted a disclosure to RCT, it was giving it a 30-day option to decide if it was interested in the technology. If it was interested, then it would pay a $1,000 fee to the university and the patent was assigned to RCT, which paid all the costs of patenting and retained a 42.5 percent share of any income.

RCT reported to the AUTM Licensing Survey from its inception until 2017. Selected data are shown in Table 1 on page 261. RCT reported receiving 635 invention disclosures in the first AUTM Licensing Survey in 1991, which was 10 percent of all invention disclosures received that year. The number it reported drifted slowly down to 426 in 1999 and then declined more rapidly over the next 10 years to 25 in 2009, the last time RCT reported receiving any invention disclosures, though it continued reporting the filing of small numbers of new patent applications until 2019.

RCT was very successful financially. It reported royalty income of $42 million to the 1991 AUTM Survey, 20 percent of all income received that year. The total grew steadily and peaked at $100 million in 1999 but had declined to $73 million in 2017, the last year RCT reported to the AUTM Survey. In total, from 1991-2017, RCT reported receiving $2.6 billion in income, of which $1.8 billion was from running royalties. RCT paid $1.4 billion, almost 52 percent of the $2.6 billion, to the institutions that the technologies came from.

The USPTO database shows 354 U.S. patents assigned to RCT.

Successes

RC and RCT have had many successes between them. Notable technologies they licensed were cis- and carbo-platin, GM-CSF, shingles vaccine, silver sulfadiazine, Vimpat, PEGylation of proteins, the PSA test, harmonic ultrasound imaging and fullerenes.

As more and more institutions created their own TTOs, and these TTOs increased in sophistication, fewer and fewer disclosures found their way to RCT. Funds continued to flow in from the technologies RCT had already licensed and RCT transitioned to being an early-stage venture fund, investing primarily in biotech and medical devices. The RCT Ventures program has assets of over $500 million.

It does not appear to have had any big hits from these programs. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4294004.*

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Table 1: RCT Reports To AUTM Survey

Year	Inv. Dis. Rec.	New. Pat. App. Fld.	Tot. Pat. App. Fld.	Iss. US Pat.	Act. Lic.	Lic. Gen. Inc.	Lic. Gen. Run. Roy.	Lic. >$1mm	Gross Inc.	Inc. Pd. Oth.	St-Ups Form.	New. Prod.
1991	635		19			107			$42,979,173			
1992	704		70		143	117			$50,345,501			
1993	666	44	51	28		135			$55,463,780	$35,379,229		
1994	671		61	20		158			$59,141,000	$37,742,000	0	
1995	632	29	119	31	294	152			$63,043,800	$40,221,100	2	
1996	575	12	21	20	195	164			$70,343,112	$41,508,217	1	
1997	575	15	32	54	217	166			$75,044,599	$48,835,084	1	2
1998	467	9	27	53	230	179			$70,587,642	$45,744,341	1	1
1999	426	11	31	21	168	168	64		$100,509,700	$46,310,600	2	2
2000	225	9	25	19	210	171	51	8	$69,296,661	$37,079,845	2	0
2001	184	20	35	14	259	209	60	6	$72,331,934	$38,203,429	2	
2002	191	15	39	12	340	222	30	6	$47,565,784	$24,995,400	0	
2003	155	3	19	7	285	240	32	5	$71,351,848	$36,374,264	0	
2004	79	19	11	13	297	233	36	4	$39,689,642	$23,267,842	0	
2005	32	15	3	6	300	256	40	1	$8,351,774	$4,562,764	0	
2006	32	7	4	10	285	232	33	3	$7,965,667	$4,268,960	0	1
2007	22	4	3	4	219	193	30	4	$31,693,569	$18,402,643	0	0
2008	27	6	3	1	223	182	32	2	$10,079,579	$5,661,162	0	1
2009	25	8	6	2	142	169	36	7	$19,087,958	$7,143,530	0	1
2010	0	10	6	3	145	125	33	4	$18,925,278	$9,749,321	0	1
2011		9	4	1	123	106	32	4	$23,800,000	$12,800,000		1
2012		6	4	3		106	27	4	$31,100,000	$16,600,000		1
2013	0	6	4	3		101	24	4	$36,500,000	$19,000,000		1
2014	0	5	3	2	4	93	27	4	$45,400,000	$23,100,000		
2015	0	3	2	3	3	73	18	3	$51,650,000	$27,700,000		
2016		2	0	2	3	76	25	3	$61,000,000	$35,100,000		
2017		3	3	3	1	62	23	3	$73,300,000	$38,300,000		

Tech Transfer North Of The 49th Parallel—Canadian Patents And Development Limited

By John A. Fraser

Origins

Canadian Patents and Development Limited (CPDL)[1] was a Canadian agency tasked with promoting the commercialization of inventions and discoveries arising from government departments and agencies, as well as those disclosed to it by universities and other publicly funded organizations. The National Research Council of Canada (NRC) founded CPDL on October 24, 1947, as a subsidiary crown corporation under part 1 of the Canadian Companies Act (now Canadian Corporations Act). However, the NRC's patent management activities had started in the 1930s when it formed committees in each of its newly formed laboratories to evaluate inventions that had been made. By 1931, it was filing and receiving 10 to 130 patents a year and starting to license some of them. During WWII, these activities were formalized in an Inventions Board.

The terms of the peace treaty which ended WWII allowed the Allies to scour Germany for industrial technologies, which were accumulated under the mnemonic BIOS. The Technical Information Advisors in DORS were initially charged with disseminating BIOS to Canadian industry; when CPDL was established, the responsibility for disseminating the BIOS information was shifted to it.

CPDL was established on a self-supporting basis and was capitalized with $295,000 that had been generated from these earlier licenses.

Mission

As a subsidiary of the NRC, CPDL was charged with handling the assessment, patenting, development, and licensing of the intellectual property developed by the scientists of the NRC. CPDL's board was made up of individuals from NRC, industry, and Canadian universities. Soon after its incorporation, CPDL began making its services available to Canadian universities and other publicly financed organizations. The University of British Columbia was the first university with which CPDL formed an agreement, signed in October 1948. A year later, the Ecole Polytechnique affiliated with the University of Montreal became the second university to make an agreement with CPDL. CPDL continued to reach out to academic researchers, and over time signed agreements with 40 Canadian universities.

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An analysis by CPDL found that a disclosure arising at a Canadian university had only about one chance in 40 of going into commercial use, compared with chances of about one in 16 for disclosures coming from government organizations. An examination of comparable figures for U.S. universities suggests that Canadian universities enjoyed a greater success in this field than did their U.S. counterparts.

CPDL attempted to make cooperating with it more attractive by getting a law passed that gave government scientists 15 percent of the royalty income their inventions generated, in addition to the $50 per patent application that they had previously received. CPDL changed its arrangements with universities from a sliding scale to a flat percentage of all revenues.

The number of Canadian agencies and departments reporting inventions to CPDL increased substantially in 1954 with the enactment of the Public Servants' Inventions Act, which made CPDL eligible to accept and manage the inventions arising from all federal departments and agencies.

In 1952, CPDL entered into agreements with the National Research Development Corporation of the United Kingdom and the Commonwealth Science and Industrial Research Organization of Australia, whereby CPDL would handle the promotion in Canada of certain inventions belonging to those organizations in return for a share of any royalty income. In the following years the same agreements were made with similar government organizations in New Zealand, India and South Africa.

From 1960 until 1990, CPDL was receiving 150 to 300 invention disclosures annually.

Licensing Policies

CPDL's licensing policies were different inside Canada than outside. It attempted to keep inventions and innovations in Canada that had been discovered with

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1. This article is based on the Wikipedia entry for CPDL and the paper: "CPDL and the Commercialization of University Research in Canada," Andrew Kretz, Ontario Institute for Studies in Education. Scientia Canadensis 36, 2 (2013) 1-36, available at *https://www.erudit.org/fr/revues/scientia/2013-v36-n2-scientia01552/1027020ar.pdf.*

public funding by actively pursuing licensing agreements with Canadian companies. CPDL licensing policies were dictated by a Treasury Board Minute, which stated that non-exclusive licenses should be granted within Canada, and exclusive licenses only when there was no other way of exploiting a patent. Non-exclusive licenses were presumed to ensure the broadest exploitation, whereas exclusive ones would encourage companies to invest in the development of inventions for future commercialization. Moreover, royalty calculations were to be made so that "when added to the cost of production, the selling price would not deter the development and distribution to the public of such inventions." When licensing patents outside Canada, ordinary commercial principles were to apply and appropriate royalty provisions were sought.

Thus, sometimes licenses were granted to small and medium-sized Canadian companies when it would have been more profitable to license to a larger multinational corporation abroad. Only when CPDL was unable to find an interested Canadian company capable of commercializing an invention were rights granted to foreign companies—mainly those based in the United States.

To encourage the use of patented inventions by Canadian industry, CPDL established a Development and Promotion Branch in 1953. The officers of this branch were tasked with engaging potential licensees, mainly through making industry aware that inventions owned by the government were available for licensing, and convincing companies that licensing inventions owned by CPDL would be profitable.

To help move inventions towards commercial development, CPDL entered into cost-sharing arrangements with a limited number of licensees for the development of prototypes or "pilot" facilities. CPDL's funds for sponsoring invention development were limited, and so inventions to which development funding was allocated were mostly short-term, small-scale projects. The goal was to help small companies overcome the development gap and to lead to the manufacture in Canada of products that would have otherwise been made under license to a foreign company, or perhaps not made at all. However, as with potential licensees and NRC laboratories, CPDL found industry largely unwilling to enter into development contracts for preliminary development, even at CPDL expense and under favorable cost terms and/or priority allocation of facilities. CPDL received about two requests for development work per year, with financial assistance ranging from between $312,000 and $482,000 in today's dollars.

University Partnerships

In 1971, adding to its list of development projects, CPDL collaborated with the newly formed Medical Research Council (MRC) to establish a pre-screening program to identify pharmacological properties and to provide biological testing of new compounds arising from university research. The program was intended to encourage Canadian universities to send compounds developed in their laboratories to CPDL for evaluation, as the general practice of universities at the time was to enter into agreements with drug companies for the screening of substances arising out of research—mostly funded by the government or the NRC. These agreements generally provided the screening company, which was typically American, first right of refusal on any patentable material. A consequence of this practice was the development and marketing of many pharmaceuticals outside of Canada. With the pre-screening program, CPDL hoped to capture the benefits of publicly supported research for Canada and to support the Canadian pharmaceutical industry. The program was established in 1974 and involved 14 participating universities. By the mid-1970s, the high cost of developing inventions to the level of commercial acceptance caused CPDL to considerably diminish its development activities. From this point on, little, if any, funds were available for development work. To assist companies in the development of licensed inventions, CPDL increasingly turned to programs in other federal and provincial departments and agencies, such as the Department of Industry, Trade, and Commerce's Program for the Advancement of Industrial Technology (PAIT), and the NRC's Industrial Research Assistance Program (IRAP), which is still in existence today.

There is evidence that universities only sent CPDL what they regarded as their less-promising inventions and marketed and licensed the more promising ones themselves.

Despite its broad mandate and many agreements, CPDL was noted by university administrators as possessing inadequate resources to effectively manage inventions for all of Canada's universities, while the industry consensus was that "CPDL's work was under-publicized, under-supported, undersold and under-followed-up."

In addition, during its history CPDL's mandate changed. Initially, more emphasis was placed on government inventions for licensing as they were more oriented to, and seen as closer to practical solutions than university inventions. In the early 1970s NRC took actions through CPDL which were seen as moving towards a position where the federal government owned all federal funded inventions, including university inventions. The university community reacted strongly, and the actions were withdrawn, but it inspired a few of the large universities to create their own commercialization committees and activities on the basis of what MIT, Stanford and the University of Wisconsin had created.

Change in Mission and Closure

In 1978, CPDL was transferred to the Ministry of Industry, Trade and Commerce and its mandate changed from licensing "for the public good" to "maximizing financial returns." This new orientation, without a commensurate increase in financing to accelerate invention development, planted the seeds of CPDL's demise.

In the 1980s, many universities did not renew their contracts with CPDL and began to build their own commercialization activities, although somewhat skeletal initially.

On February 20, 1990, the Minister of Finance announced the planned dissolution of CPDL as part of a larger government commitment to reducing the size of government and improving the efficiency of public services. A few months later, the Crown Corporation Dissolution or Transfer Authorization Bill (Bill C-73) was introduced to Parliament to facilitate the closure of several crown corporations and the transfer of their responsibilities. The bill authorized the Minister of Industry, Science, and Technology to dissolve CPDL, and made government departments and agencies responsible for managing their own intellectual property. Following the Crown Corporation Dissolution or Transfer Authorization Bill, all CPDL agreements with Canadian universities were terminated, and all patented faculty inventions held by CPDL were transferred back to each respective university. On August 1, 1993, CPDL ceased all operations. By this time, larger universities had established university/industry liaison offices. Although the ILO's primary mission was to obtain industrial research contracts, they did little commercialization of IP and, indeed, IP policies were only just starting to be drafted, so researchers would often have to pursue commercialization on their own for lack of resources and internal support.

The federal agencies worked with NRC to create the Federal Partners in Technology Transfer with NRC to provide financial and other support for their inventions. A reorganization at NRC in 2012 terminated such activity. On the other hand, in 1996, the NSERC (Natural Science and Engineering Council of Canada) initiated a three-year Intellectual Property Program (IPM) whose aim was to help universities set up appropriate commercialization units and fund patenting costs. The program was renewed once and most universities availed themselves of the opportunity, which was an attempt to bridge the gap with what U.S. universities had achieved with the Bayh-Dole Act. In 2005, the three federal research-granting councils provided funding to finance the Alliance for Commercialization of Canadian Technologies (ACCT Canada)—a community of practice amongst universities, colleges, research hospitals and TT practitioners—that established itself in partnership with AUTM.

As a crown company, CPDL had an economic development role that overrode its maximization of return objective. As such, yearly appropriations were able to sustain its operations. It suffered from the cultural differences between government laboratories closer to industry concerns and university researchers and administration that were not yet sensitized enough and felt inventions were not well enough commercialized. With hindsight, the challenges facing CPDL were likely not entirely a result of poor management, and are now recognized as common hurdles in technology transfer. Staff shortages and attrition are challenges for many university technology transfer offices, and self-sufficiency—let alone the realization of large profits—is often an elusive goal in the technology transfer business, even when managing inventions solely with a view to maximizing income. It is also frequently common for university technology transfer offices to find faculty reluctant to disclose inventions. Furthermore, complaints about the effectiveness and efficiency of CPDL are also commonly asserted against contemporary technology transfer managers today. One early study of technology transfer at five U.S. research universities found that a majority of participating faculty viewed the rewards available to inventors to be wanting, and the technology transfer operations as inflexible and overly bureaucratic. The same study found half of each university's industrial partners as feeling that the marketing, technical, and negotiation skills of the respective university's technology transfer staff could be substantially improved. Finally, for universities and government departments and agencies, underfunding of technology transfer is quite common, and a major problem in effective IP management. ■

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National Research Development Corporation/ British Technology Group—It Takes Time

By Tom Hockaday

Origins

There are two key episodes in the development of university technology transfer in the UK, both of which involve NRDC/BTG. The first involved the setting up of NRDC following the Second World War (1939–1945) and to some extent a reaction to the story of the commercial development of penicillin, one of the great research-based inventions from the UK, commercialized in the United States.

The second, in the 1980s, involved the recognition of the shortcomings of this centralized agency, now renamed BTG, and liberated universities to establish their own TT programs. The second episode was legislation in 1985 that allowed universities to develop their own TT programs and no longer be reliant upon BTG. This legislation has been described as a direct response to the story of the commercial development of monoclonal antibodies, another of the great research-based inventions from the UK. Insofar as the UK has an equivalent of the Bayh–Dole Act in the United States, the 1985 legislation is it, now referred to as the Joseph-Kingman legislation, after the politician and public servant who pushed it through.

These two episodes are seen as being caused by missed opportunities and mistakes by the government, business, and science communities in the UK, depending on the critic's perspective. On the other hand, they are fantastic stories of how great inventions and technologies from UK universities have been transferred, invested in, and developed into products that give benefit to millions of people around the world—and have stimulated substantial, sustainable economic growth.

In 1948, the UK Parliament, under a Labour government, passed the Development of Inventions Act 1948.[1] The act included the instruction to government to set up a new corporate body, the National Research Development Corporation (NRDC). This followed a 1945 government paper that had suggested establishing a National Research Trust. The NRDC was established in 1949; the first managing director was Tony Halsbury, 3rd Earl of Halsbury, who served for 10 years.

On June 12, 1950, His Majesty's Treasury issued *Treasury Circular 5/50* titled "Transference of Government Rights in Inventions to the National Research Development Corporation." *TC 5/50* describes how "their Lordships consider that Departments should transfer to the Corporation existing and future rights in inventions classified as non-secret held or to be held by them." There were a number of important exceptions: inventions relating to defence, atomic energy, gas turbines, and those outside the scope of the radio patent pools. Government departments were required "in any case" to send to the NRDC, at an early stage, copies of the specifications of all non-secret inventions. This document gave the NRDC the powers it required to build its patenting and licensing activities.

The functions of the NRDC were to develop and exploit publicly funded research outcomes, acquire IP, develop technologies, fund further research, and license intellectual property rights to business. Publicly funded research included research at universities funded by government departments and the research councils ("In this section 'public research' means research carried out by a Government department or other public body or any other research in respect of which financial assistance is provided out of public funds."). The functions of the NRDC are described in the 1967 Development of Inventions Act (an act to consolidate the Development of Inventions Act 1948, the Development of Inventions Act 1954, and the Development of Inventions Act 1965).

The Transition to the British Technology Group

In 1981, the NRDC merged with the National Enterprise Board and the merged organizations became the British Technology Group.

It is generally considered that the failure to patent monoclonal antibodies was the death knell for BTG's control over commercializing British university inventions. The technology for developing large numbers of identical monoclonal antibodies, hybridoma technology, was developed in Cambridge, UK, by César Milstein and Georges Köhler in 1975. NRDC declined the opportunity to file patent applications on the original inventions, but did file patent applications on later, related inventions in 1979.

On May 14, 1985, the Conservative government Secretary of State for Education and Science, Sir Keith Joseph, introduced legislation rescinding BTG's first right of refusal over commercializing research results arising out of Research Council-funded studies from

1. This article is based on "University Technology Transfer–What It Is and How to Do It," Tom Hockaday, *JHUP* 2020.

UK universities. The Chairman of the Science and Engineering Research Council, Sir John Kingman, wrote to university vice-chancellors and principals to ask whether their university wished to assume the rights and responsibilities relating to the exploitation of intellectual property arising out of Research Council-funded studies, now that there was no obligation to offer it to the British Technology Group. The letter raised 11 points for universities to consider in taking on these responsibilities. These included existing arrangements in place, access to expertise and finance, involvement of the inventors, revenue sharing, institutional responsibility and accountability, and also required annual reporting back to government. By 1988, 53 of the 60 universities had expressed a wish to assume responsibility for exploitation.

The Start of In-house Tech Transfer

University technology transfer in the UK, freed from the requirements of involving NRDC/BTG was born on May 14, 1985. The legislation enabling this is referred to as the Joseph-Kingman legislation, after Sir Keith Joseph and Sir John Kingman.

From 1985 onward, universities started to develop their own technology transfer capabilities. Cambridge had started earlier than this, with the Wolfson Foundation supporting the Wolfson Industrial Liaison Office, as had Manchester, setting up its technology transfer office in 1981. Oxford formed a TT subsidiary company in 1987. Universities already had research support offices of one sort or another, and alongside or within those offices grew industrial liaison offices and then technology transfer offices.

Business Arrangements

BTG had a standard approach to its arrangements with universities from the mid-1980s onwards. BTG required assignment of the intellectual property rights from the university and inventors to BTG. BTG would take on responsibility for the patenting and all patent costs, would require the involvement and support of the inventors in this, would require assignment of improvement inventions, and in return would pay to the university 50 percent of any future revenues generated from BTG's licensing activities, after netting off its costs.

British Technology Group was privatized by the government in 1992 and listed on the London Stock Exchange in 1995. Prior to listing on the London Stock Exchange, universities were given the opportunity to acquire shares in the company on favourable terms. A number of UK universities took this up, and these shareholdings took on real value as BTG was privatized. At least one UK university shareholder used the cash from selling its shareholdings to boost its own technology transfer and patent budget to good effect in the mid-1990s.

In the 10 years following privatisation, the company annual accounts (1993-2002) show total Licensing Income of £250 million, revenue sharing payments of £91 million (36 percent) and accumulated annual company losses of £52 million.

BTG Response to In-house University Tech Transfer

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As universities developed their own technology transfer operations, these standard arrangements were in conflict with the universities' own efforts to transfer their technologies. Universities began to better understand the limitations of assigning ownership of the technologies and transferring control of the patenting process. This was a time when universities increased research collaborations with industry and losing control of the intellectual properties to BTG was a problem. At the same time BTG became more commercially focussed following privatization and then public listing, and the "deal" with BTG became less attractive to universities.

In the 2000s BTG set about transforming itself from a broad-based technology licensing and development company into a life sciences company. In 2020, Boston Scientific, the large U.S. biomedical company, acquired BTG in full for $4.2 billion.

Successes

The NRDC had some major successes with the patenting and licensing of synthetic pyrethrin insecticides, cephalosporin antibiotics, continuously variable transmission gearboxes, cholesterol assay tests, magnetic resonance imaging (MRI), and other innovations. The NRDC served its purposes well in the early decades with government department research but did less well in later years with research at universities. ■

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The Development Of Tech Transfer In Germany And Ascenion GmbH

By Christian A. Stein

Development of German Technology Transfer

To write a history of German knowledge and technology transfer (KTT) is an exercise in humility. After all, we always seem to be running behind the United States, which started with the Bayh-Dole Act in 1989, the United Kingdom, and to be frank also behind Switzerland, France, and a few Scandinavian and other countries that are more entrepreneurial in their approaches to support development of inventions from academia into the market. Wherever German KTT slots in, it is not in the top tier. At the northern end we have recently seen an absolute highlight and success of possibly historic dimension. BioNTech, an mRNA start-up out of the University of Freiburg, which went on to develop a world-saving COVID-19 vaccine, showed the world that Germany can put ideas from academia into practice for the benefit of society and for the world at large. And it also shows that KTT is a global team exercise. BioNTech needed the agility, flexibility and vision of a big Pharma partner, Pfizer, for a COVID-19 vaccine to emerge. It also needed the commitment and patience of a family office. BioNTech would have not risen to its current format if they had not received substantial public funding to start with, and if they had not been financed by family offices (instead of the more common venture capital), thus escaping the usual time cycles of venture capital funds. After all, BioNTech was founded in 2008, 12 years before they had their first product on the market, and they started with an entirely different idea, with a vision to develop mRNA vaccines against cancer.

That most start-ups end up being bought by companies outside Germany and even outside Europe is relevant and a pity, and possibly a serious challenge for the German economy, but this is due more to fiscal reasons and is in no way the responsibility of the knowledge and technology transfer community, and perhaps not even a fault *per se* at all.

KTT in Germany has progressed a lot in the last two decades and German knowledge and technology transfer is alive and kicking, despite setbacks. Presently, for example, we are fighting an erratic idea of introducing a Founder's Privilege—an introduction of the former Professor's Privilege, where the IP can be claimed by the professor, or according to this new idea, a founder, and commercialized without the university or academic institution participating. This would reopen the door for industry to access IP from academic institutions via the Founder's Privilege by introducing a simple in-between step—usually for next to nothing. Never mind.

But KTT in Germany is also an endangered species, as KTT is in many other geographies. In its position between the world of academia and industry it is struggling to find acceptance in both communities, and only in the last few years are KTT offices starting to recognize their role in more than licensing academic IP, but in developing into an enabler to increase the technology readiness level up to the inflection point for an investment by either industry or investors, including via start-ups.

But now let's be a bit more systematic and examine the history of the development of German technology transfer. We could, of course, look into the very close connections between industry and academia at the beginning of the last century. In the golden age of German industrialisation in which great scientists like Bosch, Fraunhofer, Siemens and many others turned their ideas and inventions into innovations and also turned out to be great and influential entrepreneurs.

1950s: Fraunhofer Patent Centre for German Research

Probably the oldest technology transfer office in Germany was the Fraunhofer Patent Centre for German Research founded in 1955. It was a Fraunhofer institute dedicated to the protection of ideas from Fraunhofer institutes' scientists and later also inventors from universities and so-called free inventors, *i.e.*, those that enjoyed the Professor's Privilege. Private individuals could submit their ideas to be evaluated for commercial viability. When the Fraunhofer experts believed in the idea, they supported patent protection and commercial exploitation in exchange for participation in later revenues from the IP, receiving reportedly over €1 billion over the Centre's lifetime.

The Fraunhofer Patent Centre was closed down after 52 successful years for a number of reasons. One of them was that the nature of its business endangered the not-for-profit status of the entire Fraunhofer Society. The greatest success of the Fraunhofer Patent Centre was certainly the commercial exploitation of MP3, an invention by scientists from the Fraunhofer Institute for Integrated Circuits (IIS) from 1987 to 1989 that started the MP3 player on its journey to the global standard for audio coding. This led to a total licensing income for Fraunhofer of more than €1 billion. This is a fantastic success. The other side of this coin is that the innovation's major value was created outside the country of the inventors, namely in the U.S. and Asia.

The closing down of the Fraunhofer Patent Centre in 2007 left a big gap for inventors that hasn't been filled since.

1970s: Max Planck Innovation

Possibly the second-oldest technology transfer office in Germany, founded in 1970, is Max Planck Innovation, formerly called Garching Innovation, and originally named Garching Instruments. The original idea of Garching Instruments was prototype building, which turned out to be only modestly successful. Instead, this wholly-owned subsidiary of the Max Planck Society changed the emphasis of its business model into commercial exploitation of Max Planck intellectual property, in particular, patents. It took the greater part of 20 years for Max Planck's commercial IP unit to be economically successful. But this success turned out to be a beacon in the history of German academic exploitation.

East Germany

In the former East Germany, the state owned academic inventions and so the East German universities developed commercialization capabilities well before their West German counterparts, which were operating under the Professor's Privilege until well after reunification.

Early 2000s: German Bayh-Dole: The Fall of the Professor's Privilege

Finally, after decades of struggling with different lobbying groups, Germany followed suit with the U.S. and other successful economies and decided to abolish the Professor's Privilege (Hochschullehrerprivileg) in February 2001, which had contributed to stifling the technology transfer and innovation processes. The universities and many other academic research organisations were taken by surprise by this long overdue decision. Apart from Fraunhofer, Max Planck and some universities in the former East Germany, hardly any university had more than a part-time technology transfer officer or a thinly staffed tech transfer office. An infrastructure to deal with the sudden massive increase in patents at the universities had to be established quickly—and was, thanks to an unexpected large windfall profit for the German government.

The Patentverwertungsagenturen—Patent and Licensing Agencies

In summer 2000 the German government decided to auction UMTS-frequencies for 3G wireless networks to the highest bidder and received billions of Euros. A part of these profits was invested in pushing the boundaries of innovation. The government was convinced that it was losing traction in the international competition of innovation. One of the origins of this was based on the fact that, though German science was world class, translating those results into innovative products and services just did not seem to work that successfully. The solution was to provide Germany with a network of central technology transfer offices for every state. So, by around 2000, 25 technology transfer companies—Patentverwertungsagenturen—were founded, with the mission of providing IP protection services, scouting and commercial exploitation to all German universities. Some of them did well, others did not. Their development depended very much on the individual structure, political/state support, and professional development capacity.

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An Alternative Model: a Central, Specialised Tech Transfer Organisation for the Life Sciences: Ascenion and the Life Science Foundation

History

In 2001 the CEO of the Helmholtz Centre for Environmental Research and Health in Munich, a former executive board member of Hoechst Pharma, had the idea to offer industry a one-stop-shop for academic inventions in the life science sector. To this aim, he founded a central technology transfer office for the four life sciences focussed Helmholtz Centres in Germany. These four centres created first a foundation, the Life Science Foundation for the Promotion of Science and Research and subsequently founded its wholly-owned subsidiary, Ascenion GmbH, which underwent two name changes early on, first to "Innovative Technologien Neuherberg" (ITN) and then to "Anima Technology Ventures" (ATV). Ascenion's initial task was to commercialize all intellectual property of those Helmholtz Centres. Also, Ascenion was created to take and manage equity in start-ups in exchange for IP. The newly founded company was fortunate to achieve a first exit only three years after its initiation, the sale of Trion Pharma to Fresenius, which brought financial stability, visibility in the knowledge and technology transfer (KTT) sector, and street credibility.

To expand and create more critical mass in terms of number of technologies to offer to industry, Ascenion's management and board decided to increase their client base with research institutions outside the Helmholtz Association. There were to begin with 12 life science research institutions from the Leibniz Association, and also several medical universities, *e.g.*, the Medical School Hanover and Charité in Berlin. In a further expansion step, Ascenion extended its reach outside Germany and is working today in several European countries with a strong focus on Austria. Presently Ascenion has seven offices in Germany and is in the process of opening an eighth office. All offices, with the exception of its central unit in Munich, aim to deliver their services embedded at the campus of the university or research partner in order to be close to research, inventors, and scientists. Approximately 500 to 1,000 life sciences researchers are needed to justify an on-site office. This was recognized by clients early on as an essential tool to establish and maintain trust and a fast and reliable service. After all, the inventions of researchers are a sensitive good.

Currently, the Life Science Foundation consists of 11 co-founders and is still growing. Ascenion works with between 25 and 30 public research institutions and is still growing. So far, the income from licenses and exits from spin-off companies has surpassed the €100 million threshold. Most of these revenues were generated in the last decade.

Funding and Business Model

Originally, in 2001, the Ministry for Education and Research (BMBF) gave a five-year project grant to the four Helmholtz Centres to start an external central technology transfer office, Ascenion. Ascenion was contracted by those institutions to:

- Scout for inventions,
- Analyse and value invention disclosures,
- Secure IP,
- Decide on an IP, particularly patenting strategy, and subsequently
- Commercialize the IP.

The research institutes always stay the sole owner of the IP and Ascenion has had to align its commercialisation strategy with the IP owner. Option and licensing contracts are always entered into between the licensee and the research organisation as sole IP owner. Ascenion only acts as a broker.

Ascenion has three main sources of income.

1. Income from consulting contracts for all services before commercial exploitation starts:
    - Scouting
    - Valuation
    - Education
    - Etc.
2. Broker fees for option and licensing agreements
3. Success fees for equity deals

The idea behind the Life Science Foundation was to allow start-ups from research organisations to be founded, and the research organisations to therefore participate in the value created, without holding equity themselves, without having to manage this equity and without having a direct corporate legal connection. The latter is particularly relevant for the health sector, as corporate governance rules and conflict-of-interest policies are, for good reasons, particularly strict where clinical trials and the corporate interests of start-ups and/or their founders are involved. Ascenion buys stock in the founding round of start-ups, manages the equity professionally and decides independently how to manage and exit the equity. However, once Ascenion liquidates its equity, revenues from the sale or partial exit are transferred to Ascenion's 100 percent owner, the Life Science Foundation. The Life Science Foundation then passes those proceeds on as research grants for translational research to the research institution where the spinoff originated from. This way the research organisation or university can benefit from the value created in the start-up without having any involvement in that company. Ascenion earns its money by receiving a percentage participation of all the deals it makes. This applies to both start-ups and licensing deals, so that there is no vested interest for Ascenion to choose one option over the other. The academic partners of Ascenion value this service very highly as it gives them room to focus on their core competencies, research and education, and protects them from risks and saves them capacity and time.

In 2020, Ascenion assessed 152 invention disclosures, supported the filing of 71 patent applications and was managing 860 patent families and research materials in total. Its revenues were €3.168 million, its operating expenses were €3.122 million and it returned €2.45 million to the Life Sciences Foundation and €4.479 million to member institutions with a team of 35 FTEs.

Pros and Cons of the Model

"In this world, wherever there is light - there are also shadows" (Madara Uchiha), and for as many advantages Ascenion and the Life Science Foundation might offer, there are also disadvantages to this well-thought-through construct. Ascenion is and always will be, despite its best efforts, an outside consultant. Though it is sometimes easier for the institution to communicate difficult decisions via a consulting firm, Ascenion, this position makes it difficult to gain the full trust of scientists and also creates a potential hurdle in aligning interests. Additionally, it is not easy to explain to founders why Ascenion, and not their parent institution, will acquire equity.

Finally, Ascenion lives from blockbuster deals.

The majority of deals are of small size financially and loss-making for Ascenion, though they provide a welcome influx of additional funding for Ascenion's clients. The reason for this is that Ascenion is bound to commercialize all technologies from its clients, independent of their value. However, most deals need more resources from Ascenion than broker and success fees generate for the company. And blockbuster deals do not happen every few months, not even with such a large client base as Ascenion has. Instead, blockbuster deals are rare and happen only every few years. Therefore, it was, and is, essential for the business model to strike the right balance between regular and reliable consultancy income and success fees from large licensing and equity deals. For the last 20 years this fortunately has worked out.

Successes

Ascenion has co-founded more than 50 companies, exited successfully from around 20 companies and presently holds equity in 23 companies. In 2021 alone, Ascenion's portfolio companies attracted more than €160 million in venture capital investments.

Significant successes include:

- A license to Micromet, acquired by Amgen for $1.2 billion in 2012, for blinatumomab (Blincyto) that received a Breakthrough Therapy Designation in the U.S. and Orphan Drug status in the EU for the treatment of ALL (acute lymphatic leukemia);
- The sale of Activaero GmbH to the British company Vectura in 2014 for more than €130 million;
- The sale of VPM (Vakzine Projekt Management GmbH) including the license to a modern tuberculosis vaccine (rBCG) to Serum Institute India (SIILP).

Today

In the last 20 years the idea of a specialised, sector-specific, external technology transfer office has proven to be a solid and reliable approach, not only to deliver high-quality services for public research organisations, but also to deliver commercial success.

The over-arching concept that all profits of this company are being re-invested into translational research via the owner of Ascenion, the Life Science Foundation, adds substantial attraction for Ascenion's partners and clients, still draws new co-founders to the Life Science Foundation and is a unique selling point.

Knowledge and technology transfer in general, and by Ascenion in particular, have undergone rapid changes. While "traditional" TTO work used to consist mainly in securing and commercializing IP, particularly through patenting and licensing, this is today a smaller part of the daily workload. Supporting and leading the development of researchers' ideas to a higher technology readiness level, to where those ideas reach an inflection point for investment, either by industry or by investors, forms today the most important part of a KTT office's work. To meet these demands, it was not only necessary to increase the capacity of Ascenion but also to develop new expertise by employing business development specialists.

Additionally, the change from licensing to large companies to licensing to start-ups has brought changes. Deals with start-ups require back-loaded deal models, need more support by KTT units, and, frequently, need additional financial support. To meet the above challenges, Ascenion decided with suitable partners to secure money for project-development, to support start-ups, and for follow-on investments (to avoid its equity being diluted too early in later financing rounds). An investment fund to speed up development, increase efficiency and optimize value-creation is therefore the next logical step for Ascenion and its clients to contribute more value to ideas from academia to society. ■

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The Development Of Tech Transfer Down Under: Technology And Innovation Management Pty. Ltd.

By Ashley J. Stevens, Timothy P. Boyle, John Grace, and Andrew F. Sierakowski

The Development of Tech Transfer in Australia[1]

Australia was an early adopter of tech transfer at the individual institutional level, and there were several distinctively Australian aspects to its development:

- From the outset, tech transfer in Australia was organized on an individual institutional basis, in contrast to the countries that preceded Australia in establishing tech transfer—the U.S., Canada, U.K. and Germany—where centralized organizations carried out tech transfer for the whole country;
- From the outset, Australian universities decided that since they had provided the infrastructure and employees to conduct research, the resultant intellectual property should be owned by the institution which should manage and pay for patenting and license it. In the other countries actually doing tech transfer at that time—Canada, the U.K. and the U.S.—government controlled the IP and its licensing through centralized national tech transfer offices;
- The initial drivers of tech transfer weren't the six flagship, first-generation public universities founded in the colonial and Edwardian eras, collectively known as the "Sandstones" because they generally have at their heart a Victorian gothic building built from the sandstone that underlies much of Australia and resembling the central buildings in the ancient British universities. Rather, the process was driven by the newer, largely post-WWII technologically oriented technical institutes and technical universities, which had evolved from much older trade schools and which later developed into full universities;
- Another distinctive aspect of the Australian ecosystem was that from the outset, these activities were conducted by independent, wholly owned limited liability university companies rather than by operating units of the university/institute. This was because universities/institutes had to seek ministerial or government approval to transfer rights to third parties. By setting up a wholly owned limited liability university company, the red tape was reduced to getting permission for one company to have rights to all IP coming from the university;
- Yet another distinctive aspect of the development of tech transfer in Australia is that it encompassed what today is referred to as the broader mandate of knowledge transfer, rather than just tech transfer. These companies generally carried out several commercial activities:
  - Securing consulting contracts for faculty, including expert witness services;
  - Securing contracts for faculty to teach courses such as executive education and short courses;
  - Recruiting overseas students; and
  - Technology transfer.

In its early focus on promotion of consulting—*i.e.*, expert opinion—as a form of knowledge transfer, the Australian profession was decades ahead of a similar focus in the U.K. The immediate profitability of these activities contributed to the sustainability of the independent company model during the extended time required for its tech transfer activities, which were its lowest priority in the early years, to become cash flow positive.

Unisearch Pty. Ltd.

The New South Wales University of Technology was established in 1949 in response to the need for engineers and technicians that had been lost to world war. In 1958, it became the University of New South Wales (UNSW) and in 1959 the second President, Phillip Baxter, an English chemist, created a wholly owned, limited by guarantee company called Unisearch Ltd., whose purpose was to make available specialized services and advice to industry and commerce, as well as to administer patents taken out on inventions developed at the university. Its initial General Manager and Secretary was John Fraser and in 1959, it hired Barry Rosenberg as the Deputy General Manager, and he succeeded Fraser when he became seriously ill in 1976. In 1991, Rosenberg moved to Georgia Tech in the U.S. and founded its tech transfer activities and became a leader in the U.S. profession.

Some of Unisearch's early successes included:

- Memtec Ltd., an osmotic membrane for water

1. A great deal of this section is based on the book This Gown for Hire by Peter Wing, former Managing Director of Insearch, March 1993.

treatment, which was acquired by US Filter Corp for $400 million in 1997 and subsequently listed on the NYSE, and

- Pacific Solar, one of the first photovoltaic development companies which was set up by Unisearch to commercialize UNSW's thin film PV technology called Crystalline Silicon on Glass (CSG) and which raised $50 million from NSW energy provider Pacific Power for a 70% stake.

Australian Tertiary Institutions Commercial Companies Association

UNSW was 12 years ahead of the curve in establishing a commercialization entity, but by 1978, enough other universities and institutes of technology had followed suit such that a professional association was formed, the succinctly named Australian Tertiary Institutions Commercial Companies Association, thankfully always abbreviated to ATICCA. In 2001, ATICCA changed its name to Knowledge Commercialization Australasia, or KCA and remains so to the present day.

ATICCA had seven founders, all previous or current institutes of technology, though all have since become fully-fledged universities. They were:

- Insearch
  New South Wales Institute of Technology →
  University of Technology, Sydney
- QSearch
  Queensland Institute of Technology →
  Queensland University of Technology
- SARRD
  Swinburne Institute of Technology →
  Swinburne University of Technology
- Techsearch
  South Australian Institute of Technology →
  University of South Australia
- Technisearch
  Royal Melbourne Institute of Technology →
  RMIT University
- Unisearch
  New South Wales University of Technology →
  University of New South Wales
- WAIT-AID
  Western Australian Institute of Technology →
  Curtin University

Of the seven founding members, five had actually been incorporated at the time ATICCA was incorporated in 1978, while two others, QSearch and SAARD, had not actually yet come into being. Techsearch, Technisearch and WAIT-AID were all incorporated in 1971, Insearch was incorporated in 1977, SARRD was incorporated in 1979, while QSearch was not incorporated until 1984.

Of the three activities of the commercialization companies, consultancy and executive education courses were immediately cash generating, while technology transfer had a challenging cash flow model. Consulting contracts were priced competitively neutral to ensure commercial consulting companies were not undercut but were nevertheless typically priced at three times the faculty member's salary rate.

Technology-Ownership Policies

In 1982, ATICCA held a meeting at which licensing, royalties and the export of technology were discussed. The meeting reviewed the substantial costs and small returns of involvement in the transfer of technology.

Unisearch reported that it had a large portfolio of patents that it had tried with some success to sell, (*i.e.*, assign) to likely developers, both in Australia and overseas. Other companies had had some mild successes, but nobody had hit a home run. They had found the costs of technology development to be high and the success rate so low that the returns they could expect were small. Licensing, as opposed to assigning, was no better. In fact, a very small percentage of total ATICCA members' turnover was derived from licenses or product development and sales.

A 1989 ATICCA meeting had a forum on intellectual property ownership. The consensus was that, since the parent institution had provided the infrastructure and employees to conduct the work, then the intellectual property created should be owned by the institution. It was therefore the institution's responsibility to initiate patenting and to pay for it, and to develop licensing procedures. Usually, the decision whether to proceed or not was taken by its commer-

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cialization company. Institutions generally had incentive schemes providing inventors with recognition and a share in commercial returns.

The meeting discussed that an inventor could challenge their institution's rights on the grounds that the invention was so widely outside the inventor's duties to the institution as to negate any claim of the institution. Institutions had to make prudent decisions on how much time and effort should be invested in patenting and licensing any individual idea or invention. The meeting noted that inventors' ideas about how much should be invested in patent protection tended to be expansive as long as the institution was paying. Most institutions surrendered all rights to the inventor or originator if the commercialization company could see no reasonable chance of anyone bringing the invention or idea to a successful commercial end.

In a survey carried out in 1990, the revenue breakdown of ATICCA members was as follows:

- Consulting $68 million
- Courses $35 million
- Other $46 million

Tech transfer was included in "Other" and so was less than a third of all commercial revenues.

Commonwealth Scientific and Industrial Research Organization/Sirotech

Australia's well respected government science agency, Commonwealth Scientific and Industrial Research Organization, or CSIRO, was relatively late to the commercialization party. It founded its commercialization company, Sirotech, in 1984, to provide a central point of contact for industry with CSIRO.

The expansion of commercial interactions with Australian firms at the divisional level within CSIRO that occurred during the 1980s meant that Sirotech played a dwindling role as the main conduit between CSIRO and industry. Despite some commercial achievements, it was finally wound up in 1993.

CSIRO's technology with arguably the greatest global impact was its wireless local area network (WLAN, aka Wi-Fi) invented by five CSIRO radio astronomers who invented a chip that greatly improved the signal quality of Wi-Fi. In 1999, the IEEE 802.11a standard, the first standard for WLAN, relied on the CSIRO technology and in 2001, the first products entered the market.

CSIRO had already set out to encourage the telecommunications industry to take licenses for its patented technology. One non-exclusive license was executed with Radiata but other companies which were already in breach of CSIRO's patents did not take up licenses, so CSIRO transitioned to enforcing its patents. It mounted a test case in 2005 and in April 2012, there was a settlement in the U.S. CSIRO eventually had license agreements with 23 companies, representing around 90 percent of the industry and had earned more than $430 million from the technology when its last WLAN patent expired in November 2013.

Uniscan Ltd.

The University of Western Australia (UWA) started to address the issues of IP emerging from its research efforts in 1971. A patent committee was set up and UWA's first patent policies came into effect in 1975.

The regulations recognized that "seek[ing]" patentable inventions was not part of UWA policy, but inventions might be created during research activities and they should be patented "to safeguard the interests of the University and the inventor in a manner consistent with the University's obligations to the public." The regulations obliged academic staff to disclose "any patentable invention made or developed wholly or in part during the course of that person's duty or whilst using the University's research facilities" and to assign his or her rights to the university if it decided "to exercise its rights in the invention." The inventor was entitled to a specified share in the proceeds from the university's exploitation of the invention, but the university Senate was free to enter into "a special arrangement" with the inventor on different terms.

In November 1976, Uniscan Ltd. was incorporated by UWA on the recommendation of the patent committee to facilitate the development of a particular project (a graphic display system). In April 1983, UWA established a Centre for Applied Business Research (CABR) as an administrative unit to operate in conjunction with Uniscan and to take an active role in the development of intellectual property created at the university. An intellectual property unit was set up within CABR in 1984. By 1986, UWA's patent policies were reportedly in disarray and a DVC Research was appointed in 1987.

By July 1988, UWA's policy of operating Uniscan and CABR, essentially at arm's length from the university, was no longer tenable. The operations of these agencies began to be drawn back under more direct UWA management, in particular under the DVCR.

At the end of 1989 UWA tried something new in its management of intellectual property. In conjunction with the three other Western Australian public universities, it appointed Technology and Innovation Management Pty. Ltd. (TIM) to replace Uniscan and CABR in providing intellectual property consultancy services to UWA and to act as an RTTO for Western Australia. As discussed below, TIM later became Tech-Start Australia Pty. Ltd.

In 1993 Uniscan was deregistered.

Technology and Innovation Management Pty. Ltd. (TIM)

It has been difficult to find out much about TIM and how it operated—it was operational before the internet, there are few publicly available references to it, its founding CEO has passed on and we have been unable to identify anyone else who worked there that we could interview about TIM.

TIM started life in 1984 as the West Australian Product Innovation Centre and later changed its name to Technology and Innovation Management Pty. Ltd.

TIM provided tech transfer services to the four public universities in Western Australia:

- Kalgoorlie College of Advanced Education, which became Edith Cowan University
- Murdoch University
- University of Western Australia
- Western Australia Institute of Technology, which became Curtin University

Each already had its own commercialization company:

• Kalgoorlie	Kalgoorlie College Services	1984
• Murdoch	Murmin Pty. Ltd.	1987
• UWA	Uniscan Ltd.	1976
• WAIT	WAIT-AID	1971

All stayed active except for Uniscan which was deregistered in 1993. We were not able to determine what was the division of responsibilities between TIM and the individual commercialization companies, nor how they interacted.

It appears that TIM periodically ran out of money and had to be recapitalized by the four parent universities. It also appears that in 1998, the universities declined to recapitalize TIM and decided to seek outside investors.

In July 1998, McRae Technologies Pty. Ltd. (an investment company of the Clough family which owns Clough Engineering Ltd., one of Western Australia's largest civil engineering firms) formed a partnership with TIM and took majority control of it. Subsequently TIM adopted the trading name of TechStart Australia and from that time forward, TechStart's focus appears to have been on start-ups and early-stage investing.

TechStart's focus included early technical and commercial assessment and early-stage value adding in the form of technical and commercial development.

TechStart did a number of fund raisings and mergers and changed its name again to VentureAxess Capital. It subsequently went through bankruptcy in 2010, started trading again and was finally delisted in 2013.

UWA ceased using TIM for its tech transfer activities in 1998 and by 2001 had created an internal Office of Industry & Innovation and had hired Dr. Andrew Sierakowski to run it.

The Co-operative Research Centers (CRCs)

Special mention should be made of this initiative which was launched in 1991 by the Federal Government whereby research universities linked up with industry and CSIRO to address specific research themes and challenges. The program emphasized the importance of collaborative arrangements to maximize the benefits of research through an enhanced process of utilization, commercialization, and technology transfer. The program still operates successfully today and has delivered many innovations through technology transfer. Some of these innovations include the CRC-developed technology underpinning the cochlear ear implant; advanced composite materials used in the Boeing 787 Dreamliner; Tooth Mousse Plus, the treatment a dentist applies to prevent dental decay; the development of Australia's first National Guideline for the Assessment and Diagnosis of Autism; and extended wear soft contact lenses, now the leading multifocal lens in the U.S.

Other Significant Cooperative Ventures

Australia's co-operative approach in tech transfer also extends to incubators and early-stage investment funds. Some of these efforts are detailed below:

- ATP Innovations (now Cicada Innovations), an incubator founded by
  - University of Technology Sydney
  - University of Sydney
  - University of New South Wales
  - Australian National University

  Founded more than 20 years ago and now Australia's longest-running incubator. It has incubated more than 300 companies which have raised more than $900 million in funding and six of its deep tech ventures have had $1.2 billion in exits.
- Uniseed, Australia's longest-running, early-stage venture fund, founded in 2000 by the Universities of Queensland and Melbourne, with other organisations joining over the next 15 years (University of New South Wales, 2005, University of Sydney and the CSIRO, 2015) with investment capital provided by these research organizations.

  In November 2015, Uniseed started its third fund (with the five partners each committing $10 million over 10 years (total fund $50 million). This followed three high profile exits in the preceding 14 months:
  - Fibrotech sale to Shire for $75 million
  - Spinifex sale to Novartis for up to $700 million
  - Hatchtech sale to Dr Reddys Laboratories for up to $198 million

Uniseed has invested in 60 companies since inception. In March 2017, Uniseed announced the further commitment to a $20 million Follow-on Fund, and in 2018 a Co-Investment Fund was established with private capital providers through a relationship with Stoic Venture Capital.

- Trans-Tasman Fund, established in 2008 to encourage Australian superannuation (pension) funds to invest in high tech start-ups. Trans-Tasman Commercialisation Fund was a venture capital firm based in Melbourne. The firm was a collaboration between Westscheme Superannuation, the South Australian and Victorian State, and New Zealand governments and five member universities:
    - Monash University
    - Flinders University
    - University of South Australia
    - University of Adelaide
    - University of Auckland ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4254052*.

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Timothy P. Boyle is Director, Innovation & Commercialization and founder of the nandin Innovation Centre, ANSTO's center for commercialization, design innovation and entrepreneurship. Tim is an internationally recognized leader in research translation and IP commercialization with over 20 years' experience developing the interface between research and business through technology licensing, developing industry collaborations and spinning out new ventures across a broad range of technology areas and disciplines on both a domestic and an international scale. Tim has also worked in various knowledge exchange and technology development roles within higher education, information, and the pharmaceutical industry and throughout his career. Tim holds appointments as an Adjunct Professor with Swinburne University of Technology and Global Expert faculty with Singularity University.

John Grace's career has spanned over 50 years with roles as diverse as a food technologist with a start-up company, a licensor of public research to third parties and business development through in-licensing IP from publicly funded medical research institutes. He was the CEO of a new business producing concentrated cheese starter cultures and then was Sirotech's technology transfer professional for their biotechnology portfolio. He was CEO and director of AMRAD, a listed biotech company where he negotiated tech transfer deals with international partners, particularly in early biopharmaceutical discoveries. Since then, he has been a consultant for commercialization for publicly funded research organizations.

Andrew F. Sierakowski established the University of Western Australia's Office of Industry and Innovation, which was responsible for technology transfer and industry engagement activities for the university, and was its Director until 2014. He served as chair of Knowledge Commercialisation Australasia (KCA) from 2003 to 2012. In 2010, he represented KCA in founding ATTP (Alliance of Technology Transfer Professionals) and he served on its board until 2013. He started his career with Kodak Australasia and was General Manager of Joyce Rural, an agrichemical subsidiary of Joyce Corporation.

Trying To Make Tech Transfer A For-Profit Activity —University Patents, Inc.

By Ashley J. Stevens

Origins

University Patents, Inc. (UPI) was an experiment in doing tech transfer on a for-profit basis. It was incorporated in 1964 as an Illinois corporation as the exclusive licensor for the University of Illinois Foundation until 1985. It was reorganized in 1968 and then reincorporated in Delaware in 1971 and became publicly traded on the American Stock Exchange in 1973.[1]

The company signed additional agreements to be the exclusive licensing agent for the University of Arizona and the Illinois Institute of Technology (IIT Research Institute), Chicago in 1974, Arizona State University and the University of Colorado in 1976 and the University of Pennsylvania in 1978. It subsequently signed New York University. In 1993, UPI acquired 80 percent of the stock of CTI-PA, a wholly owned subsidiary of Lehigh University (Lehigh) in exchange for $750,000 payable in UPI stock. CTI-PA had a contract to manage Lehigh's technology portfolio through September 30, 1997.

UPI had a colorful history. In 1968 it acquired Regal Rugs, a profitable rug manufacturing company, whose profits were offset by the operating losses of the tech transfer business, thereby reducing Regal's income tax liability. It discontinued that business sometime in 1980. In 1988, UPI sold its technology management business to University Science, Engineering and Technology, Inc., a company founded by the equally colorful Robert Maxwell, a British publishing magnate who owned Pergamon Press and MacMillan publishing. Maxwell's empire imploded almost immediately, and he drowned after falling off of his luxury yacht Lady Ghislaine, named after his daughter (yes, that Ghislaine Maxwell) in the Canary Islands in 1991 under disputed circumstances. He was subsequently found to have plundered £800 million from the pension funds of the Daily Mirror newspaper which he owned and several other funds. Suffice it to say, UPI repurchased the tech transfer business from McMillan in 1990.

Relationship with IBM

UPI had strong ties to IBM. Its long-time chairman and CEO, L. William Miles was director of commercial development in charge of IBM's contract, patent, licensing, and acquisitions activities. One of UPI's biggest commercial successes, a plasma display panel, was licensed to IBM and generated over $6 million in royalties over its lifetime. When IBM discontinued the business, UPI created a company, Plasmaco, which raised venture capital and bought the plant.

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Successes

Other technologies UPI put significant efforts into were gallium aluminum arsenide semiconductors, polymer batteries, Retin A, a chemical tanning agent, a herpes virus vaccine, a pre-internet distance learning system and a B12 assay system.

It created a number of start-up companies, many of which had *University* in their names:

- Knowledge Solutions, Inc., a multimedia training process model from Lehigh
- Vector Vision, Inc., video compression technology from Lehigh
- Equine Biodiagnostics, Inc., diagnostic laboratory services for the equine industry, University of Kentucky
- University Communications, Inc., NovaNET, an interactive education and communication network, University of Illinois
- University Optical Products Co., bifocal contact lenses and intraocular lenses
- University Genetics, discussed below.

University Genetics

Alan Walton, who went on to become a notable biotech VC at Oxford Partners and then Oxford Biosciences, was a co-founder and president of University Genetics (UGEN) in October 1980. The company received ownership of all of University Patents' genetic engineering technologies for 25 years. UP received any royalty income UGEN received from these assets. UGEN had two other sources of technologies:

- DNA Partnership, which was set up by UP and Novack Management. It raised $2.25 million in December 1981 and used it to fund development agreements with universities that UGEN would ne-

1. This article is largely based on UPI's SEC filings.

gotiate. UGEN retained 25 percent of the funding amounts and any licensing revenues were shared 50:50 between UGEN and DNA Partnership.

- It negotiated rights to university genetic projects directly.

Its business model was to take 60 percent of the profits and split the rest with the scientist and his/her university.

In an interview, Walton claimed that the company had raised $30 million in initial financing. However, an S-1 UGEN filed in May 1983 to raise $4 million through a share and warrant offering appeared to be seeking the initial funding for UGEN and did not disclose any signs of an earlier funding round. The only funding the S-1 showed to have been raised was the $2.25 million raised by DNA Partnership. UGEN never succeeded in going public and by 1986 Walton was associated with Oxford Partners.

UGEN early successes included:

- Securing funding for a researcher synthesizing a lymphoblastoid interferon gene from Hoechst AG
- Licensing the gene sequencing technology developed by Nobel laureate Marvin Caruthers at the University of Colorado. UGEN licensed it to Applied BioSystems
- Licensing the "ice-minus" technology to Frost Technology
- Licensing HSV1 and two subunit vaccines to American Cyanamid
- Licensing a technetium labelling process that delivered a radio-opaque agent for tumor imaging to Summa Medical Corporation

UGEN's revenues were $226,000 in 1982 and $195,000 in the first half of 1983, of which $20,000 in each period were fees for options to licenses.

UGEN was a true pioneer in the biotechnology boom, having been founded a month before Bayh-Dole was passed by the Senate. This was in the very early days of the emergence of biotechnology and UGEN may just have been ahead of its time, with companies only just starting to become convinced that biotechnology was real and sustainable.

Business Model

UPI's business model was to keep 40 percent of the income from the inventions it managed and pass on 60 percent to the inventing university, competitive with Research Corporation. The business was never successful and sustained operating losses for many years. In its 1988 Annual Report it summarized its situation as follows: "While the business produced a respectable royalty revenue base, that sought-after combination of several high royalty income-producing technologies simultaneously generating significant revenues eluded us."

UPI formed a strategic partnership with its British counterpart, BTG, with each agreeing to market the other's technologies in its own country.

Impact of the Transition to In-house TTOs

The other factor in UPI's demise was universities creating their own TTOs after Bayh-Dole massively increased the number of technologies owned by universities. UPI's successful technologies became technologically obsolete (*e.g.*, plasma flat panel displays were replaced by LCD displays) and they were not replaced by newer technologies. It may have just have lacked a critical mass of technology flow.

The Demise of UPI

UPI changed its name to Competitive Technologies, Inc. in December 1994, with a ticker symbol of CTTC and changed it again in August 2014 to Calmare Therapeutics, Inc., which sold a pain therapy device it had acquired from an individual inventor. It was delisted from the NYSE Amex in 2010 and bounced between the OTCQX and the OTC Pink. Its last 10-K was filed in 2017 and its shares currently trade for $0.0002.

Competitive Technologies reported to the AUTM Licensing Survey starting in 1993 (UPI had not reported prior to the name change), with its last report being submitted to the 1999 Survey. The data are shown in Table 1. The company was still receiving up to 100 invention disclosures a year and filing patents on close to 25 percent of them, somewhat lower than is typical for TTOs. It had 102 active licenses in 1993, of which

Table 1: Competitive Technologies Reports To AUTM Survey

Year	Inv. Dis. Rec.	New Pat. App. Fld.	Tot. Pat. App. Fld.	Iss. US Pat.	Lic. w. Equ.	St.-Ups Form.	Act. Lic.	Act. Lic.	Act. Lic.	Lic. Gen. Inc.	Gross Lic. Inc.	Inc. Pd. Oth.
1993	65	12	15	7	12		102	102	102	51	$3,100,000	$1,900,000
1994	72	13	15	15	10	5	112	112	112	56	$6,700,000	$2,100,000
1995	87	12	12	5	2	2	97	97	97	65	$4,880,000	$3,250,000
1996	115	37	37	7	2	2	97	97	97	53	$9,300,000	$6,500,000
1999	23	13	13	3	0	0	98	98	98	73	$8,332,624	$4,869,448

52 were revenue generating. CTI's income in the five years it reported varied significantly from year to year but totaled $32 million, of which 57 percent, or $18 million was distributed to universities. For comparison, as discussed earlier in this special issue, Research Corporation Technologies' annual income at this time was 10 to 20 times that of CTI.

Post Bayh-Dole, universities saw both UPI and RCT as cherry-picking technologies they thought would be financially successful and rejecting most they were offered. They were also seen as being located too far away from campus. Plus, the more than 50 percent off the top was resented by both inventors and the university. UPI showed that tech transfer cannot be counted on to generate a commercial rate of return.

Spyglass and the Failure to Capitalize on the Internet

One of the consequences of the University of Illinois outsourcing its tech transfer capabilities to UPI was a lack of expertise in commercialization in the early 1990s, when its National Supercomputer Applications Center licensed out two of the university technologies that have most dramatically changed how the world works:

- Mosaic, the first web browser that could display graphics, and
- Eudora, the first email program that could attach documents

UPI was by then on its last legs and the University of Illinois had no in-house expertise available to guide the commercialization of Eudora and Mosaic. It appears that UIUC licensed the technologies itself because there were no patents on them and so UPI did not acquire rights to them (if they were even offered).

Initially UIUC licensed Mosaic itself. In May 1994, it gave Spyglass an exclusive license to Mosaic but for around 10 non-exclusive licenses it had previously granted. Spyglass had been founded by former NSCA employees in 1990. Spyglass went on to launch the *dot.com* era with its June 1995 IPO, the first IPO of an internet company, selling 2 million shares at $8.50. The stock closed the day at $27.75, up more than 200 percent. UIUC had not negotiated equity in Spyglass and so did not benefit from this.

Spyglass paid UIUC royalties based on Spyglass' net revenues from Device Mosaic and included cumulative minimum quarterly royalties and had an initial term of five years. In 1999, UIUC amended the license to eliminate royalty payments for Mosaic.

Spyglass licensed Mosaic to Microsoft for $2 million for use with Windows 95, where it became Internet Explorer, expanded the license to include the Macintosh and Windows 3.1, and finally in March 1997 granted Microsoft a fully paid-up license for an additional $8 million. Spyglass's total revenues from Microsoft for Mosaic were $13.1 million. It is not clear from Spyglass' public filings how much of the $13.1 million UIUC received.

By the end of 1995, Spyglass had also licensed Mosaic to 82 other companies for use in their software products, including IBM and Digital Equipment. The revenue stream from the licensing deals was around $20 million per year. These revenues disappeared when Microsoft started bundling Internet Explorer with Windows at no additional charge.

OpenTV bought Spyglass for $2.5 billion in March 2000.

UIUC made several poor decisions in the commercialization of its internet technologies:

- UIUC did not negotiate for equity in Spyglass
- It licensed Eudora for a fully paid-up fee of less than $1 million, and
- To settle trade secret theft litigation with Marc Andreeson over Netscape's browser, UIUC insisted on cash and turned down equity in Netscape's Series A round that would have been worth billions of dollars at Netscape's subsequent IPO

UIUC probably reaped less than $10 million in revenues from its internet technologies in total.

It did not establish its own in-house tech transfer capability until 1998. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4254059*.

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Tech Transfer In France—ANVAR And The Sociétés d'Accélération du Transfert de Technologies

By Alexandre Navarre

Development of Tech Transfer in France: ANVAR

France has had a good reputation for its high-level publicly funded education through both 'Lycées' and a large network of universities and professional institutes. Professors and researchers, while public servants, enjoy considerable freedom of action and expression, ingrained in the French culture. University intellectual property (IP) belongs therefore to the state and its educational institutions, namely the universities and publicly funded research centers. Historically, knowledge transfer was primarily through publications, student hiring and consulting. Up until 2010, universities had relatively small administrative units responsible for research contracts with industry (the DMTT)[1] and at times, protecting IP upon researchers' request and providing licences to industry.

Yet, technology transfer activities have a long history in France. In 1939, CNRS (Conseil National de Recherche Scientifique) was created as a research organization distributed across France with a mix of its own laboratories and joint appointments in its member universities. In 1967, ANVAR (Agence Nationale de Valorisation de la Recherche) was created under the auspices of the CNRS to help transfer research results from major national institutes to industry. Thus, ANVAR acted as a centralized, national tech transfer organization (NTTO).

In 1979, ANVAR's mandate was extended to include direct help for SME's adoption of new technologies. This took place through funding advances as part of licences for proof-of-concept projects. In the same period, some universities had started what were termed DMTTs, units primarily accompanying researchers in their industrial contracts and performing some frontline IP protection. However, similar to the case of CPDL in Canada, universities generally were critical of ANVAR's processes. In 1992, CNRS created its own tech transfer entity, FIST SA (today called CNRS Innovation), while other large research centers such as INSERM[2] in life sciences or CEA[3] in the energy domain were also structuring internal tech transfer operations, including licensing activities to business. In the meantime, newly available venture capital was fuelling spin-off activities in partnership with ANVAR. In 2005, after years of underfunding, ANVAR was facing a deficit of over €200 million and underwent some restructuring that led to its integration into the national innovation agency, OSEO, catering to a wider variety of financial services to companies. It later became 'Banque Publique d'Investissement (Bpifrance). During that period and until the creation of the SATTs, myriad regional innovation centers were initiated, creating a very complex innovation ecosystem, often referred to as a "millefeuille" after the well known French pastry which is made up of multiple layers of pastry and cream.

The Birth of the Sociétés d'Accélération du Transfert de Technologies

Concerned by the dismal ratings of its prestigious institutions, particularly in the Shanghai index and in OECD reports on innovation, the French Government launched in 2010 a major €32 billion investment fund called the Grand Emprunt. Since then, the total investment has been increased to €52 billion. Among its numerous initiatives aimed at reinforcing France's R&D structure, as well as industry-university partnerships, €900 million were initially allocated to a new initiative: the Sociétés d'Accélération du Transfert de Technologies (SATTs). The SATTs were intended to become a network of 14 entities (now 13) covering all of France. The objective was to allow for more specialized resources to be available to universities, including proof-of-concept funding, and to facilitate transfers with a focus on critical masses of research and SME accessibility towards those infrastructures and results. Its objective was to reduce what had been perceived as universities operating in silos.

In 2010 an initial round of project solicitations to create the SATTs was made through ANR,[4] leading to awards starting in 2011 to 2013; those selected proposals started operations in 2012. Fourteen SATTs were initially created, while one was disbanded in 2018 and its member institutions joined other SATTs and a regional initiative. SATTs were thus part of a complex array of regional hubs integrating incubators and seed funding.[5]

1. DMTT: Dispositif mutualisé de transfert de technologies.
2. INSERM: Institut National de la Santé et de la Recherche Médicale.
3. CEA: Commissariat à l'Énergie Atomique et aux Énergies Alternatives.
4. ANR: Agence Nationale de la Recherche.
5. "Valorisation de la recherche par les SATT," A. Navarre, *Techniques de l'ingénieur*, Avril 2017.

Simultaneously, universities were asked to become more financially autonomous and were instructed to have a number of research and educational institutions merge on a regional basis (the COMUE[6] exercise). There had been limited consultations with universities on the creation of the SATTs, so it was perceived as another imposition from the central government on both the regions, an important decision-making level of government, and the universities. Furthermore, while the SATTs were implementing their network, the government was reforming its regional structures cutting their number approximately in half.

Structure of the SATTs

To become eligible for the SATT program, universities were asked to present their project to ANR, a major granting agency for university research. Presentations were expected to be in the form of a consortium with different public research organisations in a given territory (universities, engineering schools, national research centers) in order to access a critical mass of inventions with a view of self sustainability after a ten-year period. Each consortium was required to have a minimum of about €300 million of research annually.

The influential *Caisse de Dépot*, the operator representing the government and the major SATT shareholder, channelled funding to universities and the other stakeholders in order for them to acquire a significant shareholding in the SATTs. The intent was to have universities committed to the interests of the SATTs. Therefore, the SATT structures became semi autonomous entities with a board consisting of the state and public research organisations representatives, often university presidents. The Caisse's shares are now held by Bpifrance. Their funding had a ten-year horizon with periodic three-year reviews. Each CEO reported to a locally designated board, while investment committees comprised of businesspeople reviewed maturation proposals which could be from €30,000 up to about €300,000. The model provided for sharing benefits between the SATTs, member establishments and inventors. Generally, though with some variance, revenue sharing was based on 50 percent of net revenues to the inventors and equal sharing of the remainder between the institution(s) and the SATT. However, the lack of standardization with respect to sharing agreements exacerbated issues, especially in inter-institutional co-invention cases.

Attitudes of the Various Stakeholders

There were different reactions within the French research ecosystem with respect to the SATT initiative. While the SATTs are now well-integrated into the innovation ecosystem, initially their acceptance was nuanced depending on the specific region. Such factors as the political orientation of the regional government and of the university administration, the willingness of their DMTT, which were the precursors of the SATTs and reported generally to the vice president of research, to integrate the SATTs were determinant factors in their early adoption. As a result, delays were noted in the early implementation of the program, at least in some regions. Universities by and large recognized the opportunity the SATTs provided, especially with additional proof of concept funding accruing by way of maturation projects.

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However, resistance was felt in the research community, which was not prepared for the expectation of commercial outcomes. Most researchers were happy to transfer their knowledge at no cost to the public through publication. Industry felt deprived of free access to universities' research results since the SATTs were given the first right to look for inventions by their member institutions. Regional administrations were ambivalent, recognizing the economic impact but resenting the political intrusion. Existing DMTTs within universities were directly threatened with extinction. Furthermore, the unique French university system of joint appointments between agencies (CNRS, INSERM, CAE, INSA...called EPSTs)[7] and universities created conflicts as the majority of those agencies maintained their own tech transfer units, some of which were very successful, making joint IP issues a challenge in terms of leadership, management and income sharing.

As a result, the SATT model met with limited success in its early years. Initially it was rejected and criticized as a new layer, hence the comparison with the "millefeuille." Researchers were not keen either because while they were tapping into new sources of funding for proof of concept (maturation), they were directed towards a commercial path in the expectation of potential returns, a path not universally accepted. Such cultural differences would take years to subside. In the meantime, the French government supported the SATT initiative through different administrations and increased their dedicated funding. Some SATTs were the object of inter-regional political differences and tensions that resulted from the number of stake-

6. COMUE: Communautés d'universités et d'établissements created via a Decree 2018-1131 leading to 19 COMUEs, 7 Associations and 3 Experimental Establishments.

7. EPST: Établissements Public à caractère Scientifique et Technologique.

holders, some having up to eight universities on their board, not including state officials.

In France as in the U.S., it is compulsory to protect IP through the national jurisdictional authority. INPI (Institut National de la Propriété Intellectuelle) provides some advantages since one can file for a patent without full proof of concept. The IP is also akin to "industrial property" (propriété industrielle), which adds to the confusion since the notion is often ingrained in industrial quarters that publicly sourced and funded IP should be publicly accessible and free. This is the difficult context in which SATTs had to establish themselves.

Results

Today, after a decade of struggling efforts, SATTs have become part of the university discovery and innovation ecosystem, covering 165 institutions, universities, research hospitals and engineering schools. Their record is on the climb with over 16,000 inventions evaluated, over 3,600 patent applications filed, over 1,400 licences granted, and 672 start-ups created. SATTs can take an equity position in start-ups, securing further their long-term self-financing. The latter have generated investments of over €1.1 billion in the past 10 years. This is still a small fraction of all French start-up creation but is growing and the SATTs start-up portfolio has great potential. Additional graphics of the SATTs metrics progression can be found in Annex 1. Those provide a unique documentation of what a sustained technology transfer program can achieve within a decade.

Success stories can be found on the Réseau SATT website.[8] A few examples are:

- Valbiotis,[9] whose technology addresses arterial hypertension often found in diabétic patients, which has just raised €15 million and has established a partnership with Nestlé
- EpiLAB,[10] which has just raised €1 million to develop a first-ever portable tuberculosis test
- SeqOne,[11] which has raised €23 million to implement an advanced genomics analysis platform

The SATT initiative remains a concrete example of government resolve with respect to harvesting inventions from universities. It is now an established network that will support French-driven innovation, part of its inherent tradition and globally recognized. A recent Deloitte study[12] has shown that for each €1 invested in start-ups created via the SATTs, the induced economic benefit is €17. In addition, an ANR study[13] has illustrated that SATT licencees are increasing their revenues significantly (over 20 percent) as well as their financial profile.

The Future

At present, it appears that the French government intends to pursue funding the SATTs for the foreseeable future since this well-endowed program has managed to survive three different governments to date and is led through the prestigious Commissariat Général à l'Investissement (CGI), reporting directly to the Prime Minister. Noteworthy, across the Channel, the British government has supported tech transfer at British universities since 2003 and currently invests £210 million annually through the HEIF (Higher Education Innovation Fund) program. However, the €100 million annual funding of the SATTs does not take into account other tech transfer operations conducted internally by its major research Centers, such as EPSTs like CNRS or INSERM.

Annex 1

A Decade of Commercialization Progress Through the SATTs

These graphics below were provided by Réseau SATT, an organization intended to promote SATT activities and whose members are the SATTs. Special thanks to Caroline Dreyer, current president of this network as well as of SATT Conectus (located in Strasbourg) which provided the metrics used in this annex.

It is therefore a unique opportunity to illustrate the progression via metrics across time from a national university technology transfer program, the French university ecosystem. In 2018, France's R&D expenses in higher education establishments represented €7.6 billion, excluding EPSTs whose R&D budget was €5.8 billion.[14] Given some joint appointments between EPSTs and universities, the actual university R&D expenses are far larger than €7.6 billion. It represents close to 300,000 researchers (28 percent being women), out of which 150,000 are part of the SATT network.

The cumulative metric analysis presented below since the SATTs' inception in 2012-13 shows an initial

8. *https://www.satt.fr/.*

9. *https://www.sudouest.fr/charente-maritime/la-rochelle/perigny-la-start-up-de-la-sante-valbiotis-leve-15-millions-d-euros-2157799.php.*

10. *https://biotechinfo.fr/article/medtech-la-start-up-epilab-boucle-une-premiere-levee-de-fonds-de-1-million-deuros-pour-finaliser-le-developpement-de-son-kit-portable-simple-et-rapide-de-depistage-de-la-tuberculose/.*

11. *https://seqone.com/ and https://www.annuaire-startups.pro/startup/seqone/.*

12. *https://www.satt.fr/etude-deloitte-2021/.*

13. *https://www.technopolis-group.com/wp-content/uploads/2021/02/satt_note_de_synthese_vf_2020-10-23.pdf.*

14. *https://publication.enseignementsup-recherche.gouv.fr/eesr/FR/T622/le_financement_des_activites_de_recherche_et_developpement_de_la_recherche_publique/#ILL_EESR14_R_46_01.*

acceleration in the number of invention disclosures followed by what is now a steady state progression. While one of the graphics shows that only 25 percent of reported inventions are protected, it only includes priority patent applications and not other software, trade names or IP titles. It also is an indication of low TRL levels that French research is generally producing.

However, about 50 percent of protected inventions are being licenced, which is in line with AUTM metrics, recognizing that those are soft conclusions due to time lag and sometimes bundling of different pieces of IP. The data shows a significant and sustained increase in the number of start-ups, likely linked to the number of maturation projects and availability of further financing. However, not all maturation projects are either leading to a licence or a start-up. At this stage, it would be difficult to access mortality rates because of lag times involved between invention disclosure, further proof of concept funding and commercial activities. However, about 70 percent of protected inventions receive an initial maturation.

The high start-up propensity may likely be due, among other causes, to a cultural gap within industry in its willingness to licence early-stage academic IP. It also rides on VC and angel funding availability and perhaps as well to a new trend amongst researchers to be start-up founders. In fact, the latter is exemplified by the funding raised by those start-ups, which started to materialize on average five years after the beginning of the program and seems to have taken a new up-hill momentum in 2020. It confirms what tech transfer professionals' experience have noted: the lag time between invention disclosure and the real development of a start-up. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4254066*.

The Author

Alexandre Navarre has had a career dedicated to innovation in industry with Dow Chemicals, with the Canadian Federal Government, and with university tech transfer offices as director (McGill and Western Ontario) and as founder and CEO of one of the French SATTs. He was also Quebec manager of the Canadian Science and Engineering Research Council of Canada (NSERC), a founding member of ACCT Canada and a long time chair of the Development Committee of the Canadian AUTM section. Actively retired, he currently consults on innovation and IP policy issues and writes articles on innovation challenges.

Figure 1: Number Of Invention Disclosures

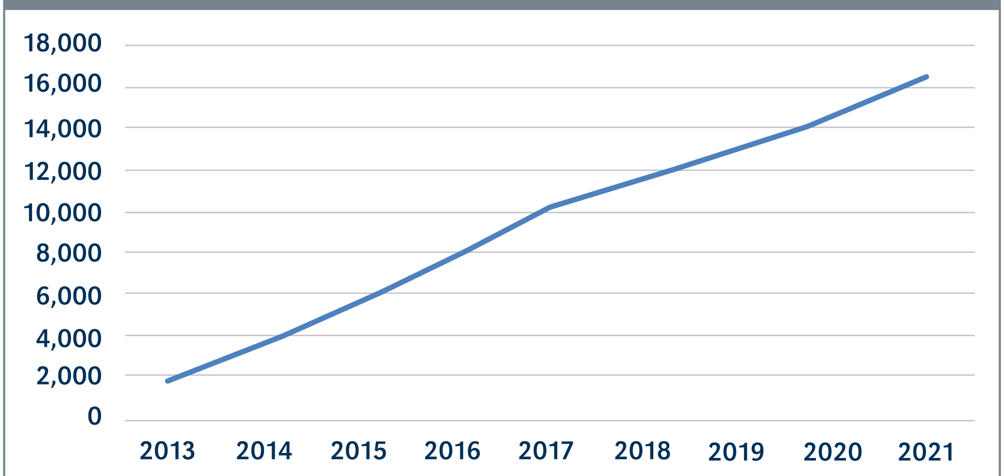


Figure 2: Number Of Patents Filed (First Patent)

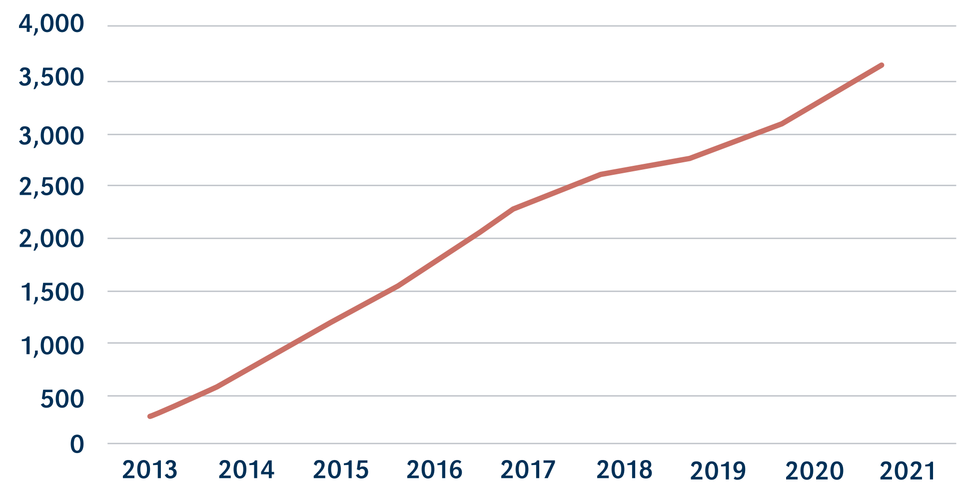


Figure 3: Number Of Licenses Signed

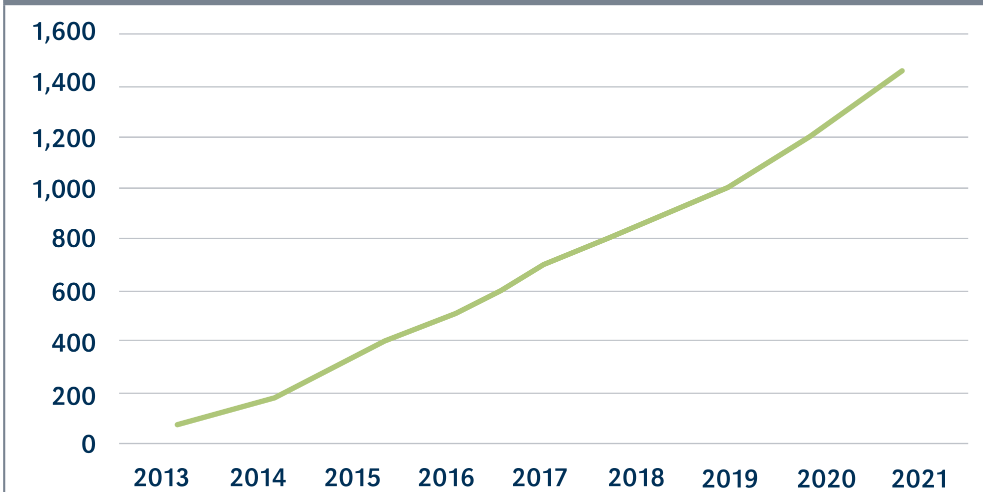


Figure 4: Number Of Start-Ups Created

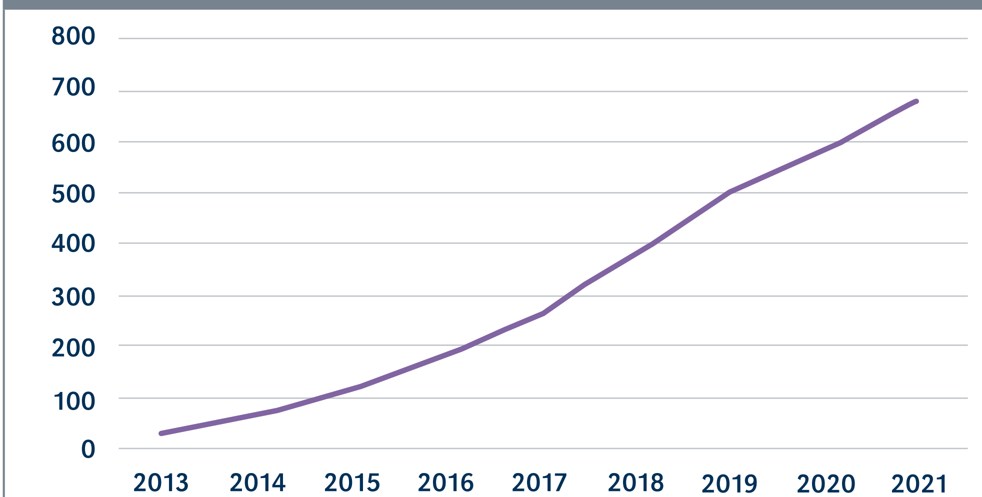


Figure 5: Number Of Proof Of Concept (Maturation) Projects

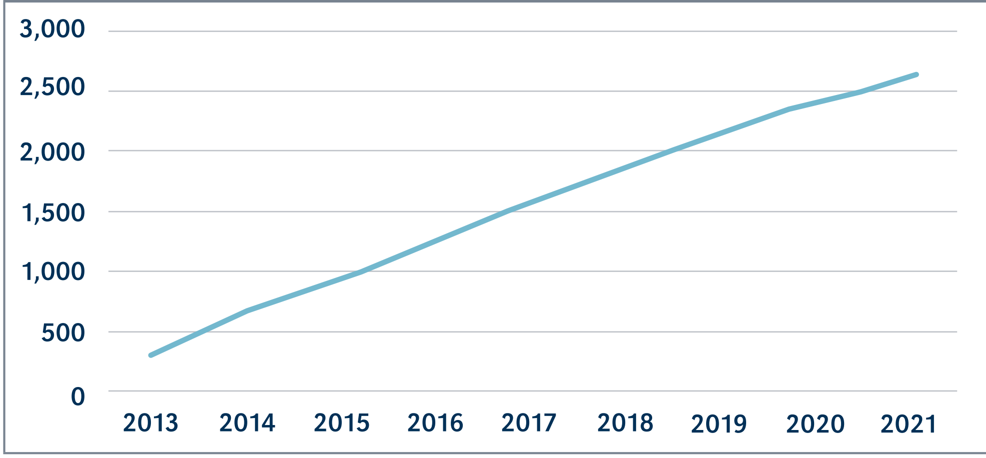
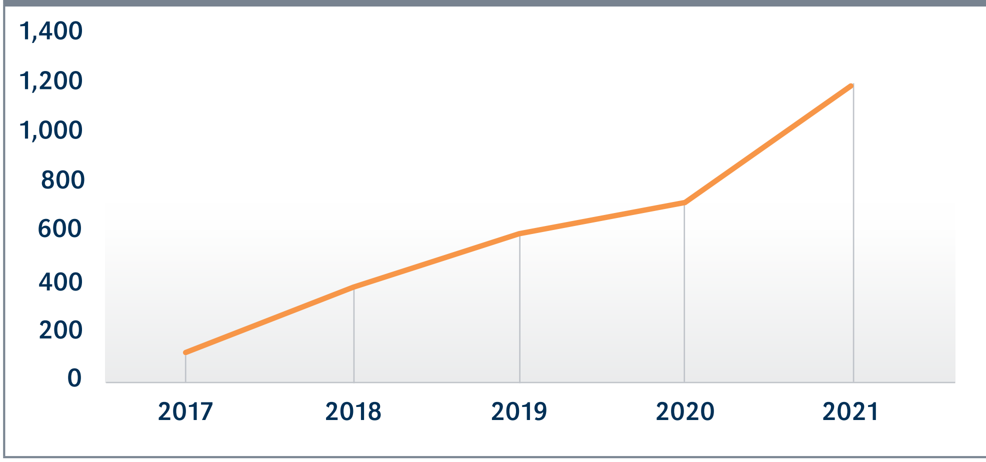


Figure 6: Funding Raised By The Start-Ups In M€



An Early Regional TTO In The U.S.—Washington Research Foundation

By Ashley J. Stevens

Origin

Washington Research Foundation was established in 1981 in response to the passage of the Bayh-Dole Act by three prominent members of Seattle's business community who were friends of the University of Washington—Tom Cable, Bill Gates, Sr. and Hunter Simpson.[1]

Simpson had left IBM in 1966 to become president of Physio-Control Corporation, a then-struggling medical device company that later became known internationally for its Lifepak defibrillator monitors. The company is now owned by Stryker and its AED products are still major sellers. In the mid-1970s, Physio-Control began manufacturing two products derived from research done at the University of Washington (UW). The university had no mechanism in place to commercialize any technology arising from research and Simpson took the unusual step of paying voluntary royalties to UW for the technologies that Physio-Control commercialized.

With the passage of Bayh-Dole and the emergence of biotechnology, Cable, Gates and Simpson wanted to see UW capitalize on its intellectual property and felt that by having it managed by an independent organization, the organization could be created with a commercial rather than an academic mindset.

They therefore corralled 35 local companies to guarantee a $1 million revolving line of credit to finance Washington Research Foundation's (WRF) initial activities. WRF finally paid off the line of credit in 1990 and the guarantees were released (amidst a big celebration).

Cable, Gates and Simpson modeled WRF on the Wisconsin Alumni Research Foundation. WRF's relationship with UW was not exclusive—UW could run with any individual technology that it chose to. One hundred patents were assigned to WRF during the time it was active in tech transfer.

After a tax audit in 1983, WRF lost its tax-exempt status. Slade Gorton, one of the state's senators, and Bob Dole sponsored legislation that restored WRF's tax-exempt status. As part of the negotiations leading to this, WRF agreed to offer its services to all the public research organizations in the state, including Washington State University, and Eastern, Central and Western Washington Universities. WRF evaluated a number of technologies from these universities and applied for patents on a few of them but did not license any of them—all of the 170 licenses it signed were for UW technologies. It did make a number of grants to WSU, EWU, CWU and WWU.

In its early years, WRF went through a number of CEOs fairly quickly. In 1986, Rob Sloman became CEO and in 1990, Ron Howell succeeded Sloman and held the position for nearly 30 years until his retirement in 2021. Howell was the first African American to lead a major, highly successful tech transfer organization. He also anchored the brass section of the AUTM Band, the Infringers, playing a mean saxophone alongside the NIH's Steve Ferguson on trombone.

Financially, WRF was very successful and is still in existence, though its role and mission have completely changed.

Business Model and Successes

WRF's business model was to retain 40 percent of licensing revenues, and WRF was fortunate to have at least three major hits, all from UW:

- The Hall patents for expressing genetically engineered proteins in yeast; GSK used the technology for its Engerix-B hepatitis B vaccine, Merck for Recombivax, its own Hepatitis B vaccine and Novo for its insulin. The patents were owned jointly with Genentech and the first application was filed in 1981; nothing had issued when the TRIPS Agreement came into force and the final continuation was filed on June 7, 1995. The first patent issued in 1997 and enjoyed 17 years of patent life, expiring in 2014. Despite co-inventing the yeast expression system with Genentech, major disputes developed between Genentech and UW over the future use of the system.
- The Suominen patents for an RF receiver, used in many electronic devices and the basis for Bluetooth connectivity. WRF sued Apple for unlicensed use of these patents.
- The Davie patents for Factor IX, commercialized by Genetics Institute (now Pfizer).
- The Whiteley patents for B. thuringiensis (Bt).

It was particularly creative in licensing the Hall patents. It initially licensed them non-exclusively, but later started licensing fields exclusively subject only to pre-

1. This account is based on information obtained from WRF's website (*https://www.wrfseattle.org/*) and conversations with former employees of WRF.

viously granted licenses and was prepared to attempt to claw back rights from earlier licensees in return for higher running royalty rates if successful, a program it called "residual field of use exclusivity."

WRF was not afraid to enforce its IP and conducted 11 related litigations, winning all of them. It also was aggressive in auditing licensees to ensure that it was receiving the royalties it was owed.

Spin-Outs

In 1981, WRF helped form ZymoGenetics and licensed the Hall and Davie patents to it. ZymoGenetics helped Novo develop a recombinant insulin and Novo bought ZymoGenetics in 1988 for $23 million. Novo subsequently spun Zymogenetics back out in 2000 and Bristol-Myers Squibb acquired ZymoGenetics in 2010 for $885 million. BMS subsequently shut down the operations and the facility was sold to the Fred Hutchinson Cancer Center.

Another early success was an airline search engine developed by a company called Farecast, based on the work of UW computer science professor Oren Etzioni; which was bought by Microsoft for $115 million in 2008. Seattle-based Corus Pharma was bought by Gilead Sciences for $365 million in 2012.

Issues

Reportedly, when the University of Washington saw the share of the revenues of the Hall patents that WRF retained, they determined to start their own TTO. Another issue, perceived with many third-party TTOs, was that WRF was considered as "them" by many in the UW community, even though UW's own TTO rented space in the same office building as WRF.

Current Status

UW's TTO started operations in 1983.

In 1992, UW cancelled the Technology Administration Agreement between UW and WRF, though WRF continued to receive and manage disclosures for a while longer.

However, the deals that WRF had done while they were in charge of the patenting stayed in place and WRF received $455 million in royalties, of which $228 million was returned to UW.

Grant Program

As it started to generate a significant surplus, WRF created a number of grant programs that returned part of the surplus to UW. This in turn allowed WRF to retain the remaining part of the surplus to build up its own asset base, eventually resulting in the creation of WRF Capital.

The creation of WRF grants programs gave WRF a structure to respond to the plethora of choices from the many grant requests by communicating its preferences and objectives to grant applicants. Some of these programs were:

- WRF Postdoctoral Fellows Program
- WRF Innovation Grants, which supported UW's:

–Institute for Protein Design

–Clean Energy Institute

–Data Science Institute, and

–Institute for Neuroscience

WRF has made grants to UW totaling over $100 million.

WRF Capital

In 1994, WRF created an early-stage venture fund, WRF Capital, which makes investments of $1.5 to $5 million in new companies and to date has helped start 110 companies in the State of Washington. WRF was one of the region's most active early-stage venture investors and has been a key contributor to the region's innovation economy related to the transformation of technological research into operating businesses.

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One of its biggest successes is Juno Therapeutics, based on chimeric antigen receptor T cell (CAR-T) technology from the Fred Hutchinson Cancer Center and Seattle Children's Hospital. Juno Therapeutics was bought by Celgene in 2018 for $9 billion.

Other successful WRF Capital venture investments include:

- Alder Biopharma
- Clarisonic
- Omeros
- Arzeda
- AbSci
- Icosavax
- Lyell Immunopharma
- Proniras
- Neolukin Therapeutics

WRF Capital also invested as a limited partner in other venture funds. This gave WRF more access to large fast-moving deals that it could not otherwise get into:

- Arch Ventures (two funds)
- Voyager Capital (one fund)
- Founding Partner UW W Fund
- The Accelerator (two funds)

Inteum

WRF was operating in the pre-Internet era, and also relatively early in the PC era and there were no specialized IP management tools available for PCs. Ron Howell, before he became CEO, created a proprietary database to organize all of WRF's invention disclosures, patent filings, etc., called the Daily Evaluation and Licensing Support database (D.E.A.L.S.Db). After the TAA was terminated and WRF's technology management activities decreased markedly, Sloman left WRF, licensed the D.E.A.L.S technology, and used it as the foundation of Inteum, the first vendor of specialized tech transfer management systems and still one of the leaders in the field.

Operating Results:

The University of Washington and WRF have always made a joint report to the AUTM Survey. Selected data are shown in Table 1. The early years reflect the results achieved by WRF and show that it was highly successful, achieving a large number of revenue-generating licenses. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4254070*.

The Author

Ashley J. Stevens is President of Focus IP Group, a consulting company providing consulting, educational and legal services in IP, technology commercialization, tech transfer and valuation. Previously, he was Executive Director of Boston University's Office of Technology Transfer for 17 years, following four years in a similar role at the Dana-Farber Cancer Institute. He teaches and publishes extensively on various issues affecting the tech transfer ecosystem and is a Past President of AUTM.

Table 1: University Of Washington/Washington Research Foundation Reports To AUTM Survey

Year	Tot. Res. Exp.	Inv. Dis. Rec.	New. Pat. App. Fld.	Tot. Pat. App. Fld.	Iss. US Pat.	Act. Lic.	Lic. Gen. Inc.	Lic. Gen. Run. Roy.	Lic. >$1mm	Gross Lic. Inc.	St.-Ups Formed	New. Prod.
1991	$356,000,000	111	20	29			78			$2,500,000		
1992	$413,000,000	141	22	32		89	89			$3,000,000		
1993	$430,153,000	164	36	51	22	175	71			$14,755,000		
1994	$459,000,000	153	29	58	15	166	87			$12,300,000	5	
1995	$404,000,000	142	44	161	19	210	118			$10,085,000	5	
1996	$418,000,000	233	51	85	20	189	101			$8,651,000	3	
1997	$528,602,441	280		62	34	271	142			$11,510,000	25	
1998	$432,383,000	255	65	146	48		204			$21,303,796	8	
1999	$479,654,994	226	24	114	36	207	185			$27,879,919		
2000	$652,100,000	209	72	109	59	505	385	81	4	$30,303,963	6	10
2001	$622,054,438	145	81	110	49	556	414	115	4	$26,446,297	4	
2002	$683,748,627	225		125	43	553	418	116	5	$24,823,037	2	6
2003	$784,411,974	199	73	123	46	620	350	99	6	$29,282,203	3	9
2004	$833,907,430	233	104	133	38	672	322	131	5	$25,202,792	7	2
2005	$895,349,071	268	84	167	40	740	333	120	6	$29,317,473	4	
2006	$936,360,325	310	84	151	37	875	371	123	8	$36,199,485	10	20
2007	$961,483,207	335	88	166	43	1040	429	133	7	$63,283,697	11	56
2008	$1,026,788,452	349	149	227	56	1122	494	153	6	$80,330,765	9	42
2009	$1,076,044,801	349	145	263	40	1153	516	182	5	$87,339,905	10	29
2010	$887,329,593	354	125	273	69	1309	517	174	6	$69,032,163	7	25
2011	$966,817,063	356	151	341	70	1213	524	184	8	$67,362,185	9	24
2012	$995,623,918	462	182	404	61	1271	531	209	6	$76,955,819	9	20
2013	$1,012,471,661	410	215	487	94	1272	594	213	6	$99,491,173	17	31
2014	$1,186,828,000	421	189	488	82	1260	585	198	4	$104,767,138	18	29
2015	$1,213,000,000	373	196	489	81	1332	632	206	6	$42,840,261	15	27
2018	$1,323,000,000	253	118	345	101	1313	732	197	2	$22,442,267	10	33
2016	$1,290,042,000	363	181	476	98	1288	625	205	0	$19,628,870	21	25
2017	$1,287,000,000	339	164	412	103	1342	615	165	2	$16,750,848	15	27
2019	$1,320,000,000	287	160	386	69	1335	727	199	1	$19,110,830	14	30
2020		300	165	427	107	1417	756	183	4	$27,364,553	13	29

University Technology Corporation —Another Attempt At A For-Profit TTO

By John A. Fraser

Origins

University Technology Corporation became operational on July 4, 1986. It was co-founded by Carl Wootton (previously the director of the TTO at Duke University), Stanley Fisher (co-founder of the law firm Oblon Fisher) and John Fraser. It was launched as a for-profit company and served as the exclusive licensing agent for five universities (Georgia Tech; University of Connecticut; University of Maryland, College Park; University of Iowa; and Kansas State University). The headquarters were in Durham, North Carolina with on-campus technology liaison officers (TLOs) at the member university campuses.

Original Funding

Based on the business plan, the company raised $3.5 million in private sector funding ($500,000 from Japanese investors and the rest from private individuals through the Robinson Humphries brokerage firm in Atlanta).

Business Model

In return for signing a contract for exclusive access to campus IP for an initial five-year term, University Technology Corporation (UTC) provided a grant to each campus of $125,000/year and hired a technology licensing officer who would be a university employee but who was supervised by UTC staff. The $125,000 covered the technology licensing officer's salary and fringe benefits as well as the office's operating expenses. Patent costs were a separate item.

UTC had several other unique assets:

- An Industry Advisory Board comprised of seven people from well-known companies that were actively in-licensing university research results; and
- 200 public, then-current Wish Lists from companies looking for external technologies or research expertise that had been gathered by Wootton over the years.

UTC would pay for patenting expenses. When royalties were eventually received by UTC, they would be split as follows:

- 16 percent to UTC for patent expense recovery
- 42 percent to the University
- 42 percent to UTC

UTC's $125,000 annual grant was not repayable.

The Strengths and Weaknesses of the Model

For the universities involved, the deal was attractive, because six years after the signing of the Bayh-Dole Act in 1980, the member institutions had not yet committed to funding an internal TTO. UTC was considered an excellent first step for a five-year period to build up knowledge and determine the level of interest in IP commercialization on campus.

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UTC's Ultimate Fate

In 1989, after three years of operations, while seeking another round of financing, UTC was sold to USET Inc., a subsidiary of Macmillan Publishing, New York, then owned by Sir Robert Maxwell. USET was then merged with University Patents, Inc. in Connecticut and its assets transferred to USET, but UTC's employees were terminated. A separate article in this special issue on USET provides additional information on the company. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4254166*.

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The Final Attempt At For-Profit Tech Transfer—University Science, Engineering And Technology, Inc.

By Ashley J. Stevens

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Origin

University Science, Engineering and Technology, Inc. (USET) was a fairly short-lived player in the for-profit tech transfer space. The company was founded in February 1986 by Maxwell Communications Corporation (MCC), owned by the colorful Robert Maxwell, a British publishing magnate who also owned Pergamon Press, MacMillan publishing and the leading British daily tabloid, the *Daily Mirror*. MCC's initial investment in USET was $3 million. The company was headquartered in McLean, VA.

MCC wanted USET to create a database of licensable technologies, and by 1990 it had created a searchable system comprising several databases—*e.g.*, SBIR grants, grant awards, patents, etc., containing in total 185,000 abstracts of licensable technologies. To assist in this, it bought the software company that had created the TeleScan financial information system.

Acquisition of University Patents' Tech Transfer Business

USET started its activities by buying the tech transfer business of University Patents, Inc. (UP) headquartered in Connecticut for $3.25 million. In October 1989, it acquired University Technology Corporation headquartered in North Carolina (UTC). The tech transfer business was run out of UP's facilities in Connecticut.

Norman Latker, the father of Institutional Patent Agreements and a strong advocate for Bayh-Dole within the U.S. government agency Health, Education and Welfare (HEW), joined USET as vice president, giving USET considerable credibility. USET sought a 50:50 revenue split with the institution and sought to have the institution pay the cost of U.S. patenting, with foreign costs paid by USET and recovered upfront from license income. A proposal USET made to the Smithsonian called for an annual payment by the Smithsonian of $24,000, which would cover three U.S. patent filings a year.

Implosion of the Maxwell Empire

Unfortunately, USET was founded just as Maxwell's empire was starting to implode and he drowned after falling off of his luxury yacht Lady Ghislaine, named after his daughter (yes, that Ghislaine Maxwell) in the Canary Islands in 1991. It was never established whether his death was an accident, suicide, or murder, but he was subsequently found to have plundered £800 million from the pension funds of the *Daily Mirror* and one or two other companies he owned.

UPI repurchased USET's tech transfer assets in 1990 for $1 million and up to $3.75 million based on the royalty income UPI received from the USET licenses. UPI consolidated UTC's operations to its Connecticut office, terminating the UTC employees in North Carolina.

USET was certainly ahead of its time in seeing the potential for a searchable database of technologies but was probably constrained by the need for a proprietary interface to allow access. The advent of the internet and graphics-based browsers such as Mosaic and Netscape just five years later would have facilitated this part of USET's business model. **That** said, technology marketplaces boomed at the height of the *dot.com* era 10 years later, but have not proven to represent a viable business model and to be sustainable for-profit businesses. ■

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Spain: An Early Adopter Of Institutional Ownership; Consorci de Transferencia de Coneixement and Univalue Valorización, SL

By José Manuel Pérez Arce, M. Carme Verdaguer, Ashley J. Stevens and Santiago Romo

1. Development of Tech Transfer in Spain

A year before China emerged from the Cultural Revolution after Mao Zedong's death in 1976 and had to start creating a modern society and its legal underpinnings from scratch, the death of Spanish dictator General Francisco Franco resulted in the establishment of a parliamentary democracy under a constitutional monarchy, and Spain started a rapid journey from being a backward economy largely based on agriculture and tourism to its current position as the fourth largest economy in the E.U.

1986 was a particularly momentous year in the modernization of Spain.

- On January 1, Spain and Portugal joined the E.U.
- On March 26,1986, Law No. 11/1986 on Patents was passed and came into effect in June of that year. The law created a modern patent system in Spain, paving the way for Spain to join the European Patent Office on October 1 of that year. The law gave ownership of inventions made by employees to their employer, thereby giving universities ownership of their professors' inventions.
- On April 14, 1986, Parliament adopted Act 13/1986, of 14 April, Promotion and General Coordination of Scientific Research and Technique, launching large-scale research in Spanish universities.

Spain jump-started institutional ownership of academic inventions in Europe, enabling it to be a pioneer in establishing an organized tech transfer ecosystem. Two years after passage of the Patent and Scientific Research laws, later in 1986, the first Spanish university TTOs were established in Barcelona and Pamplona. A relevant precedent was the creation in 1985 of the TTO of Consejo Superior de Investigaciones Científicas (CSIC), the main Spanish public research organization.

In 1997, la red de Oficinas de Transferencia de Resultados de Investigación (RedOTRI), a professional tech transfer association was established, which published its first survey of tech transfer activity in 1999. In 2002, RedOTRI reported that total tech transfer employment in Spain was 471 full-time employees. With 52 universities reporting to the survey, this implies an average of nine staff per office.

Several programs funded by the Spanish Ministry of Science and Innovation financially supported the TTOs at universities, research hospitals and research organizations from 1990 to 2012.

An official registry of TTOs is managed by the Ministry of Science and Innovation, with 203 TTOs officially registered in Spain in 2022.

2. MiTTOs in Spain

There were two Multi-institutional Technology Transfer Offices (MiTTOs) in Spain. Both operated for relatively short periods of time.

a. Consorci de Transferencia de Coneixement

Consorci de Transferencia de Coneixement (CTC) was established in 2005 and formally closed in 2010. It brought together the TTOs of several universities in the region of Catalonia around Barcelona.

CTC was created and financed by the regional government (Generalitat de Catalunya) as an association of public and private universities with public administration. Its main objective was to promote knowledge transfer from Catalan universities and research centers to the economic and social sector and encourage the collaboration between all the agents involved in this process. The consortium was intended to be the only gateway for companies to gain access to the knowledge and technologies developed at the Catalan universities and research centers. In addition, and according to the CTC Articles of Association, part of the financial resources of the organization were planned to come from the activities performed by the consortium. Licensing activities were not explicitly mentioned.

There are two main reasons that partially explain the short life of CTC:

- First, the lack of funding impeded hiring an adequate team of professionals with senior profiles

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who could have developed the planned activities at the international level.

- Second, the design and implementation of CTC was done following a top-down approach, without the necessary involvement of the TTOs of the Catalan universities.

That is a major reason why CTC was perceived, to a certain extent, as a threat by the individual TTOs that formed the consortium. CTC successfully collaborated with the Spanish national TTO network, RedOTRI, in organizing some events for tech transfer professionals.

b. Univalue Valorización, SL

i. Origin:

Univalue was set up in 2011 by nine Spanish universities (the Grupo 9 Universidades):

- Universidad de Cantabria
- Universidad de Castilla La Mancha
- Universidad de Extremadura
- Universidad des Illes Balears
- Universidad de La Rioja
- Universidad de Oviedo
- Universidad del País Vasco (UPV/EHU)
- Universidad Pública de Navarra
- Universidad de Zaragoza

The nine member universities are located in different regions of Spain, including the University of the Balearic Islands (Mallorca, Menorca, Ibiza and Formentera).

Figure 1. Nine Member Universities In Spain

The Manager of University and Enterprise Relationships at the Universidad del País Vasco led the initiative, and the director of each university's TTO was tasked with securing the approval of their board.

Approvals were received because all the universities felt it was the best way to transfer the patents and know-how they were generating.

Univalue was essentially a national TTO, serving the Grupo 9 Universidades located across Spain, rather than a regional TTO as CTC was.

ii. Objectives

Univalue was set up:

- To evaluate the research results of the member universities, identify potential licensees and conclude agreements.
- To create a highly qualified team capable of doing tech transfer with a company focus.
- Positioning G9 Group of Universities as a leader in Spain and Europe in tech transfer.
- To improve the tech transfer activities of the G9 group, looking for cooperation with technology centers and other universities and creating synergies to create an entrepreneurial ecosystem.

iii. Organization

Despite its formation having been led by the Universidad del País Vasco, Univalue was not located on the UPV campus but had its own freestanding offices in Bilbao.

Univalue had a staff of six:

- A general manager
- Four area managers
- One administrative support

The area managers were involved in both evaluation and commercialization of technologies, with the general manager in charge of supervising and approval of final evaluation reports, negotiating with potential licensees and managing Univalue's relationships with the CEO, Board of Directors and university partner TTOs.

iv. Initial Funding:

The initial funding of Univalue was contributed by the nine founding universities which invested €1 million.

There were two classes of shareholders:

- Premium, bought by seven universities, which each owned 12.5 percent of Univalue
- Standard, bought by two universities, which each owned 6.25 percent of Univalue.

Half the capital was paid in year one, and the other half a year later.

v. Business Model:

Univalue received a share of the income that it generated, as follows:

From patented inventions:

- €10,000 per contract; plus
- Royalty of 3 percent of net sales

From know-how (*i.e.*, unpatented inventions)

- €3,500 per contract
- No running royalties

The remaining income went to the inventing university(ies)

The initial plan was that the member universities would provide 137 disclosures per year for its five years of operation, for a total of 685.

The actual outcome was slightly less than half of this, 336 disclosures, of which only around a third, 100 disclosures, passed the initial assessment and were carried forward and were marketed to 6,500 companies, resulting in 280 expressions of interest and licensing proposals being made and resulting in seven signed deals. The proposals were for upfront fees from €0-500,000 and averaging €27,000 plus running royalties with a two-year holiday after product launch.

vi. Challenges

The member universities fell in two camps:

- Half of the universities were very supportive and contributed as much as they could to provide Univalue with disclosures and ensuring support by their faculty when necessary.
- The other half were more difficult and duplicated Univalue's activities themselves, ultimately providing Univalue with lower-quality disclosures—some patents and know-how were more than seven years old.

Some of the issues Univalue faced were:

- The early stage of many of its invention disclosures.
- Many of the inventions had been protected only in Spain.
- Some of the member universities' TTOs regarded Univalue as a competitor.
- Most of the founding board members changed within the first two years and their successors were not as committed to Univalue as the founding board members.
- The under-delivery of inventions by the member universities meant Univalue lacked critical mass.
- Univalue's recommendation not to proceed with the majority of the inventions it evaluated was not well received by the disclosing universities.

vii. Ultimate Fate

At the end of 2015, Univalue's board assessed its situation as follows:

External

- The economic crisis in Spain resulted in a lack of funds for patenting in the universities.
- This lack of economic resources resulted in many R&D teams shutting down and many researchers left universities for stable jobs in the private sector or even left Spain to continue researching in other countries, particularly Europe and the United States.

Internal

- At this point, many of the member universities' TTOs had convinced their management that Univalue was not hitting its targets and meeting their needs and that its activities could better be achieved by their in-house TTOs.
- Univalue's initial funding was nearly depleted, and the low deal flow had not resulted in self-sustainability.
- The board therefore decided to close the company and cease all activity on December 31, 2015. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4254175*.

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Another U.S. Regional Tech Transfer Office—Triangle Universities Licensing Consortium

By Ashley J. Stevens

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Background

In the early 1980s, as universities were working out how to respond to the Bayh-Dole Act, the three major universities in the Research Triangle region of North Carolina—Duke, University of North Carolina Chapel Hill and North Carolina State University—were devoting minimal resources to tech transfer—half an FTE each at UNC and NSU, one FTE intermittently at Duke—and were behind their peers at other major public university systems.[1]

The president of the UNC system commissioned a consulting study on how to improve tech transfer throughout the system's 16 campuses in 1983. The consultants, Cambridge Associates, recommended an inter-university technology transfer collaboration and that Duke be included in it. By including Duke, the universities could tap into funding from the Triangle Universities Center for Advanced Studies Inc. (TUCASI). Cambridge Associates proposed a five- or ten-year collaboration; at Duke's suggestion, the initial term was five years.

The three universities had different reasons for wanting to increase their industry engagement, but all three agreed to join. Each had a different culture of industry engagement, with UNC being the most hostile to industry; the collaboration ensured a uniform approach to industry across all three.

Funding

With all three universities on board, TUCASI agreed to fund the consortium, which was named Triangle Universities Licensing Consortium or TULCO at a rate of $360,000 per year for a period of five years; funding after that initial period would be at a lower rate and determined at a later date. TULCO also gained access to free space at the Research Triangle Institute (RTI, now RTI International, an independent nonprofit research institute), with the understanding that TULCO would also handle any licensing needs that RTI had.

1. This article is based on "Institutional Evolution and the Collaborative Development of Technology Transfer Capabilities," M. Donegan and M. Feldman, *International Regional Science Review*, 1-27, 2020, DOI: 10.1177/0160017620922886" and conversations with individuals active in the Research Triangle area in the late 1980s.

Business Model

TULCO was formed solely to provide technology licensing services for each of the three universities, enhance their existing internal capacity and realize significant efficiencies and cost savings. The universities were concerned about TULCO gaining too much power and the chancellor of UNC wrote to the president of TUCASI to tell him that TULCO had been structured in such a way as "to avoid the possibility of developing a 'life of its own,' independent of the wishes of its parent universities."

Operations

TULCO opened for business in January 1988, five years after the start of the discussions, with a staff of eight, which considerably exceeded the TTO staff at Duke, NCSU, and UNC at the time. TULCO had an immediate impact in increasing the transfer of technologies from all three universities.

The three universities made different uses of TULCO. UNC maintained only a very small on-campus activity and used TULCO for everything. Forty-six percent of the invention disclosures TULCO received from 1988-1994 came from UNC. NCSU maintained an in-house patent agent, while Duke immediately instituted a search for a director of a new TTO.

Outcome

As the initial five-year grant was expiring, TUCASI offered to renew the grant at half of the previous rate, so that the member institutions would have to bear half the cost (or more; resources had not been increased despite patenting and licensing activity having increased by over 50 percent during its first five years). This prompted Duke to cease its full membership in TULCO, (though it continued to contract with it through 1995), feeling it would be better off investing its contribution to TULCO in building up its own in-house capabilities.

Duke's departure left UNC and NCSU paying for a good portion of TULCO's activities and two years later, they withdrew their support, devoted all the resources to developing their own internal capabilities and TULCO ceased operations in 1995.

Because it had not generated its own revenue stream, there is no trace of TULCO today, in contrast to WRF. The three universities did indeed succeed in ensuring that TULCO did not develop a "life of its own."

Successes

TULCO was clearly a productive and successful licensing organization. By 1992, its peak activity year prior to Duke's departure, it was handling almost 150 invention disclosures a year, signing around 40 licenses annually and getting close to 100 patents issued annually. License income in 1992 was $1.1 million at NCSU, $450,000 at UNC, and $500,000 at Duke. Several of TULCO's licenses of Duke technologies generated lifetime incomes over a million dollars. Licensees included Fibrogen and Trimeri, whose drug Fuzeon used Duke technology. The Research Triangle area's strength in biotechnology is attributable to TULCO's activities. TULCO promoted economic development by stressing licensing to North Carolina companies. ■

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The Development Of Technology Transfer In Norway—A System In Flux

By Randi Elisabeth Taxt, Anne Christine Fiksdal, Lasse Olsen and Jorun Pedersen

Background

The history of technology transfer in Norway goes back more than 100 years. Perhaps the best-known example is Professor Kristian Birkeland, a physicist at the University of Oslo. Birkeland was interested in electromagnetism and correctly predicted that the Northern Lights were due to electrical particles from the sun being funneled into the polar atmosphere by the earth's magnetic field. He received no credit for this idea until the 1970s when spaceships allowed measurements to be made that showed Birkeland was correct.

He invented an electromagnetic cannon that could fire a kilo piece of iron with the force of a bullet. He invited armaments manufacturers to a demonstration and attempted to fire a 10-kilo projectile, but the gun misfired and produced an enormous explosion. The inferno that shot out of the cannon had a temperature of more than a thousand degrees and was later called Birkeland's "plasma arc."

A week later, Birkeland had dinner with Sam Eyde, an entrepreneur who was looking for a way to fix atmospheric nitrogen. Eyde told Birkeland that there was an industrial need for the biggest flash of lightning that can be brought down to Earth in order to make artificial fertilizer. Birkeland's climactic reply was: "I have it!" A week later, Birkeland applied for a patent and two weeks later Eyde and Birkeland applied for a patent on a process for making calcium nitrate, also known as Norwegian Saltpeter.

These patents paved the way for Eyde and Birkeland to set up Norsk Hydroelektrisk Kvælstof-Aktieselskab in 1905, financed by the Swedish Wallenberg family, which constructed fertilizer plants at Notodden and Rjukan. Norsk Hydro got its electricity from a hydro power plant built to utilize the Rjukan waterfall, which Eyde had bought in 1902. Hydro is currently the world's biggest producer of mineral fertilizer (Hydro, 2022).

This may be the earliest example of an academic discovery being transferred through formal processes involving IP, an act which also marked the beginning of and enabled the industrialization of Norway.

The more recent history is however very much about how to organize the publicly financed instruments and infrastructures to stimulate the commercialization of research. Among others this development has resulted in the establishment of 11 technology transfer offices (TTOs). Eight of these are today classified as regional TTOs. Whether the "Norwegian Model," largely founded based on the U.S. system, can be considered successful or not is today a highly relevant question which is the subject of ongoing debate. In the following sections the history and status of the Norwegian TTO model will be presented. Most of the problems and the opportunities the various TTOs, their owners and collaborating partners are facing must be considered global and are reported on in the literature across both organizational models and various forms of innovation systems. Only a few of these topics are covered in this article, inevitably providing a somewhat simplified account. The story has mostly been told by the Norwegian tech transfer community itself through a project funded by the Research Council of Norway (RCN). This project included a historical review of funding mechanisms and the evolving TTO community in Norway. The authors worked closely together on this project (FG prosjektet, 2022). Along with many national reports and evaluations in the field, this TTO competence project is the most important source for this article.

Development of Technology Transfer in Norway

The best place to start the modern history of tech transfer in Norway is back in the late 1970s. Norway historically followed a professor's privilege model and the first TTOs (either limited companies or foundations) were established at the large hospitals during the 1980s. Research parks such as Forskningsparken in Oslo and ASEV in Trondheim were established in 1984 and Marineholmen Forskningspark in Bergen in 1986. In addition, several companies were established in connection with universities and university hospitals to help and support researchers in their efforts to develop, patent and commercialize their research ideas, including ASEV in Trondheim (1984), Medinnova in Oslo (1986), UNIFOB in Bergen (1986), Norinnova in Tromsø (1990) and Bioparken in Ås (1991). Many of these companies are precursors to the TTOs that we know today, as summarized in Table 1. During this period, a lot of technology and know-how was transferred transparently, seamlessly, and effectively from universities by professors to Norwegian companies such as Kongsberg, Hydro, Elkem, Statoil, etc. There existed some external companies, mostly publicly funded, to help and support commercialization of research ideas. In 1993 the Norwegian government implemented legislation that gave the universities and other higher education institutions a new assignment to transfer knowledge to society. Retrospectively this new assignment was mostly perceived as a mission for dissemination of research and not so much an assignment for knowledge and technology transfer to promote innovation and commercialization. However, something was about to happen, and a year later, in 1994, the "one third / one third / one third" income distribution model was introduced for the first time to the policy agenda. This was in connection with an ongoing discussion on management of intellectual property rights (IPR) at the University of Oslo. During the same period specific public funding instruments for commercialization of research were established, in addition to programs for entrepreneurial start-ups and academic spin-offs, including several incubators. In 1995 RCN established the FORNY Program for commercialization of research, and Startfondet was established in 1998 by the government to fill the gap identified in financing start-ups in Norway. In addition, several companies started to appear with various types of public and private ownership to provide TTO functions, such as, for example, Campus Kjeller in 1995 (Lillestrøm), Coventus in 1998 (Kristiandsand) and Prekubator TTO in 2002 (Stavanger). Some of these companies were also part of, or were in close connection with, incubation facilities for start-ups. In 1999 The FORNY program was restructured by the government and given a more formal responsibility for TTOs. This resulted in a requirement that funding applications sent to FORNY pass through an approved TTO, or commercialization agents, as they were designated by RCN.

Institutional Ownership and the Establishment of TTOs

In 2003, a new law was passed implementing institutional ownership.[1] The legislation was enacted and implemented quite rapidly, with little debate by politicians, academics or industry, and was very much driven by a few senior civil servants from the government and the biggest universities such as the University of Oslo, University of Bergen and the Norwegian University of Science and Technology (NTNU) in Trondheim. There had been several delegations to the U.S. and the impact of Bayh-Dole had been studied. When the professor's privilege was abandoned in 2003 through the revised legislation for the higher education sector TTOs were established at the major universities, partly funded by the FORNY program. NTNU Technology Transfer AS in Trondheim, Birkeland innovasjon AS in Oslo and Bergen Technologioverføring AS (BTO) were established during 2003 and 2004 and TTO Nord AS in 2005, all structured as limited liability companies. In Norway, the research institutes have in many sectors historically played a bigger role than universities in transferring technology and Sintef, the largest research institute in Norway, established its own TTO, Sinvent AS, in 2004. Table 1 provides an overview of the establishment of the 11 Norwegian TTOs. Spilling and his colleagues also give a good overview of this process (Spilling *et al.*, 2015).

Norway is a small country with a decentralized structure, which also is reflected in the research and development sector (R&D). Many of the Norwegian TTOs were for this reason established as regional multi-Institutional TTOs (MiTTOs) from the start, owned by multiple public and private entities. The MiTTOs were set up to provide services to universities, colleges, and research institutes. This organizational structure was chosen to achieve critical mass for the TTO organizations. However, the TTOs were from the start expected to become self-financing through income from successful commercialization projects, and the choice of the organizational model was also justified by the fact that limited liability companies can operate at universities independently and with less bureaucratic restrictions than internal TTOs. Although different in organizational structure and ownership, the TTO functions within these organizations are shown to be very similar (FG prosjektet, 2022, p. 22). See Table 1.

The implementation of the new law was followed by a period characterized by growth, structuring and professionalization of the Norwegian TTOs. Table 2

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1. NOU 2003: 25, Ny lov om universiteter og høyskoler: *https://www.regjeringen.no/no/dokumenter/nou-2003-25/id148008/?ch=3.*

Table 1. Overview And Background Of The Establishment Of The 11 Official Norwegian TTOs, Which Is Part Of The Norwegian Technology Transfer Offices Network (Norwegian TTOs)[2]

Name	Estab-lished	Organ-isation	Owners	City/Region	Comments
Norinnova AS	1990	MiTTO	UiT the Arctic University of Norway, Helse Nord Regionalt helseforetak	Tromsø/Troms	Merged with TTO Nord
Kjeller Innovasjon AS	1995	MiTTO	The Oslo school of Architecture and Design, The Norwegian Defence Research Establishment (FFI), IFE, Institute for Energy Technology, researches for a better future, OsloMet, Oslo Metropolitan University, NILU - Norwegian Institute for Air Research, NGI (Norge Geotekniske institutt), The University of South-Eastern Norway (USN), Justervesenet (Norwegian Metrology Service), The Norwegian Veterinary Institute, The Norwegian food research institute Nofima	Oslo/East Norway	
Innoventus Sør AS	1998	MiTTO	University of Agder, NIVA, Sørlandet sykehus, Teknova	Kristiand-sand/ Agder	Merged with Coventus AS
NTNU Technology Transfer AS	2003	MiTTO	NTNU, Norwegian University of Science and Technology, Helse Midt-Norge Regionalt helse-foretak	Trondheim/ Trøndelag	
SINTEF TTO AS	2004	Not an MiTTO	SINTEF	National organisation with base in Trondheim	Research institute
VIS Vestlandets innovasjonsselskap AS	2004	MiTTO	The University of Bergen, Helse Bergen (Haukeland University Hospital), The insitute of Marine Research (IMR), Western University of Applied Sciences (HVL), NHH Norwegian School of Economics	Bergen/ Vestland	
Inven2 AS	2010	MiTTO	University of Oslo, Helse Sør-øst regionalt helseforetak	Oslo/ South-East Norway	A merger of Birkeland innovasjon AS and Medinnova AS. Specialist on Life Science
Validé AS	2015	MiTTO	University of Stavanger, Norwegian University of Life Sciences (NMBU), Norwegian Institute of Bioeconomy Research (NIBIO), The Norwegian food research institute Nofima, NORCE Norwegian Research Centre, Western University of Applied Sciences (HVL), The Norwegian School of Economics (NHH)	Stavanger/ Rogaland	A merger of Ipark AS and Prekubator AS
Ard Innovation AS	2016	MiTTO	Norwegian University of Life Sciences (NMBU), Norwegian Institute of Bioeconomy Research (NIBIO)	Ås	Specialist on agriculture
Nord Innovasjon AS	2017	Not an MiTTO	Nord University	Bodø/Nordland	
TTO at Molde University College	2019	Not an MiTTO	TTO at Molde University College		Not a separate AS, internal TTO

2. There are other TTOs registered in Norway, such as Simula Innovation and NORCE TTO, but these are not officially registered by the RCN and are not part of the Norwegian TTOs.

Table 2. Overview Of Norwegian TTO Activity, 2006-2020 (MRS reporting RCN,[3] Impello Management, 2020)

Activity	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Research based ideas from employees	160	255	293	241	175	317	236	465	401	455	671	578	647	708	785	749	909	718
Patent applications (priority, pct, national)	5	26	61	105	100	115	125	174	172	201	171	203	222	259	245	267	231	239
Number of licence agreements	0	1	4	16	16	25	25	39	55	61	70	96	122	119	87	77	69	79
Number of spin-offs	8	8	14	13	21	16	21	11	18	15	20	32	23	31	23	12	21	13

shows the results in terms of numbers of ideas, patents, license agreements and academic startups from the TTOs, showing a good progression during the first ten years after the transition away from the professor's privilege model.

In 2008 an evaluation of the FORNY program was conducted, concluding that the program was not delivering results as expected (Borlaug *et al.*, 2009). Following this evaluation, a program was opened for applicants outside the TTO system, such as newly established academic spin-offs. In addition, the allocation of basic funding of the TTOs became gradually more competitive and was based on applications and therefore no longer evenly distributed among the TTOs. RCN funding for commercialization of research and the FORNY program experienced a growth from 2013-2018,[4] and external project funding became more and more important as a funding source for the TTOs. The TTOs were continuing to collaborate as a community but were also increasingly becoming competitors for attracting funding.

From 2010 there followed a period characterized by restructuring and mergers of many of the TTOs, and therefore a consolidation of the Norwegian MiTTO system. Inven2 was established as a merger between Birkeland Innovasjon (UiO) and Medinnova (Rikshospitalet) in 2010. Valide was established in Stavanger as a merger of the incubator IPark and the TTO Prekubator in 2015 and VIS followed in 2017 by taking in Nyskapingsparken, an academic startup incubator run by the Western University of Applied Sciences (HVL). Table 1 gives an overview of the 11 official TTOs in Norway today. Many of these organizational changes were initiated by a strategy for several of the TTOs to become more prominent actors in their regional innovation and entrepreneurial ecosystems and to offer services such as consulting and incubation to entities outside their formal academic owners.

However, at the same time, and in parallel with the growth and development of the TTOs, the government expected the higher education institutions to increase their collaboration with private and public entities. This "third mission" had already been implemented in the legislation in 2005,[5] but the response from the universities was not particularly prominent until around 2012. At this time, the concept of the entrepreneurial university started to emerge also in Norway, as in other European countries (Etzkowitz, 2004, Sánchez-Barrioluengo and Benneworth, 2019). The higher education institutions started to set up internal instruments and supportive structures for innovation and entrepreneurship, primarily for students but also for researchers. This development did—slowly and over time—cause increasingly overlapping roles and tensions between the universities and the TTOs (O' Kane *et al.*, 2020). The government started a new round of evaluations of the TTOs in 2015 (Spilling *et al.*, 2015). In addition, a general review with the aim of a better harmonization of the national instruments for innovation and commercialization, including commercialization of research was initiated by the government (Deloitte, 2019).

The Ongoing TTO Debate in Norway

Critical voices started to become more frequent, both in various reports in connection with the national evaluations but also in the public debate (see, for example, Lekve, 2019b). The discussion of the role of TTOs and whether Norway should have adopted the U.S. system to the extent that it did was debated. Many were arguing that the Norwegian MiTTO system, by putting responsibility for commercializa-

3. The Norwegian TTOs report key numbers about their performance to the RCN (FORNY reporting).

4. Forskningsrådet i tall (*forskningsradet.no*).

5. Lov om universiteter og høgskoler av 1 april 2005: *https://lovdata.no/dokument/NLE/lov/2005-04-01-15*.

tion external to the universities and other research organizations, prevented them from including innovation, and especially commercialization, in their daily operations (Grünfeld *et al.*, 2018). In addition, it was argued that the TTOs were taking too much of the income from IPR and that the researchers should be better incentivized by receiving a bigger share (*ibid*). The sizes and effectiveness of the TTOs were also criticized (Lekve, 2019a). The critique was aimed towards both individual TTOs and towards the TTO system in general, and the voices came both internally from the TTO owners themselves and from external actors. Many of the universities, which now increasingly were aiming towards becoming entrepreneurial universities, started to critically evaluate their own TTOs. RCN, partly as a result of the national evaluation of instruments for innovation and commercialization, but also influenced by the TTO critique, also made some changes. From 2018 the FORNY program became open to applications from all research actors, not only TTOs and early-stage academic spin-offs. In addition, the termination of an exclusive and important TTO funding program for early phase research ideas was announced by RCN.

For most of the TTOs this development seemed to come as a surprise. Being busy with positioning themselves strategically as participants in the ecosystem or internally managing growth and merger processes, they were perhaps not sufficiently aware of the steady transition of the higher education sector causing overlaps and tensions with their activities. In addition, there was at that time an emerging global trend of innovation and entrepreneurship becoming more and more part of the agenda for both industry and the public sector. This change was also, among others, causing the establishment of many new intermediates in the innovation ecosystem such as private innovation companies, incubators and industrial cluster organizations. In addition, some of the research organizations abandoned being partners of the TTOs and established their own TTO, *e.g.*, the establishment of Nord Innovasjon AS in 2016 and NORCE Innovation in 2020. The pressures on the TTOs therefore came in many different forms at the same time, such as changes in framework conditions and increased competition. In addition, concepts like user-oriented innovation, innovation in the service sector and new business models based on open innovation and the sharing economy were starting to emerge. These new concepts were in many ways challenging the traditional TTO working process, *i.e.*, reducing their focus on managing IP and thus challenging the TTOs' core competencies. Some of the TTOs in this period were starting to struggle with the burden of showing a continuous increase in the operating results since their establishment. 2016 was in many ways the peak year for the national TTO community and the road has been much bumpier since then, as shown in Figures 1 and 2. For some TTOs this started to result in economic problems. The TTO competence project (FG prosjektet, 2022) also showed that Norwegian TTOs are confirming the international trend that most TTOs in general have operating expenses exceeding the gross income they receive (Abrahams *et al.*, 2009; ASTP, 2020).

The present status is that a study by the Nordic Institute for Research in Innovation, Research and Education (NIFU) has recently been initiated based on an assignment from the Norwegian Ministry of Education and Research (Borlaug *et al.*, 2022). NIFU was given the mandate to study models for the organization of TTOs based on the Norwegian system for technology transfer. Four possible models for the organization and

Figure 1. License Agreements Granted by Norwegian TTOs, 2019-2010 (MRS reporting RCN, Impello, 2020)

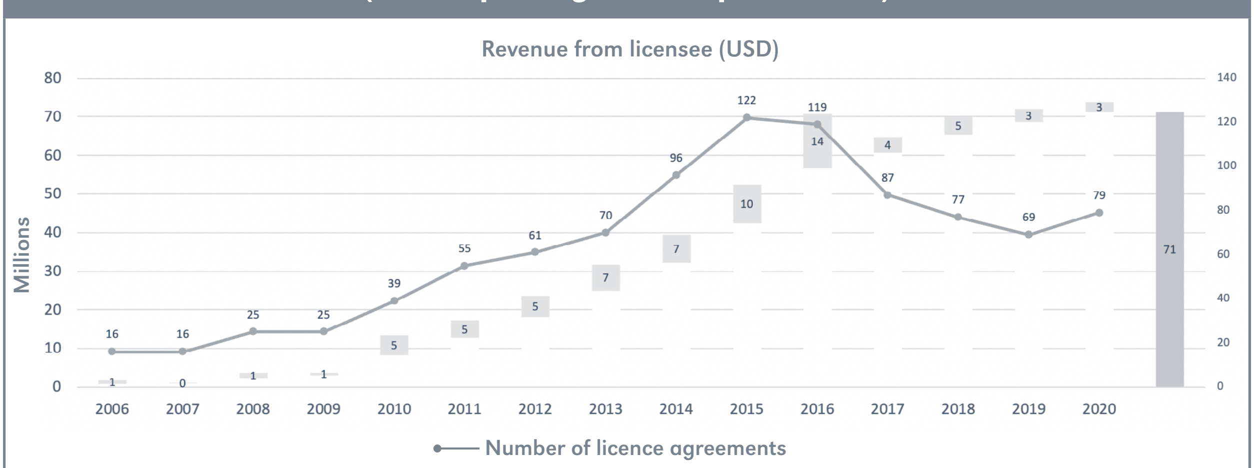
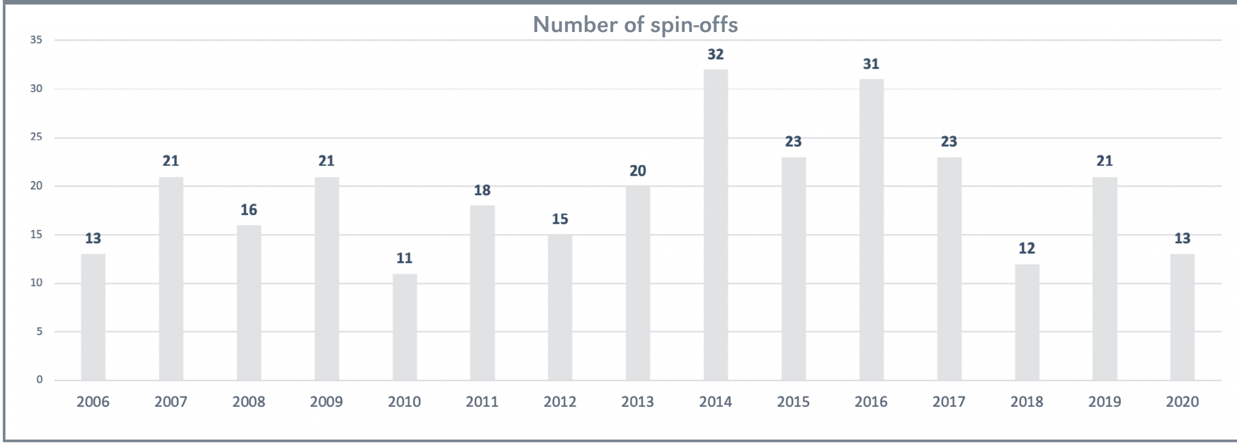


Figure 2. Number of Academic Spin-offs Created by Norwegian TTOs, 2010-2016 (MRS reporting RCN, Impello, 2020).



financing of TTOs were identified. The report has been used as a basis for further discussions and the Norwegian government is giving strong signals that the publicly funded R&D institutions in Norway will be given both incentives and assignments to take more responsibility for their innovation and commercialization activities, including the TTO function. The process is expected to conclude during the fall of 2022 and a new financing model is planned to be implemented from 2023.

Some Concluding Remarks and the Way Forward

The history of the Norwegian TTO system is not unique. The role, competence and expected results from TTOs have been constantly debated around the world, given the nature of TTOs as an intermediary organization. Commercialization of research is a very complicated task, including personal relationships, prestige, specific skills, competencies and collaboration across sectors. Last, but not least, the process often includes both institutional and individual financial rewards, making it especially challenging. Commercialization is also in many ways considered to be in direct conflict with the traditional culture of academia (Perkmann *et al.*, 2013). Very often, academics consider commercialization to be outside their mission and to be the responsibility of their employers. The TTO literature is replete with models and examples where the TTOs are considered bureaucratic structures slowing down the innovation process (Link, Siegel and Wright, 2015; Hayter, 2016). However, the literature also has other threads showing how TTOs are important intermediaries bridging the difficult gap between conducting research and making an impact on society (Cunningham, 2020; Hossinger *et al.*, 2020). Many researchers are not sufficiently motivated or incentivized to take on innovation, commercialization or entrepreneurial tasks or projects. Some are even visibly very negative in public. TTO executives and TTO organizations are therefore frequently at risk of being excluded from the academic circles. Successful innovation and commercialization processes are, on the other hand, reported to be a result of close relationships and good collaborations between the various partners and stakeholders in the project (Weckowska, 2015; O'Kane, 2018). In addition, proper management of IP stemming from public funded research provides many opportunities but need competence and control to be properly managed (Spilling *et al.*, 2015). Seen through the lens of successful knowledge and technology transfer, exclusion of TTOs can therefore result in many missed opportunities.

Norway is one of the countries in the world with a very prominent national MiTTO system. This system is historically partly designed by government and policymakers and has partly emerged through organic growth within the various regional innovation ecosystems. The Norwegian universities, as most universities around the world, struggle in implementing the "third mission" in their activities. As a result, organizational knowledge as well as internal systems for technology transfer are often deficient. It is a trend that academic institutions in Norway have stopped including their TTOs in their internal innovation policy processes the way they did in the first decade after 2003. This may possibly be a result of complex ownership models but can also be a result of the growth and ecosystem positioning for many of the MiTTOs together with the emerging entrepreneurial universities. It may also be a result of the cultural and knowledge gap that still exists between research and commercialization but is most probably a mix of all the above-mentioned causes. According to several of the TTO competence projects conducted by the Norwegian TTOs (Teknologioverføringskontorene i Norge, 2022) many of the Norwegian TTOs are today struggling with uncertainty because of the constantly changing framework conditions. The TTOs and the TTO processes may also suffer from not being included in the academic society they are there to serve. This has resulted in a significant loss of key personnel leaving the TTO community in Norway, risking Norway losing important competencies. And, as in Europe, we see TTOs moving from technology transfer to a broader focus on knowledge transfer (Campbell *et al.*, 2020). This change is also more clearly reflecting that knowledge and technology transfer cannot be set up as a profitable business. Most of the Norwegian reports and evaluations over the years have concluded that TTOs are important and professional contributors in the value chain from research to commercialization. This is also supported in the scientific literature. Hopefully the Norwegian government and the TTO owners will give their TTOs the opportunities and framework conditions that will allow them to align their strategies and operations along with the constantly evolving third mission of universities and other academic institutions. We also hope these changes will result in a system being able to keep and use the specialized and valuable competencies that have been developed in the TTOs over a long period of time. Finally, we hope that the Norwegian TTOs will also be able to embrace and exploit such opportunities and will not stick to "business as usual." ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4254208*.

References

Abrams, I.; Leung, G.; and Stevens, A.J. (2009). "How are U.S. technology transfer offices tasked and motivated-is it all about the money." *Research Management Review,* 17(1), 1-34.

ASTP (2020). "Survey Report on Knowledge Transfer Activities in Europe." On ASTP webpage (04.03.2021). Avaialble at: *https://www.astp4kt.eu/about-us/kt-news/astp-survey-report-on-knowledge-transfer-activities-2020.html* (Accssed 20.08.2022).

Borlaug, S.B.; Grünfeld, L.; Guldbrandsen, M.; Spilling, O.R.; and Vinogradov, E. (2009). "Between entrepreneurship and technology transfer: Evaluation of the FORNY-programme." NIFU STEP rapport 19/2009.

Borlaug, S.B.; Korseberg, L.; Gulbrandsen, M.; Thune, T.M.; and Svartefoss, S.M. (2022).

"Organisering av teknologioverføring ved norske forskningsinstitusjoner: Mulige modeler"

NIFU-rapport 2022:4. Available at: *https://nifu.brage.unit.no/nifu-xmlui/handle/11250/2975758*(Accssed 20.08.2022).

Campbell, A.; Cavalde, C.; Haunold, C.; Karanikic, P.; and Piccaluga, A. (2020). "Knowledge Transfer Metrics - Towards a European-wide set of harmonised indicators." European Commission webpages, 2020. Available at: *http://dx.doi.org/10.2760/907762* (Accessed 19.08.2022).

Cunningham J.A.; Harney, B.; and Fitzgerald, C. (2020) "Effective Technology Transfer Offices. A Business Model Framework." Switzerland: SpringerBrief's in Business.

Deloitte, 2019. "En områdegjennomgang av det næringsrettede virkemiddelapparatet." Available at: Regjeringen.no, 21.10.2021: *https://www.regjeringen.no/no/dokumenter/vmg/id2677304/* (Accessed 19.08.2022).

Etzkowitz, H. (2004). "The evolution of the entrepreneurial university." *International Journal of Technological Globalization* 1: 64-77.

FG prosjektet, 2022. "Fra mulighet til virkelighet i spennet mellom forskning—forvaltning—forretning." Rapport fra kompetanseprosjektet Finansgruppen (FG-prosjektet). TTO kompetanseprosjekt.

Grünfeld, L.A.; Teie, M.G.; Hvide, H.; Spilling, O.; and Borlaug, S. (2018). "Insentiver for kommersialisering av forskning." *Menon Publikasjon* 9/2018

Hayter, H. (2016) "A trajectory of early-stage spinoff success: The role of knowledge intermediaries within an entrepreneurial university ecosystem." *Small Business Economics* 47: 633–656.

Hossinger, S.M.; Chen, X. and Werner, A. (2019) "Drivers, barriers and success factors of academic spin-offs: a systematic literature review," *Management Review* 70(1):97–134.

Hydro, 2022. 1903: "Explosive winter days," Hydro webpages, 20.08.2020. Available at: *https://www.hydro.com/en-NO/about-hydro/company-history/1900---1917/1903-explosive-winter-days/* (Accessed 19.08.2022).

Impello Management, 2020. "Resultater av TTOenes kommersialiseringsvirksomhet." Report to FG-prosjektet. TTO kompetanseprosjekt.

Lekve, K. (2019a). "Adding value: From world-leading research to profitable commercialization." Siumla webpages (November 2019). Available at: *https://www.simula.no/sites/default/files/report_adding_value_simula_2019_0.pdf* (Accessed 20.08.2022).

Lekve, K. (2019b). "Leverer TTOene godt nok?" 03.12.2019. Khrono (03.12.2019). Available at: *https://khrono.no/kyrre-lekve-leverer-tto-ene-godt-nok/424607* (Accessed 20.08.2022).

Link, A.N.; Siegel, D.S.; and Wright, M. (2015) *The Chicago Handbook of University Technology Transfer and Academic Entrepreneurship,* The University of Chicago press.

O'Kane, C. (2018) "Technology transfer executives' backwards integrations: An examination of interactions between university technology transfer executives and principal investigators," *Technovation* 76-77:64-77.

O'Kane, C., Cunningham, J.A., Menter, M. and Walton, S. (2020). "The brokering role of technology transfer offices within entrepreneurial ecosystems: an investigation of macro-meso-micro factors." *The Journal of Technology Transfer* 46 (6):1814-1844.

Perkmann, M., Tartari K., McKelveyb, M., Autioa, E., Broströmc, A., D'Ested, P., Fini F., Geunae, A., Grimaldif, R., Hughesm, A. Krabelh, S., Kitsong, M., Llerenai, P., Lissonij, F., Salter A, and Sobrerof., M. (2013) "Academic engagement and commercialisation: A review of the literature on university–industry relations," *Research Policy* 42(2):423-442.

Rasmussen. E., Borlaug, S.B, Bulanova, O., Clausen, T., Spilling, O.R. and Sveen, T., 2013. "Verdiskaping i forskningsbaserte selskaper og lisenser støttet av FORNY-programmet." SIB-rapport nr. 2.

Sánchez-Barrioluengo, M. & Benneworth, P. (2019). "Is the entrepreneurial university also regionally engaged? Analysing the influence of university's structural configuration on third mission performance." *Technological Forecasting & Social Change* 141:206–218.

Spilling, O. R., Borlaug, S. B., Iversen, E. J.,Rasmussen, E. Solberg, E. (2015). "Virkemiddelapparatet for kommersialisering av forskning—status og utfordringer: Sluttrapport fra evalueringen av virkemiddelapparatet for kommersialisering av offentlig finansiert forskning." NIFU-rapport 18.

Teknologioverføringskontorene i Norge (2022). "Oppsummering av teknologioverføringskontorenes (TTO)kompetanseprosjekter 2020-2022" (Final report).

Weckowska, D. (2015) "Learning in university technology transfer offices: transaction-focused and relations-focused approaches to commercialization of academic research." *Technovation* 41-42:62-74.

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South Africa's Technology Transfer System

By Jacqueline Barnett

Background

A Tale of Two Eras: Before and After the IPR Act of 2010.

South Africa's technology transfer system can be divided into two eras:

- pre-IPR Act, and
- post-IPR Act.

The IPR Act,[1] the Intellectual Property Rights from Publicly Financed Research and Development Act, was signed in 2008 and came into effect in 2010. This was South Africa's "Bayh-Dole" moment and had a similar effect on the South African technology transfer landscape as Bayh-Dole had in the U.S.

The IPR Act was the result of over a decade's policy evolution in South Africa.[2] The first major policy step was the *1996 White Paper on Science and Technology*, the first comprehensive post-apartheid policy document in South Africa on science, technology, and innovation (STI). This 1996 white paper introduced the concept of a national system of innovation and, over the two following years, a national review of public sector STI institutions was undertaken. This led to the National R&D Strategy of 2002 which specifically identified that there was inadequate intellectual property legislation and infrastructure, and that inventions and innovations from publicly financed research were not being effectively protected and managed.

There was thus a need for legislation similar to the Bayh-Dole Act that would provide certainty of ownership of IP at South African public universities, and thus could lead to commercialisation. It should be noted that there were no private universities that undertook state-sponsored research but also that, unlike in the U.S., the state did not claim ownership of state-sponsored research. However, institutional IP policies were either non-existent or varied wildly: some institutions allowed inventors to own their own IP even if developed using public funds, and some institutions claimed ownership but without having the capacity to exploit the IP. One of the biggest challenges, though, was industry-sponsored research that was heavily subsidised by state funds but with the industry partner then claiming full ownership of arising IP with no benefit back to the public purse. Most institutions did not have the capacity or power to assert ownership in this situation.

The IPR Act was designed to address these challenges by providing certainty on IP ownership arising from publicly financed R&D: institutions (which included universities and state-owned laboratories) are the owners of such IP and must commercialise it "for the benefit of the people of the Republic." In addition, the Act aimed to drive commercialisation of IP by obliging institutions to have the capacity to identify, protect and manage IP, and to commercialise and utilise it, where appropriate. The Act also established the National IP Management Office (NIPMO) to promote the objectives of the Act and provide guidance to institutions, monitor disputes, build skills and capacity, and so on.

The IPR Act was thus the beginning of a new era in South African tech transfer; but what came before?

Back to the Beginning: Before the IPR Act

The first technology transfer initiatives in South Africa were not at universities but at two of the Science Councils—government translational research laboratories that undertook both industrial contract research as well as their own projects. The Science Councils had been set up to drive industrialisation and were typically at the development or user-driven end of the R&D value chain. One of their aims was to transfer technologies to industry and create new industries, thus having a technology transfer function as a natural part of their activities. The CSIR[3] had Business Development Manager positions from the early 1990s whose job description included the management of patents and technology transfer to industry. The CSIR's Industrialisation Support Group (ISG)[4] was then established in 1993 as a central services group managing patents and undertaking commercialisation activities across all divisions.[5] In 1999, the CSIR incorporated a subsidiary, Technovent, as a commercialisation and holding company after the government requested the CSIR to be more active in transferring technologies to industry.[6] The Medical Research Council, too, established a tech-

1. *https://www.gov.za/documents/intellectual-property-rights-publicly-financed-researchand-development-act.*

2. *https://www.dst.gov.za/index.php/resource-center/rad-reports/tt-ip-survey.*

3. Council for Scientific and Industrial Research (now only known as CSIR)—they did R&D projects in most fields except health and agriculture (which fell under two other Science Councils).

4. This eventually became the core of the central CSIR TTO.

5. Personal communication, Rudi van der Walt *https://www.linkedin.com/in/rudi-van-der-walt-73a06361/.*

6. Technovent formed and managed six spinout companies but, within three years, the CSIR developed a new strategy and decided to reduce the focus on technology transfer; Technovent still exists but is not the TTO for the CSIR.

nology transfer office during these early years—their Innovation Centre was established in 1995 to manage innovation opportunities from MRC research. CSIR now has an internal TTO.

The first universities in South Africa to develop an IP policy and start a technology transfer office were the University of Cape Town (UCT) and Stellenbosch University (SU), both in 1999. North-West University (NWU) also started informal commercialisation activities during this period but only established a formal TTO in 2003. The main catalyst for these developments in the late 1990s appears to have been an awareness of international trends in developing capacity for protecting and commercialising IP. However, they faced significant difficulties:

- A weak disclosure rate due to a lack of awareness of IP among staff and students;
- High patenting costs with very limited budgets;
- Limited capacity and skills to staff the offices; and
- Limited licensing opportunities.[7]

In addition, researchers were more interested in receiving research funding from companies, which then patented the outputs and used them in their own businesses.

One other challenge was the expectation that these early TTOs would be self-sustaining within five years from income earned from commercial activities. However, the management of the TTOs (and, we assume, university management) soon discovered the long lag time between new invention disclosures and income generation from protected IP.

A critical intervention for TT development during the early 2000s was the creation of the Innovation Fund. This government-funded body was responsible for funding very early-stage commercialisation projects, but also played a broader role in the developing ecosystem, building TT capacity through their "Chuma" Commercialisation Manager program, providing incentives for patenting, and providing seed funding for TT offices in institutions with the most potential for rapid growth.

A second critical intervention for capacity-building came in the form of SARIMA,[8] the Southern African Research and Innovation Management Association, which has been addressing this challenge since 2002. SARIMA was formed to foster and coordinate activities relating to research and innovation management, both nationally and regionally. Unlike many similar associations in other countries, SARIMA covers both research management and innovation and technology transfer activities. The Association has developed a portfolio of training courses and is considered the primary network for research and innovation professionals in the region.

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This meant that, by 2007 when early discussions about the IPR Act began, the number of TTOs with at least 0.5 FTE had reached six. SARIMA training workshops, utilising experts from the U.S. and the UK, were starting to make inroads into the capacity gap. Challenges remained, but the system had started growing and, just three years later when the Act came into being in 2010, the number of TTOs had grown to 16.

Post-IPR Act: Thriving and Growing

As most South African universities are publicly funded, and the IPR Act specifically mandates that an office of technology transfer be established at each institution to perform a technology transfer function, the Act accelerated the development of TTOs and skills to support them. There are currently 37 institutions—26 universities and 11 statutory institutions (government laboratories)—that fall under the IPR Act in South Africa. All institutions are also obliged to have an Intellectual Property policy under the Act; these differ between institutions, but certain provisions are legislated, such as an obligation for inventors to disclose IP to their institution, and for institutions to share any benefits from commercial success with inventors. There are also walk-in rights for government in the case of non-commercialisation.

The system has seen growth in a challenging and resource-constrained environment, especially considering that many universities have limited research income. As the most significant factor determining the number of potentially commercializable research outputs that are created and could be transferred is the volume of research undertaken at a university, this severely limits the scope of its technology transfer opportunities. In addition, education and awareness creation of academics has had to be a focus of the newly created TTOs, which themselves have limited resources.

There is, however, good financial and development support for some activities. The Technology Innovation Agency (TIA), the successor to the Innovation Fund, provides significant seed funding for early-stage pre-commercialisation projects: up to R800,000 (ap-

7. Wolson R. 2007. Technology Transfer in South African Public Research Institutions. *In Intellectual Property Management in Health and Agricultural Innovation: A Handbook of Best Practices* (eds. A Krattiger, RT Mahoney, L Nelsen, *et al.*). MIHR: Oxford, U.K., and PIPRA: Davis, U.S.A. Available online at *www.ipHandbook.org.*

8. *https://www.sarima.co.za/*.

proximately $50,000) per project; R190 million (approximately $12 million) has been invested over the last five years. TIA also provides larger commercialisation development funding to projects and start-up companies, but this has been challenging for university-driven projects to readily access. NIPMO provides funding for staff and development of the TTOs as well as financial assistance to TTOs for IP patent and prosecution costs—this patent cost support is approximately R20 million per annum (approximately $1.3 million) to 24 institutions. NIPMO also provides financial support for IP audits, contract drafting, technoeconomic feasibility analyses, market assessments, and business plan development. SARIMA has continued to play a role in developing capacity through training and networking.

This has meant that, while in 2008 there were 101 invention disclosures across the whole country, this rose to 298 by 2018. However, while there were 103 new first patent filings in 2008 and this had increased to 177 by 2015, it had dropped to 119 in 2018. This is possibly due to the cost of filings and a more selective approach as TTOs mature. Transactions (licenses and assignments) increased dramatically, though, from seven in 2008 to 68 in 2018—although this had dropped from a high of 85 in 2017. The number of start-up companies also increased significantly, from four in 2009 to 17 in 2018.

The Future

The 2019 White Paper on Science, Technology and Innovation[9] recognises that South Africa's innovation performance is relatively flat, and that significant challenges remain. This is partly due to funding and capacity constraints in the TT system, and the White Paper commits government to strengthen support for TTOs to grow capacity and increase the quantity and extent of TT outputs. There are also new initiatives such as the University Technology Fund[10] that aim to bridge the gap between technology ideation, research, intellectual property development and commercialisation. Thus, despite these challenges, the system is vibrant and growing with enormous potential to address some of the many socio-economic challenges in the country.

South Africa's Regional Technology Transfer Offices

After the passing of the IPR Act in 2010 and the establishment of NIPMO, there was a drive to ensure that all universities had a technology transfer function or, at least, access to one. The Act mandates that all institutions:

> "establish and maintain an office of technology transfer

or

> designate persons…within the institution to undertake the responsibilities of the office of technology transfer."

Recognising that this would be difficult for some institutions, the Act also allowed institutions to establish a regional office with NIPMO's agreement. NIPMO may also provide assistance to these regional offices including financial assistance, and co-ordinating its establishment.

Two regional offices were thus created in South Africa:

- The Eastern Cape Regional Technology Transfer Office in 2011; and
- The KwaZulu-Natal Regional Office of Technology Transfer in 2014.

These offices comprised all the universities within the two provinces (Eastern Cape and KwaZulu-Natal) and 35 percent of all South African universities that were in existence at the time (eight out of 23). The operations and structure of the two offices were alike, and both were initially supported and funded by NIPMO.

The distance between the institutions in the Eastern Cape is significant (Figure 1): Nelson Mandela University (Mandela University) is in Gqeberha (Port Elizabeth), which is a 90-minute drive from Rhodes University (Rhodes) in Makhanda (Grahamstown). The University of Fort Hare (UFH) is in Alice, a 90-minute drive from Makhanda, although UFH's Research Office is in East London, which is also a 90-minute drive from Alice and either a short flight, or a three-hour (and dangerous) drive from Gqeberha. Walter Sisulu University of Science and technology (WSU) is even further: their main campus is in Mthatha, a three-hour (and dangerous) drive from East London and six hours from Gqeberha, with very few flights available.

This was not the case in KwaZulu-Natal: three of the institutions are Durban-based: the University of KwaZulu-Natal (UKZN), Durban University of Technology (DUT) and Mangosuthu University of Technology (MUT); and the University of Zululand's (UniZulu) main campus is in Empangeni, a two-hour drive north of Durban. See Figure 1.

Eastern Cape Regional Technology Transfer Office (ECR-TTO)

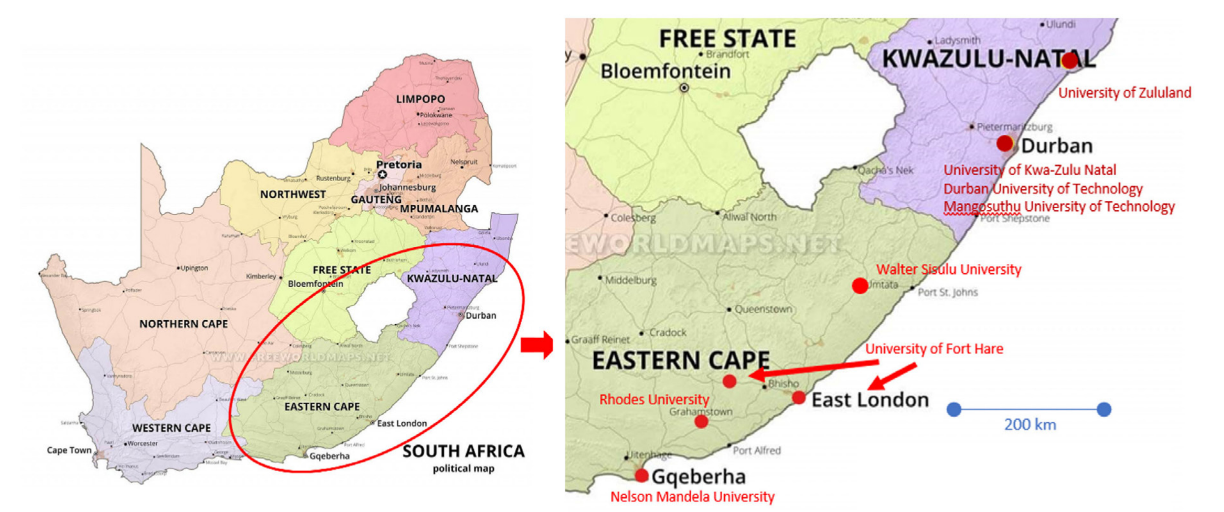
The ECR-TTO was established in 2011 to ensure that all universities had access to technology transfer support; prior to this, only Mandela University had a TTO which was established

ECR-TTO
EASTERN CAPE REGIONAL TECHNOLOGY TRANSFER OFFICE

9. *https://www.dst.gov.za/images/2019/White_paper_web_copyv1.pdf.*

10. *https://utfund.co.za/.*

Figure 1. South Africa Map And Detail Showing The Two Provinces That Had Regional TTOs



in 2007. The anchor university for the ECR-TTO was Mandela University. It is the largest university in the province, with R392 million (approximately $25 million) in research expenditure in 2018 to 2019[11] and 717 researchers. Rhodes, while much smaller than Mandela University in terms of total numbers of students (8,200 vs. 30,000), is a traditional research-intensive institution and spent a similar amount on research (R347 million) with 433 researchers. The other two universities undertake much less research: UFH spent R168 million on research and has 356 researchers, while WSU spent R71 million on research, although their researcher headcount numbers are reported to be higher (619). The four universities therefore spent R978 million (approximately $62 million) on research in 2018 to 2019.

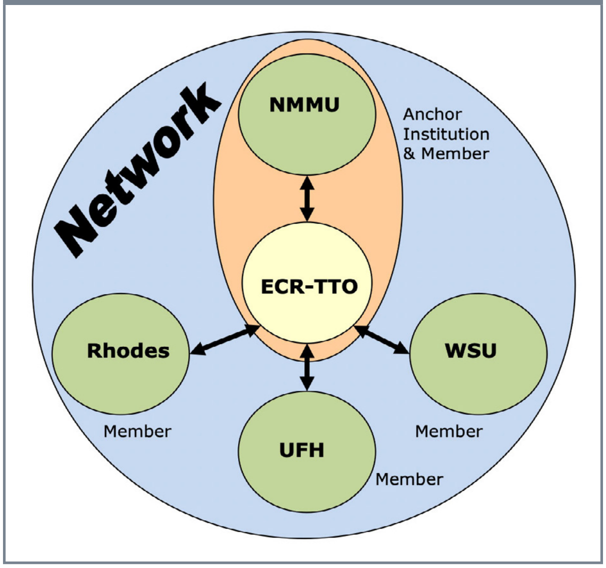
The seed of the ECR-TTO started in 2007 when Mandela University signed an agreement with the Innovation Fund for funding to create its own institutional TTO. Financial support of R3.6 million (approximately $220,000) would be provided for three years, with Mandela University providing 20 percent match funding over that period, as well as committing to support the Mandela University TTO for a further three years thereafter. One of the deliverables under this agreement was "Regional Capacity Development," wherein Mandela University had to provide support to the other three institutions in the Eastern Cape and aim to sign an agreement between the institutions.

11. South African National Survey of Research and Experimental Development, Statistical Report 2018/19. Accessed online at *https://www.dst.gov.za/images/2021/RD_StatisticalReport2018-19_WEBV01.pdf.*

Progress was initially slow, with a report from June 2008 indicating that a meeting with Rhodes had been set up, but the other institutions had only just appointed the required senior decision-makers and thus had yet to start considering it. By early 2009, the director of the Mandela University TTO had met individually with all the institutions, and, in June 2009, a joint meeting was held—together with government representatives who became part of the yet-to-be-formed NIPMO—which agreed in principle to the establishment of a regional office with Mandela University as the anchor institution. A concept document for the ECR-TTO was submitted to the Department of Science and Innovation in October 2009 and a final proposal in May 2010. A contract between Mandela University and the Department was signed in February 2011, along with a Memorandum of Understanding between all four institutions. (While these time frames seem extended, it is worth noting that this was the first such proposal in the country and this happened during the period when the IPR Act was being developed and implemented.)

The proposal detailed the model for the ECR-TTO (Figure 2): it would not be a separate legal entity; each university would designate at least one person to perform a technology transfer function; there would be a coordinator (Regional TT Manager or RTTM) appointed by Mandela University but focussed on regional activities; a steering committee made up of institutional representatives would meet every two months to discuss progress. It was specifically noted that the ECR-TTO "network" would initially consist of newly formed TTO functions at each member institution, headed by directors or managers that had little working relationship

Figure 2. Model for the ECR-TTO*
***NMMU is Mandela University**



with each other. The network would create the opportunity to develop informal connections between the member institutions, gradually building up to a point where the level of member interaction could support a fully integrated resource-sharing network structure. The ECR-TTO would also play an important role in being the voice of the institutions at a national level.

The ECR-TTO was to assist with developing IP policies at the institutions (only Mandela University had one at the time), analyse disclosures received by the institution, liaise with patent attorneys, report to NIPMO and advise on commercialisation. The RTTM would negotiate the deals, although the institution would sign them and receive all income (Mandela University received no share of the income). In addition, the RTTO would assist with awareness raising and capacity building inside each institution. Funding was requested and approved for three years covering the salary of the RTTM, travel and office costs; each institution committed to providing their own staff and covering their patent and legal costs. An operational plan with Key Performance Indicators was developed; this included increasing disclosures received by each institution by two (from a very low base—except for Mandela University, none of the institutions had any formal disclosures) by Year 2 and increasing IP licenses at each institution by one by Year 3.

Initially things were positive, and an RTTM was appointed in August 2011 with a formal contract of employment with Mandela University. However, it became apparent very quickly that there were challenges with the RTTM appointment, in particular with communication, ability, and speed of delivery. The RTTM also did not respond to line management at Mandela University, and wanted to act completely autonomously, without even informing the TT representative at each institution what was happening on their own campuses. The RTTM would meet with academics and patent attorneys and start negotiating deals without informing the institutions whose technologies were being transferred.

It was difficult to determine whether this was the primary challenge, or whether the distances between the institutions meant that, regardless of who had been appointed, the structure would not work. During 2012, the relationship between the staff at Mandela University and the RTTM had deteriorated to such an extent that Mandela University's TTO declined to appoint further staff dedicated to the ECR-TTO, even though funding was available. Rhodes followed suit, and the other institutions were not able to appoint staff as they were under administration by the government (for unrelated reasons). At a meeting in December 2012, the Steering Committee discussed the issues and concluded that a TTO was required at each institution, with regional cooperation and sharing of best practices, but no central office. (It should be noted that the four Western Cape institutions, which included two of the largest and oldest TTOs—the University of Cape Town and Stellenbosch University—operated this way: they each had their own TTO but had a very successful quarterly forum to share ideas, note trends, discuss projects, and so on.)

The December 2012 meeting discussed the disadvantages of the regional structure: confusion on accountability and responsibility; confusion on the roles and responsibilities for TT activities with some activities duplicated and others not performed at all; inconsistent reporting to NIPMO, and inconsistent communication from NIPMO as sometimes this was with the institutions and sometimes with the RTTO; the distances were too large for meaningful interaction; the TT person must be easily accessible to researchers; there was confusion within the university community as to who was responsible for TT; the Steering Committee was time-consuming and unproductive. In addition, it was noted that although the ECR-TTO was anchored at Mandela University, the ECR-TTO made no contribution to Mandela University's TT activities as it had its own fully-fledged TTO—although that may have been due to personality clashes rather than the structure. In summary, the meeting concluded that the creation of the regional office had added an intermediary, which had reduced efficiency and effectiveness and added to workload.

In May 2013, a meeting was held with NIPMO regarding the future of the ECR-TTO, as the institutions had proposed that the remaining funds be used to build capacity within each institution and that the RTTM move to one of the other institutions. NIPMO insisted that the structure should continue until the end of the contract in July 2014, but the RTTM could relocate to one of the other institutions to be closer to their academics. However, after a long and protracted disciplinary process, the RTTM resigned in October 2013. The Steering Committee then agreed that, until the contract with NIPMO ended, a staff member from Mandela University's TTO should be seconded for 50 percent of their time as Acting RTTM to coordinate activities and assist the other institutions. The other institutions would then develop funding proposals to staff their own TTOs in future, but with a collaboration agreement to share best practices and tap into Mandela University's experience.

The last nine months, without the original RTTM, went reasonably smoothly. However, it was clear that, even without the personnel challenges, the structure and distances were challenging. Some of the universities had infrastructure and IT challenges, so the Acting RTTM struggled to get responses; others did not want the Acting RTTM to contact academics directly but also did not provide the requisite local capacity. It therefore remained difficult for a regional resource to undertake TT at the institution unless there was a complete handover of responsibility to the RTTM; this was not envisaged in the initial documentation as the institutions wished to play a role in the process. However, they did not have the resources to do so, and thus the process was not followed and information was lost.

Despite the challenges, there were some successes: by the time the ECR-TTO dissolved, all institutions had an approved IP policy; all institutions had recognised processes and templates for invention disclosures and due diligence; invention disclosures increased from seven to over 25 (excluding Mandela University's numbers); over 100 academics had attended IP awareness training; an IP database was available for each institution; and seed funding for the development of specific innovations had been received. In addition, all institutions had a dedicated TT resource which became the seed of their own TTO. However, it appears that its short period of existence did not result in successfully commercialized products.

KwaZulu-Natal Regional Office of Technology Transfer (KZN-ROTT)

(information provided by Thabang Jase and Lungelwa Kula, NIPMO)

The KZN-ROTT was established in 2014 to assist the four universities in the province to increase technology transfer activities and gain efficiencies via economies of scale. The anchor university for the ROTT was University of KwaZulu-Natal (UKZN). UKZN is the largest and most research-intensive university in the province, with R962 million (approximately $61 million) in research expenditure in 2018 to 2019[12] and 2,400 researchers. The other three universities are significantly smaller: DUT spent R256 million on research and has 474 researchers; UniZulu spent R185 million on research and has 320 researchers; and MUT spent R34 million on research and has 209 researchers. The four universities combined therefore spent R1,437 million (approximately $90 million) on research in 2018 to 2019.

Initial funding for the KZN-ROTT was provided by the Department of Science and Innovation,[13] the government department responsible for socio-economic development through research and innovation, through NIPMO. In later years, funding was also provided by the KZN Provincial Department of Economic Development. The funding was disbursed to the anchor institution (UKZN) although, under a Memorandum of Agreement entered into by the universities, governance of the KZN-ROTT was by a Steering Committee comprising members from all four universities. The funding was used to cover staff costs and expenses of the regional office but could also be disbursed to each institution to cover IP prosecution costs and the costs of other activities, such as IP awareness sessions for staff and students.

The main function of the regional office was to provide support and services, such as IP assessment and commercialisation, to the member institutions, as well as to coordinate activities and capacity building. The RTTO would negotiate the deals, although the institution would sign them and receive all the income, with the RTTO receiving no share of the income. In addition, the KZN-ROTT also reported the activities of each institution to NIPMO. Each university was meant to have its own technology transfer function with at least some resources who could coordinate local activities, although they were also at liberty to assess and commercialise their own IP if they desired; however, the KZN-ROTT would also provide this service if required.

There were several advantages to the regional office structure:

- The pooling of resources which allowed each university to have access to better support;

12. South African National Survey of Research and Experimental Development, Statistical Report 2018/19. Accessed online at *https://www.dst.gov.za/images/2021/RD_StatisticalReport2018-19_WEBV01.pdf.*

13. *https://www.dst.gov.za/.*

- Shared best practices learning, and the ability to have a stronger voice in the region; and
- Better recognition by stakeholders, especially the KZN provincial government, industry, other funders, communities, and researchers.

However, there were several challenges, mostly to do with differing cooperation between institutions, and between institutions and the regional office. In addition, while the roles and responsibilities between the regional office and each institutional technology transfer function were clear, some institutions neglected their obligations to create awareness and identify IP and expected the regional office to act as an internal function at their institution. There were also strong personality clashes between the representatives of the institutions, and some did not give their support to the regional office or the regional manager.

Despite this, an inventor who was assisted by the KZN-ROTT received an IP Creators Award in 2018 by NIPMO, which came with a cash prize to further develop the innovation.

The KZN-ROTT was dissolved in 2019 when the institutions decided to improve their individual capacity and function independently of each other, although some joint activities remain under UKZN auspices, such as coordinating the reporting on the IP Creators Award.

- UKZN applied for financial assistance from NIPMO for additional staff members;
- UniZulu has established a TTO guided by a team that includes a representative from NIPMO, with plans to apply for NIPMO funding to enhance the office;
- DUT has set up a TTO that is functioning; and
- MUT has set up a TT function in their Research Office which is slowly growing.

The four institutions are also now independently reporting to NIPMO as per their obligations under the IPR Act.

As with the ECR-TTO, it appears that the major success of the KZN-ROTT was in capacity-building and initiating tech transfer in its region but that its short period of existence did not result in successfully commercialized products. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4254212*.

The Author

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A National Tech Transfer Office Serving National Labs—TechLink, U.S.

By Brett R. Cusker

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History and Funding Sources

TechLink is a Federal- and state-funded technology transfer (TT) center at Montana State University, operating as a partnership intermediary as defined by government legislation 15 U.S.C. 3715. From 1996-1999, TechLink worked with NASA TT, and since 1999, it has served as the lead Department of Defense (DoD) technology transfer partner, helping to develop productive technology partnerships between the private sector and the DoD laboratory system nationwide. In February 2019, TechLink formed an additional partnership with the Department of Veterans Affairs (VA) to help their technology transfer outreach and licensing efforts. TechLink also serves as a university connection to the high-tech sector in the state, region, and nation. TechLink currently has 42 full-time employees based in Montana and at government labs across the U.S.

TechLink is a metrics-based organization, and performance is measured annually against expectations established by program managers as well as by the long-term impact of agreements brokered with TechLink assistance. Metrics are centered on total numbers of technology transfer agreements executed during the Federal fiscal year. Additionally, TechLink conducts impact studies to assess the warfighter, economic, and societal impact of agreements brokered with its assistance. Details can be found in the "Impacts" tab at *techlinkcenter.org*.

As an agency-level (DoD and VA), funded nonprofit economic development center of Montana State University, TechLink does not charge labs or private sector clients for services and does not have a financial stake in any agreement that is brokered with its assistance. Rather, licensing income is returned to the labs and supports their technology transfer functions as well as ongoing lab-based research and development. TechLink's efforts have garnered an estimated $198 million return to DoD labs since its inception.

Over the past 10 years, TechLink facilitated over 80 percent of all DoD license agreements, and as of a 2018 impact study, TechLink-brokered agreements resulted in over $6.9 billion in total economic output, including more than $1.1 billion in direct sales to the U.S. military.

Business Model

TechLink works directly with DoD laboratories across the nation through their Offices of Research and Technology Applications (ORTA), and with regionally assigned VA ORTAs. Each ORTA has a primary point of contact within TechLink, which is responsible for managing all technology evaluation, marketing, and licensing activities conducted on behalf of the individual laboratories. TechLink is not funded to provide support to Federally Funded Research and Development Centers (FFRDCs) or University Affiliated Research Centers (UARCs), which generally have their own tech transfer capabilities.

TechLink specializes in the evaluation, marketing, and licensing of intellectual property (IP) and advises the labs on IP expenditures. It serves as an important outreach arm to the private sector for technology transfer licensing opportunities.

TechLink reviews all DoD/VA laboratory inventions multiple times throughout the IP life cycle to assess the potential for military, societal and economic impact that could be achieved through commercialization of the IP, then markets these commercialization opportunities to entrepreneurs, small businesses, and nontraditional partners nationwide. All available opportunities are fully searchable on the TechLink website (*https://techlinkcenter.org*) and catalogued by technology category and individual laboratory. Each opportunity listing includes a business-friendly description with supporting materials and IP-related information provided for each.

For select opportunities with high-impact potential, TechLink performs detailed market research to identify the most capable and appropriate partners for the technology and performs outreach to these prospects directly.

TechLink leverages innovation ecosystems to identify nontraditional partners such as entrepreneurs and small businesses that may not be identifiable through market research and presents these partners with curated opportunities based on specific ecosystem partner interest and objectives. TechLink regularly partners with accelerators and supports pitch events, etc., with ecosystem partners as appropriate. While TechLink does not itself directly create start-ups, it helps select start-ups with their business/commercialization plans and helps them connect to government resources, etc.

Once commercialization interest is received, TechLink acts as an intermediary between the interested party and the laboratory to assist the company through the due diligence process, to help prepare license applications and commercialization plans which meet statutory and laboratory requirements, and to help both the interested party and the laboratory negotiate terms that result in a win-win agreement that ultimately results in the introduction of impactful new products and services to the Warfighter, Veterans and the general public.

Pluses and Minuses of the Model

Sustained program funding for over 25 years has allowed TechLink to recruit and retain an experienced, technologically savvy team of licensing experts that is capable of evaluating, marketing and licensing inventions ranging from freshly conceived ideas without significant reduction to practice to high technology readiness level (TRL) inventions with a clear connection to fielded capabilities/clear market applications.

On the flip side, as an intermediary TechLink acts as a broker between the private sector and the government, and has no decision-making authority. TechLink works to minimize delays and to get the government decision makers to work at the speed of business. A lot of people within the government have to say "yes" in order for a license to be granted.

Biggest Hits

Descriptions of some of TechLink's success stories can be found at *https://techlinkcenter.org/success-stories*.

One example is from the Naval Information Warfare Center, Pacific (NIWC Pacific), which licensed a groundbreaking inertial sensor, a technology that uses laser light, to California-based Lumedyne Technologies. Lumedyne was founded by former Navy engineers Brad Chisum and Richard Waters in 2006 under the name Omega Sensors, based on work Waters did while serving with the San Diego-based Space and Naval Warfare Systems Center, or SPAWAR. Lumedyne was acquired by Google in 2014 for $85 million. Google planned to use Lumedyne's technology in its self-driving vehicle program.

Current Status/Future

Partnership intermediary agreements with both the DoD and VA, along with program funding, are expected to remain in place for the foreseeable future. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4254246*.

The Author

Brett R. Cusker is the executive director of the MSU TechLink Center, an economic development center of the Montana University System. TechLink operates as a partnership intermediary for the Department of Defense and the Department of Veterans Affairs. He is a retired Air Force Colonel, and prior to joining TechLink in 2016, served as the Chief, Command and Control Division for Air Force Acquisition at the Pentagon, where he was responsible for a $4 billion/year acquisition portfolio. Brett has master's degrees in strategic studies, operational art and science, and human relations.

Switzerland's Approach To Tech Transfer—Biotectra And Unitectra

By Adrian Sigrist

Unitectra is the technology transfer office of the Universities of Basel, Bern and Zurich, the three big universities in the German-speaking region of Switzerland, offering research and teaching in a broad range of subjects. Unitectra is organized as a not-for-profit incorporated company wholly owned by the three universities.

Origin

The organization—at that time called Biotectra—started in 1996 as the TTO of a national program, the priority biotechnology program of the Swiss National Science Foundation. In 1999 Unitectra, Inc. was formed by the Universities of Bern and Zurich. The University of Basel joined in 2011. It operates a local office at each of the universities, which enables Unitectra to keep in close contact with the researchers and the governing bodies as well as the administration of the universities. But it operates as a single company and its employees don't provide technology transfer services for just one but for all of the universities, based on their background and experience.

Business Model

Unitectra offers the following services to the researchers of its universities:

i) Identification, protection and commercialization (licensing) of intellectual property (via spinouts or other industrial partners),

ii) Negotiation of research contracts, mainly with industry.

Unitectra is funded by the three universities according to the time spent working on cases of each of the universities. Its annual budget is shared among the universities according to a key calculation based on prior time expenditures. Patent and other external legal costs are paid for by each of the universities for their inventions. All license and research income directly flows to the respective university without Unitectra receiving a share. Any conflict of interest of Unitectra in this regard is therefore excluded. It does not need to maximize short-term license income in order to pay its salaries but can negotiate deals that are in the best long-term interests of the universities. All announcements of commercialization and successes are issued in the name of the originating university, not of Unitectra.

Unitectra is controlled by its universities via its board of directors. The board consists of two representatives of each university and three representatives of industry. Each university nominates one industry expert. All university board members are at the same time members of the executive board of their university. Unitectra considers this to be an absolute key for its business model and one of its success factors, as it provides a close relationship, full support and direct access to the leadership of the universities.

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A further success factor, not surprisingly, is its employees. Most of them have a scientific or legal degree and have worked in industry for several years. Hence, they know how industry works and what its requirements are. Unitectra also attaches importance to its employees acting in a service-oriented manner, being flexible and treating the researchers as customers. It tries to act as enablers, finding creative solutions, always provided the solution stays within the boundaries possible at a university. If this is not the case, it makes the limits clear to the respective researcher. A TTO cannot be everybody's friend, which again highlights the importance of having close contact with the universities' governing bodies to get the necessary understanding and backing when they get complaints. Many of its employees have been with Unitectra more than 10 years and were able to build up a long-term relation of trust with their customers, a further important success factor.

Successes

In the so far around 20 years of its existence it has evaluated 2,100 invention disclosures, filed 1,300 priority patent applications, over 1,000 licenses have been negotiated, over 200 spinouts have been launched, and over 100 products have reached the market (not including research reagents). 18,000 research contracts have been negotiated, bringing in over CHF1.7 billion in research funding. Licensing income of more than CHF90 million (approximately $100 million) has been achieved.

Biogen's Alzheimer antibody treatment Aduhelm® (aducanumab), which recently received FDA approval, is licensed under patent rights of the University of Zurich (via spinout Neurimmune). However, Aduhelm has proven to be controversial, and its sales are currently low. Examples of further successful spin-out companies are Prionics (now part of Thermo Fisher), Anaveon (raised CHF110 Million in 2021) and Molecular Partners.

In 2011 Unitectra won the European Biotechnica Award for "having made an exceptional contribution to the initiation and promotion of cooperation between the publicly funded research community and business."

The Future

Unitectra has established a successful model that has served the needs of its member universities for over 20 years, and it currently appears to be an example of an RTTO that will continue to operate for the foreseeable future. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4254249*.

The Author

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The UniQuest Multi-Institution Technology Transfer Model

By David Henderson

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Background

In 1996, the University of Queensland in Brisbane Australia invested $5 million into its commercialisation company, UniQuest, with the long-term objective of increasing translation and commercialisation of research. With this funding, UniQuest implemented a commercialisation model that scaled over the next 15 years to 100 people commercialising exclusively for eight universities and public sector research organisations, with peak revenues of $100 million. Over 70 start-ups were created, which raised over $500 million, and 200 licences were executed and managed, including the licence for the blockbuster HPV vaccine Gardasil.

The rationale for the investment was to address the commercialisation challenges faced by the University of Queensland. One major challenge was location. Australia then was a country of 18 million people with a small financial and industrial base a long way from global financial and industrial centres, and Brisbane was a regional city of 1.5 million people, itself remote from Australia's financial and industrial centres. Other challenges were a short-term commercialisation focus on generating income, and a growing disconnect between the university's research community and commercialisation/translation.

With this investment, UniQuest set about building a proactive, professional commercialisation team, deploying a hub and spoke model to connect more closely with researchers, and increasing size/scale to support deep commercial expertise across all fields of research.

Organizational Structure

The hub and spoke model was developed and refined, with four variants tested over a five-year period. The model evolved to become:

- Spokes—UniQuest staff located in each faculty, with a joint reporting line to UniQuest and to the dean, working with researchers and faculty staff to build mutual communication and understanding, identifying innovations with commercial potential, initiating IP protection, supporting research and consulting, and leading/coordinating hub commercialisation resources. Each "spoke" was responsible for an average of 260 research staff and students, although the actual number varied by faculty and research field. The role was derived from the "client relationship management" model used in professional partnerships and the computer industry. The "client relationship manager" (spoke) managed the relationship and did considerable work personally, but with 260 clients to service, was mainly the gateway and manager for access to the central resource pool.
- Hub—Specialists provided business development, due diligence, project structuring and packaging, industry/finance relationships, IP, negotiation and legal services and overall management. Hub specialists focussed on two to three projects at a time and were responsible for delivery of project outcomes.

The "spoke" roles were funded equally by UniQuest, the faculty and the university, ensuring that each party had a vested interest in its success. Objectives for the roles and staff appointments were mutually agreed and performance jointly reviewed annually.

This model was tested and validated in two faculties, and subsequently expanded to all University of Queensland faculties and research Institutes. It was then relatively easy to add in external organisations. The University of Queensland supported UniQuest partnering with other public sector research organisations so it could benefit from the increased scale and depth of expertise that this expansion brought to UniQuest.

A key element of the model was developing relationships with major companies and investors, understanding their strategic focus and showcasing only quality, due diligenced projects that addressed that focus. Industry and investors knew that a project put forward by UniQuest would be targeted to their areas of interest and would not fail in due diligence, and so potential partners were normally quite receptive.

As UniQuest grew and its reputation developed, it became easier to recruit high-quality talent, many from industry and investment roles overseas. Most of these people would have been unlikely to consider roles in technology transfer at a single university office, but were attracted to the broader opportunity and ambitions at UniQuest. Access to their expertise and network was critical in progressing many projects and would certainly not have been available to many of the smaller partners acting alone.

Business Model

Despite the benefits above, there was no financial support available from government or any other source to underpin the extension. While the University of Queensland supported the expansion, it did not want existing UniQuest resources diverted and required that the costs of any additional resources were covered by the external organisations.

On this basis, UniQuest developed a sustainable commercial external partnering agreement with key terms as follows:

- UniQuest staff were located at the external partners, paid for by the partner
- A proportionate contribution to hub costs was made by the partner
- All partner IP was exclusively commercialised by UniQuest, with final sign off on terms by the partner
- A share of commercialisation income was retained by UniQuest
- Management of "spoke" staff was by UniQuest in close consultation with the partner

Benefits to the partners included access to a large team with deep sector and functional expertise, skilled proven management and development of commercialisation staff, and leverage from UniQuest's network and reputation—with the expectation of better commercialisation outcomes than could be achieved with a small, necessarily generalist, internal team.

Issues/Challenges

The model was not without its challenges. One challenge was to satisfy partners that their projects would not be sidelined in favour of University of Queensland projects, and vice versa. This was addressed by aligning the share of commercialisation income so that there would be no advantage or disadvantage to UniQuest working with any party—so the project selection criteria were solely based on merit. UniQuest was reported to retain one-third of revenues from University of Queensland projects.

While this approach addressed the question initially, more challenges emerged over time because project flow from each partner was erratic. In one year, for example, Partner X brought forward more good projects which received a greater share of central resources than other partners. This seeming "unfair" treatment was addressed with frank and open discussions about project quality and prospects for commercial engagement. Over time, the issue diminished in importance as the flow of good projects from Partner X decreased and more resources were applied to good projects that came from other partners.

However, the partners saw the benefit of access to a breadth and depth of expertise that they could not have assembled themselves, and the large resource pool to drive projects expeditiously when required. Most importantly, partners' projects were introduced to the global companies and investors in UniQuest's network, leading to a number of deals and investments that would not have occurred otherwise. For example, UniQuest was able to bring investment from large international groups including the Walton family (Walmart) and J&J into partner projects.

Ultimate Fate

Over a period of eight years, UniQuest entered into seven of these arrangements covering four external universities, one medical research institute and two state health departments. The team of "spokes" grew to 30, eight located at partners and 22 at University of Queensland faculties and research Institutes.

In 2012 there was a leadership change at the University of Queensland, and in 2013 UniQuest reconsidered the external partner program and decided its resources were better deployed supporting the University of Queensland only. The partners then re-established technology commercialisation functions in their organisations, with a number recruiting their former UniQuest representatives to staff them. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4254250*.

The Author

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Prior to joining UniQuest, David managed startup companies in the United States and Australia, completed an MBA at Harvard, and consulted for a number of globally recognized companies with Booz Allen and McKinsey.

The History Of Tech Transfer In Japan: The Role Of Two Regional Tech Transfer Offices

By Koichi Sumikura and Kosuke Kato

1. The Origins of University Technology Transfer Organizations in Japan

Birth of TTOs

Technology transfer organizations (TTOs) first appeared in Japan in 1998. In the same year, the "Act on Promotion of Transfer of Technology Research Results from Universities, etc. to Private Business Operators" (commonly known as the "Act on Promotion of University Technology Transfer") set forth the conditions for obtaining government approval as an "approved TTO." In that year, the first four institutions as TTOs received approval under the Act.

In 1999, Article 30 of the Act on Special Measures for Industrial Revitalization established the so-called Japanese version of the Bayh-Dole Act, which states that if the contractor meets certain conditions, 100 percent of the intellectual property (IP) rights related to all contracted research and development conducted by government-funded agencies can be attributed to the contractor. Certain conditions are defined as follows:

1. The research results must be reported to the government when they are obtained;
2. The contractor shall license the IP right to the national government free of charge when it is necessary for the public interest;
3. The contractor shall license the IP right to a third party at the request of the national government when the IP right has not been used for a considerable period of time.

However, at that time, national universities were not subject to this provision because they did not have a legal identity. Therefore, the right to obtain a patent for an invention created at a national university was attributed to either the individual or the national government, and which of the two was the case was decided by the invention committee in each university. In this system, the university could not become the owner of the patent nor manage it as an institution. The Japanese version of the Bayh-Dole provision was later transferred to Article 19 of the Industrial Technology Enhancement Act in 2007.

In 2002, the Outline of the Intellectual Property Strategy and the Basic Act on Intellectual Property were enacted. Article 13 of the Basic Act states that the government should "develop a system to utilize human resources with expertise in IP at universities, etc., and improve registration and other procedures related to intellectual property rights." The government's Intellectual Property Strategy Headquarters, established in March 2003 in response to the Basic Act, announced the "Promotion Plan" described below in July of the same year.

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In 2002, the "Working Group on Intellectual Property" of the Ministry of Education, Culture, Sports, Science and Technology (MEXT) reviewed the attribution of patent rights after the incorporation of national universities and how patent management should be carried out. In the "Report of the Working Group on Intellectual Property" released in November 2002, it states that "Universities, as universal entities for human society as well as social entities living with the times, need to position more direct contributions to society as their 'third mission' in addition to their traditional basic missions of education and academic research, and tackle them head-on." The report also states that "in principle, intellectual property rights should be attributed to institutions," which was a precursor to the incorporation of national universities that was implemented in April 2004, about a year and a half later.

Incorporation of National Universities and Development of University Intellectual Property Headquarters

July 2003 marked a historic turning point for Japan's national universities: on July 8, 2003, the government's Intellectual Property Strategy Headquarters announced the "Promotion Plan for the Creation, Protection and Exploitation of Intellectual Property." On July 15, MEXT announced the 43 selected institutions for the "University Intellectual Property Headquarters Development Project." Incorporation of National Universities was enacted in April 2004. National university corporations are now required to set up an organization such as the "University Intellectual Property Headquarters" within the university to manage IP.

University Intellectual Property Offices and TTOs

Some TTOs were regional TTOs, which meant that they were in charge of technology transfer from universities in a particular region to industry, but others only represented specific universities. Therefore, in some universities, the TTO as an external organization and the University Intellectual Property Headquarters, as an internal organization, stood side-by-side, and personnel with the role of coordinator for industry-academia-government collaboration were assigned to each of them. Therefore, ideally, the TTO and the University Intellectual Property Headquarters would collaborate with each other while separating their functions to promote technology transfer efficiently and effectively.

As an example, the University Intellectual Property Headquarters is expected to:

1. Establish internal rules such as the "Intellectual Property Policy," "Rules on Employee Inventions," and "Conflict of Interest Policy";
2. Serve as a contact point for resolving any problems that may arise in the recognition of inventors and conflicts of interest; and
3. Receive reports on inventions from researchers who have made inventions.

On the other hand, TTOs are expected to:

1. File patent applications in cooperation with outside patent attorneys;
2. Act as a contact point for companies to sell the university's technology seeds; and
3. Negotiate licenses with companies and conclude contracts.

Of these, the processes of the report of invention, filing a patent application, sales promotion and license negotiation are inseparable parts of the whole, so seamless communication between the University Intellectual Property Headquarters and the TTO is essential. The same applies to decisions on whether to apply for a patent for an invention or not, and how to respond to a request from a company to introduce its technological seeds. In addition to the University Intellectual Property Headquarters and TTO, the process of industry-academia collaboration is also closely involved with the university's internal contact point for concluding joint research contracts, that for managing external research funds, and internal and external start-up support organizations. Management was required to prevent the "negative effects of vertical division" among these organizations, but it was also apparent that they were struggling to clarify the separation of duties. To date, after many years of trial and error, most universities have achieved a clear division of functions and avoidance of duplication through organizational integration and reorganization.

As of September 21, 2021, there are 32 institutions as approved TTOs. Of these, 20 are the organizations outside university such as corporations and foundations, and 14 are internal university organizations.

2. Techno Network Shikoku Co., Ltd.

History

Techno Network Shikoku Co., Ltd. (TNS) was established in February 2001 with the aim of fusing the seeds of Shikoku's universities and other institutions with the needs of businesses in order to promote the development of local communities and revitalize industries. It has 14 staff members. TNS was approved by the Japanese government as an approved TTO under the Law for the Promotion of University Technology Transfer.

Partner Universities

As of June 2021, TNS has signed technology transfer agreements with four medium-sized universities in the Shikoku region, which have about 700 scientific researchers per university. Initially, TNS' only office was at its headquarters in Takamatsu City, Kagawa Prefecture, but since September 2014, TNS has established offices at three partner universities, where licensing associates work closely with the university faculty. The total number of invention disclosures received from these partner universities is about 130 per year.

Original Source of Funding

TNS's main source of funding was a subsidy from the Japanese government for accredited TTOs, but since that subsidy expired after five years, TNS has shifted to the following business model.

TNS Business Model

TNS's sources of income are outsourcing fees based on technology transfer contracts from universities, success fees for technology transfer and other activities where TNS earns a share of the income from licenses, and contracted project fees from governments and public research institutions. TNS has exclusive rights to license technologies for member universities. As a model for its technology transfer operations, TNS has adopted the Niels Reimers marketing model since 2014. Mr. Reimers, who established the Stanford Office of Technology Licensing (OTL), emphasized the importance of marketing in the process of technology transfer from university to industry. In the 1990s Mr. Takafumi Yamamoto, who started a division in a private company for supporting technology transfer from university to industry, met Mr. Reimers and learned about university technology transfer. Later Mr. Yamamoto took the position of the president of TODAI TLO, Ltd., which is the TTO for the University of Tokyo, and disseminated the Reimers marketing model in the community of university technology transfer in Japan. Based on this model, TNS focuses on marketing its inventions. In addition, in order to carry out its work efficiently, TNS has decided to give authority and responsibility to each licensing associate and outsource the patent application work to outside patent firms. TNS recommends to each member university whether each patent should be filed or not. Then, each member university decides whether to file the patent application or not. Each member university pays the patent expenses and controls the budget. Since human resource capacity is the mainstay of TNS's business, the majority of its expenditures are personnel costs.

The Pluses and the Minuses of the Model

TNS considers the pluses of the model to be the following points:

(1) TNS can increase its sustainability and secure human resources by obtaining outsourcing fees based on technology transfer contracts from universities.

(2) By setting up a branch office on the campus of the partner university, TNS can conduct technology transfer activities in close liaison with the university.

(3) TNS will be able to act as experts in technology transfer.

On the other hand, TNS considers the following three points to be the minuses of the model:

(1) It is not always possible to obtain outsourcing fees based on technology transfer contracts from universities every year.

(2) It is difficult to concentrate only on the technology transfer due to the variety of tasks within the university.

(3) Currently, it is difficult to stabilize the management of the company with only contingency fees such as licensing income.

Examples of Successful Technology Transfer

Kagawa University and Okura Corporation jointly developed and commercialized the Endo barrier (Photo 1), a virus infection prevention system for endoscopes, to enable patients and medical personnel to perform medical inspections with peace of mind during the COVID-19 pandemic. This case is unique in that it was an urgent response to the world's situation and that it licensed designs in addition to patents. TNS also has other unique and successful cases of technology transfer through licensing of trademarks and seeds.

Current Situation

TNS assesses the current situation as follows:

(1) As a group of professionals, TNS employees are making efforts to improve their individual skills and increase their licensing income.

(2) There is a difference in skills between experienced employees (more than five years) and inexperienced employees, and they are willing to improve their skills through training programs. In addition, they are considering the possibility of securing human resources in new fields for the next new project.

(3) It is necessary to establish a system to maintain TNS and to secure new sources of income as soon as possible.

(4) TNS considers it important to continue communication with the university president, directors, and those in charge of industry-university collaboration in order to catch up with the policies of partner universities as soon as possible.

Future Prospects

TNS has the following future prospects in mind:

(1) As technology transfer specialists, TNS hopes to be positioned as one of the leading TTOs in Japan.

(2) TNS would like to grow into a TTO that can manage its business on the basis of success fees (share of the income) from its core business of technology transfer to increase the sustainability of TNS.

(3) TNS would like to promote licensing activities not only with Japanese companies but also with overseas companies.

3. Tohoku Techno Arch

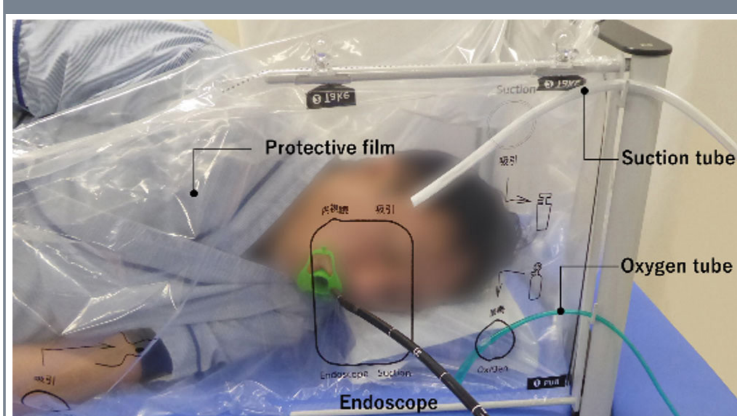
History and Outline of Activities

Tohoku Techno Arch (TTA) is a TTO established on November 5, 1998 with the support of faculty members of the national universities and technical colleges in the Tohoku region, with the aim of supporting the creation of new businesses and industries using IP created at universities and other institutions. TTA received approval from the Japanese government as an approved TTO under the Law for the Promotion of University Technology Transfer on December 4, 1998.

Partner Universities

As of June 2021, TTA is collaborating with 12 universities, mainly in the Tohoku region, and about 90

Photo 1: Endo Barrier



percent of the university technologies for which TTA conducts technology transfer activities were created at Tohoku University (TU). TTA's office has been located on the campus of TU since its establishment. In the past, time spent traveling to distant universities (geographical distance) was a problem, but since web conferencing became mainstream with COVID-19, TTA feels that the problem can be solved by fully utilizing Zoom. TTA's shareholders are TU and faculty members and other individuals who belong to national university corporations in the Tohoku region. TU's acquisition of TTA's shares as the first corporate shareholder in May 2021 was a major turning point for TTA.

Original Source of Funds

Initially, TTA's main source of funding was the aforementioned Japanese government subsidies to approved TTOs, but these subsidies were for a limited period of time, and after the end of the subsidy period, the main project income came from success fees (*i.e.*, a share of the income) and technology transfer income from each university where TTA receives a share of income from licenses.

The Content of the Outsourcing

The content of the outsourcing varies depending on the university that signed the technology transfer agreement, but focusing on the agreement with TU, the explanation is as follows. Initially, TU entrusted TTA with the technology transfer activities and rights acquisition for IP rights owned solely by TU. However, since there are many projects in which licensing and joint research agreements proceed in parallel, there was a discussion that it might be more efficient in some cases to consolidate not only TU's solely owned IP, but also all operations related to management and exploitation, as well as operations related to joint research with companies, into TTA. Therefore, TU established a system to outsource to TTA the management of IP such as technology evaluation and acquisition of rights, joint application work between TU and companies, and the negotiation and coordination of joint research contracts that take into account background and foreground IP. Because of this integrated consignment, TU's only licensing route to companies is through TTA. Universities other than TU do not have such an integrated consignment system, which varies considerably from university to university. For example, some universities focus on specific fields such as life sciences and outsource their licensing activities to TTA.

Relationship with Partner Universities

TTA believes that the relationship between TTA and its partner universities and shareholders is very good, as the shareholders continue to be supportive of TTA's founding principles. TTA has built a trusting relationship that allows for constructive discussions between the universities and TTA on a regular basis, not only when organizational changes occur at the partner universities, but also to maximize the results of technology transfer and industry-university collaboration. In addition, TTA makes proposals to universities and other organizations and decides on the priority of projects and matters on which TTA will focus its technology transfer efforts after consultation.

Lessons Learned from Best Practices

As a result of analyzing the successful commercialization projects in the past 20 years of TTA's technology transfer activities, it was found that the projects were not one-off patent licenses, but rather projects that led to license agreements through multiple option agreements and joint research agreements. In addition, it was found that the projects were accompanied by support for obtaining government competitive funds, etc., while sharing the challenges for commercialization with the companies, thinking together with them how to commercialize the project, and providing appropriate support.

Future Prospects

All 16 of TTA's technology transfer staff are full-time employees, eight of whom are new to the company, having joined within the last two years. TTA believes that it is important for each staff member to have a number of promising commercialization projects such as the ones mentioned above, but it is difficult for new staff members to handle such complex projects. Therefore, TTA has made a proactive decision to hire and train a large number of full-time employees now to ensure success in the next 10 years. ■

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The Authors

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Kosuke Kato currently serves as the Assistant Head, Office of Industry-Academia-Government Collaboration, Co-Creation Bureau at Osaka University. He is an Associate Professor in the Management of Industry and Technology Division of the Graduate School of Engineering at Osaka University. He completed the Technology Transfer Fellowship program offered by Boston University's Office of Technology Development and has been globally recognized as a Registered Technology Transfer Professional since November 2013.

Quebec Supports Tech Transfer— The Sociétés de Valorisation And Axelys

By Alexandre Navarre

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Historical Background

Around the beginning of the 21st Century, the Montreal Stock Exchange determined that its IPO pipeline was drying up and that university spin-offs could become a strategic new stream for them. As a result, a university-sourced commercialization program was announced in 2001 with a $100 million provincial allocation over a five-year period.

In Quebec, the university ecosystem is made up of 19 entities funded by the provincial government, of which McGill, University of Montréal and Laval University are the largest. Even though McGill has a joint intellectual property (IP) policy and all the others are, at least for now, governed by an institution-owned IP policy, there is considerable flexibility when researchers desire to undertake their own IP exploitation, though not without conditions. Responding to pressures from university presidents, it was decided that four consortia entities, performing technology and knowledge transfer, would be created, each having a sufficient critical mass in terms of IP to become self-sustaining after 10 years.

Each of the major universities became the pillar of a so called Société de Valorisation Universitaire (SVU), which also included smaller entities and affiliated research hospitals. A $50 million budget was reserved to those supervised by Valorisation Recherche Québec, a not-for-profit organization, and involved as well setting up public-private research consortia, such as CRIAQ (Consortium for Research and Innovation in Aerospace in Quebec) or MEDTECH (medical devices). SVUs in theory had privileged access to their member's IP, assuming all the resultant costs while splitting a portion of their net revenues between researchers and the institutions according to their own IP policies, which differed from one institution to another.

At the time, most larger universities had research offices responsible for research contract negotiations, as well as protecting valuable IP and licensing it. They were called Bureau de Liaison Entreprise-Université or BLEUs for short. The spin-off trend had just started, fueled by the availability of venture capital in the Montreal region. This drive was no doubt influenced by early successes such as the McGill spin-off, Biochem Pharma, which discovered 3TC (lamivudine, sold as Epivir), a treatment for HIV. BioChem Pharma was bought by Shire Pharmaceuticals for $4 billion in 2000. Another early Quebec success was VoiceAge Corporation, whose ACELP voice recognition algorithm was developed at Sherbrooke University and used in billions of portable phones worldwide, earning Sherbrooke over $160 million in royalties until the patents expired in 2012.

Issues

SVUs were set to have a bright future, particularly because the Quebec industrial ecosystem had moved towards a pronounced high-tech orientation. Research parks emerged, as well as incubators. However, SVUs, well financed as they were, encountered an unexpected headwind: the BLEUs quite subtly resisted their presence and resented their higher pay scales. The result was a time bomb. In some universities, decisions with respect to IP remained in-house together with the licensing activities. The University of Sherbrooke even created a separate SVU, Socpra,[1] while remaining a member of Aligo, one of the three remaining SVUs (the others being Univalor and Sovar). Aligo was the result of a merger in 2012 between MSBi and Valeo. Despite such obstacles the SVU concept survived for 20 years and was funded by successive governments, intent on securing the outcome of so many years of hope with investments of close to $4 million annually. It had a slow and shaky ramp-up,[2] although it reached a steady state after 15 years.[3] To put it in perspective, Quebec universities' R&D budgets were of the order of $1.8 billion annually at the time.

The distribution of the university entities per SVU, as of 2020, was as follows:

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1. Socpra is not considered as an official SVU since it was not funded by the Québec Government; it is still in operation under TransferTech Sherbrooke.

2. A. Navarre, "La valorization de la recherché piétine," *ACFAS-Découvrir*, Decembre 2012.

3. A. Navarre, "Quels progress pour la valorization de la recherche universitaire au Québec," *ACFAS-Découvrir*, Mars 2017.

- Aligo:

  McGill U, Sherbrooke U, Bishops, Concordia, ÉTS. UQAM,[4] UQO, UQAT, UQTR, UQAR and affiliated hospitals
- Univalor:

  Université de Montréal, Polytechnique, HEC and affiliated hospitals
- Sovar:

  Laval U, UQAC and affiliated hospitals
- TransferTech Sherbrooke (initially called Socpra):

  Sherbrooke U and affiliated hospitals

Accomplishments

The SVU initiative had some significant outcomes:

- It instilled the notion that commercialization of university IP is a direct continuum from some of its research results;
- It sensitized university administrations about the importance of IP, reinforced by the constant watch of government officials;
- It showed in a tangible way that not only financial results mattered, but also that social innovation was a reality;
- It addressed mainly orphan technologies, generally risky breakthrough technologies, as opposed to nonexclusive licenses;
- It resulted in the creation of more than 100 start-ups during the period;
- It created a pool of highly trained TT professionals.

Some great companies have emerged from the SVU initiative, creating at its peak about 15 start-ups annually with a 50 percent success rate, success being defined as sustained outcome whether within a start-up, or through merger or acquisition. Examples include:

- Kinova inc., Robotics, *kinovarobotics.com*;
- Emovi Inc., Knee wear evaluation, *emovi.ca*;
- Laurent Pharmaceuticals, Inc., cystic fibrosis treatment, *laurentpharma.com*;
- Mimetogen, oral treatment for cystic fibrosis-linked dry eye, *mimetogen.com*;
- SPARK Microsystems International, ultra-wide band wireless systems, *hsparkmicro.com*;
- Resonant Inc., RF filter systems, *resonant.com*;
- Medicago Inc., plant-derived vaccines, *medicago.com.*

To put this in perspective, Stanford University as well as the French SATTs have had a much lower rate of start-up creation, as a percentage of research funding over the same period.

Rough Waters

Institutions held ambivalent postures towards SVUs. The model was not theirs and they had little control, if any, over their management. The trust relationship had never really been fully established and was deteriorating over time. Larger universities did not recognize the value added by the SVUs and believed they could do a better job internally. Sometime the low-hanging fruits were retained internally, and the more complex cases were sent to their SVU.

Creation of Axelys

The SVUs' traction was not enough for the government program to pursue its financing without an overhaul. From 2003 to 2018, the provincial government invested $114 million in the SVUs, including a proof-of-principle incentive program (POP). In 2020, after an extensive review of the results over the past 20 years and consultation within the innovation ecosystem, the Quebec government announced the creation of a new entity, branded Axelys,[5] with a $100 million budget to commercialize all technologies from publicly funded institutions, not only universities. It started operations in April 2021, so the jury is still out on its prospects and success. However, in 2022 a new $100 million early-stage investment fund, Eurêka,[6] was created under the management of Investissement Québec and will be available to Axelys's projects, which will enhance its development. ■

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The Author

Alexandre Navarre has had a career dedicated to innovation in industry with Dow Chemicals, with the Canadian Federal Government, and with university tech transfer offices as director (McGill and Western Ontario) and as founder and CEO of one of the French SATTs. He was also Quebec manager of the Canadian Science and Engineering Research Council of Canada (NSERC), a founding member of ACCT Canada and a long-time chair of the Development Committee of the Canadian AUTM section. Actively retired, he currently consults on innovation and IP policy issues and writes articles on innovation challenges.

4. Université du Québec has different campuses, each with an independent governance: ÉTS : École de technologie supérieure; UQAM: Université du Québec à Montréal; UQO: Université du Québec à Ottawa; UQAT: Université du Québec en Abitibi-Témiscamingue; UQTR: Université du Québec à Trois-Rivières; UQAR: Université du Québec à Rimouski; UQAC: Université du Québec à Chicoutimi; note that INRS, Institut national de recherche scientifiques, while part of Université du Québec has chosen not to belong to any SVU.

5. *Axelys:https://www.newswire.ca/news-releases/axelys-takes-off-accelerating-innovation-for-tomorrow-s-society-852421331.html*.

6. *https://www.investquebec.com/quebec/fr/produits-financiers/toutes-nos-solutions/fonds-eureka.html.*

The First National Network Of Multi-Institution TTOs—Germany's Patentverwertungsagenturen

By Bram Wijlands

The Patentverwertungsagenturen

The history of the development of Germany's tech transfer structures (mainly focused on IP) has been addressed elsewhere in this special issue by Stein where he discussed Ascenion GmbH. Stein briefly mentions the creation of 25 Patentverwertungsagenturen (PVA or Patent and Licensing Agencies) starting in 2000. In this article we will discuss these PVAs in detail. They can best be viewed as multi-institutional tech transfer offices (MiTTOs) that primarily serve research institutions, universities and universities of applied sciences in their own federal state.

PVA: What's in a Name?

In theory every organization that offers patent assessment and exploitation activities on a commercial basis for research institutions may call itself a PVA. In fact, there is no formal accreditation procedure to achieve the official status of PVA. All of them were founded to support local universities and universities of applied sciences to manage their IP management and licensing processes. It was the German federal government, backed up by the "Länder" (the federal states), that drove this development from the start. Apparently, the policy makers had strong opinions about both the responsibility for and the capability of universities in needing to suddenly deal with the ownership of their IP. Before the 2002 German equivalent of the "Bayh-Dole Act," tech transfer structures within universities were mostly not very well developed—at least not as nearly developed as TTOs such as Max-Planck-Innovation and the Fraunhofer system's Patent Office. Researchers within universities operated under the "professor's privilege" paradigm and thus were completely free to handle their IP by themselves; internal structures for IP activities within universities therefore barely existed.

The decision by the federal government to support IP commercialization activities by creating a central support structure for each federal state was therefore understandable. In the early 2000s it would not have been possible for German universities to found companies and strive for economic impact with their own business-driven activities. Apart from a few pioneering institutions such as, for example, TuTech Innovation in Hamburg and TuDag in Dresden, the majority of the universities were still not able to operate in this commercial space. The need for fast capacity building and bundling of expertise also argued for a centralized model. Besides these issues there were also reservations about the mindset and culture of universities in dealing with state funding. Many years later, someone from the federal ministry (who was involved in the process from the beginning) expressed this quite clearly to the author: "Universities are like a black hole." This is not a very flattering reflection on academia, but it gives off-the-record insight into why policy makers decided that funding should only be supplied to the universities by commissioning PVAs. This was ground-breaking for the development of external structures in the German academic field of tech transfer.

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PVA: the List

The landscape of PVAs is heterogenous; six already existed before the transition away from the professor's privilege in 2002. Some were clearly linked with their home university, while some originated in industry and also served regional development roles. Some have changed their original business model, while some have disappeared over time and, moreover, the absence of a formal accreditation process doesn't make it easy to develop a comprehensive list of all the PVAs.

The listing in Table 1 is based on extensive research and provides as good a summary as can be achieved of the history of the German PVA landscape and the institutions the PVAs serve. A number of these PVAs, which are shaded grey in Table 1, only serve a single institution and hence do not meet the definition of an MiTTO and are not included in subsequent analyses. They are included here for completeness.

Funding and Business Model

The heterogeneous world of the PVAs was discussed above. This also applies to their funding models: there is no "one size fits all." Some PVAs were already in the market before the government started encouraging and supporting their activities (*e.g.*, TLB, EZN). Some received funding from industry foundations (*e.g.*, BayPat), but most of them received their funding directly from their member universities. The universities in turn relied primarily on the government funding they were offered by Berlin (mainly funding from the Schutz von Ideen für die Gewerbliche Nutzung, program (SIGNO—Idea Protection for Commercializa-

Table 1: Location, History and Membership of PVAs					
Federal State	Registered Office	PVA	Institutions served		Founded - (Terminated)
Brandenburg	Potsdam	Zukunftsagentur Brandenburg GmbH (ZAP)	Univ. Potsdam B-TU Cottbus Univ. Frankfurt Oder Appl. Univ. Eberswalde	Appl. Univ. Havel Appl. Univ. TH Wildau Appl. Univ. Potsdam	2001 - present
Berlin	Berlin	ipal Gesellschaft für Patentverwertung Berlin mbH	TU Berlin HU Berlin FU Berlin		2002 - 2015
Baden-Württemberg	Freiburg	Campus Technologies Freiburg GmbH	University of Freiburg University Hospital Freiburg		2002 - present
	Karlsruhe	Technologie-Lizenz-Büro (TLB) der Baden-Württembergischen Hochschulen GmbH	Stuttgart Univ. Univ. Ulm Heidelberg Univ. Univ. Konstanz Univ. Mannheim	Appl. Univ. Hohenheim Appl. Univ. Konstanz Appl. Univ. Offenburg Univ. Tübingen	1998 – present
	Heidelberg	Technology Transfer Heidelberg GmbH	Univ. Hospital Heidelberg		2011 – present
	Heidelberg	Innovation Management DKFZ	Deutsches Krebsforschungszentrum		? – present
	Heidelberg	EMBL Enterprise Management Technology Transfer GmbH	European Molecular Biology Laboratory (EMBL)		1999 – present
Bayern	München	Ascenion GmbH	DZNE – Helmholtz HZDR – Helmholtz HZI – Helmholtz MDC – Helmholtz Helmholtz Münich ATB – Leibniz DiFE – Leibniz DPZ – Leibniz FLI – Leibniz HKI – Leibniz Borstel – Leibniz	LIN – Leibniz LIV – Leibniz Hospital Univ. Kiel Hospital Charité Berlin Hospital Univ. Hannover Hospital Univ. Innsbruck Hospital Univ. Göttingen	2001 – present
	München	Bayrische Patentallianz GmbH (BAYPAT)	LMU München & Hospital TU München & Hospital Univ. Bayreuth Univ. Nürnberg-Erlangen & Hospital Univ. of Augsburg Univ. of Bamberg Appl. Univ. Hof Appl. Univ. Kempten	Appl. Univ. Ingolstadt Appl. Univ. Coburg Appl. Univ. Deggendorf Appl. Univ. Augsburg Appl. Univ. Ansbach Appl. Univ. Aschaffenburg Appl. Univ. Amberg-Weiden	2007 – present
Bremen	Bremen	innoWi GmbH	Univ. Bremen Univ. Oldenburg Appl. Univ. Bremen Appl. Univ. of Arts Bremen Appl. Univ. Bremerhaven Appl. Univ. Jade IWT – Leibniz		2001 – present
Hessen	Frankfurt	INNOVECTIS GmbH	Univ. Frankfurt		2000 – present
	Gießen	TransMit GmbH	Univ. Gießen Univ. Marburg Appl. Univ. Mittelhessen		1996 – present
	Kassel	GINo Gesellschaft für Innovation Nordhessen mbH	Univ. Kassel		2002 – 2022
Hamburg-Harburg	Hamburg	TuTech Innovation GmbH	Univ. Hamburg Hospital Hamburg-Eppendorf TU Hamburg Appl. Univ. Hamburg		1992 – present
Meckleberg-Vorpommern	Rostock	PVA Mecklenburg-Vorpommern AG	Univ. Rostock Univ. Greifswald Appl. Univ. Neubrandenburg Appl. Univ. Stralsund Appl. Univ. Wismar		2001 – 2019
Niedersachsen	Göttingen	MBM Science Bridge GmbH	Univ. Göttingen Univ. Lüneburg Univ. Hannover TU Clausthal Appl. Univ. Hildesheim Appl. Univ. Ostfalia Appl. Univ. science & arts Hildesheim/Göttingen/Holzminden		2004 – present

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Niedersachsen	Hannover	EZN Erfinderzentrum Norddeutschland GmbH	Univ. Hannover TU Braunschweig Univ. Osnabrück Appl. Univ. Technik & Wirtschaft Berlin Appl. Univ. Osnabrück Appl. Univ. Emden/Leer Appl. Univ. Technik Berlin	1986 - present
Nordrhein -Westfalen	Aachen	RWTH Innovation GmbH	RWTH Aachen University & Hospital	2017 – present
	Bochum	Rubitec GmbH	Univ. Bochum	1998 – present
	Mühlheim a/d Ruhr	PROvendis GmbH	Appl. Univ. Aachen Appl. Univ. Bielefeld Univ. Bielefeld Appl. Univ. Bochum Appl. Univ. für Gesundheit Bochum Univ. Bochum Appl. Univ. Bonn Rhein-Sieg Univ. Bonn Appl. Univ. Dortmund TU Dortmund Univ. Düsseldorf Appl. Univ. Düsseldorf Univ. Duisburg-Essen Appl. Univ. Gelsenkirchen Appl. Univ. Hamm-Lippstadt Appl. Univ. Sporthochschule Köln Appl. Univ. TH Köln Univ. Köln Appl. Univ. Münster Univ. Münster Appl. Univ. Niederrhein Appl. Univ. TH Ostwestfalen-Lippe Univ. Paderborn Appl. Univ. Rhein-Waal Appl. Univ. Ruhr West Univ. Siegen Appl. Univ. Südwestfalen Univ.Witten/Herdecke Univ. Wuppertal	2002 – present
	Münster	Clinic Invent	Univ. Hospital Münster	? - present
Rheinland -Pfalz	Kaiserslautern	IMG Innovations-Management GmbH	Univ. Koblenz-Landau Univ. Kaiserslautern Univ. Mainz Univ. Trier Appl. Univ. Bingern Appl. Univ. Kaiserslautern Appl. Univ. Koblenz Appl. Univ. Ludwigshafen Appl. Univ. Mainz Appl. Univ. Trier Appl. Univ. Worms	1996 - present
Schleswig-Holstein	Kiel	Patent- und Verwertungsagentur für die wissenschaftlichen Einrichtungen in Schleswig-Holstein GmbH	Univ. Kiel Univ. Lübeck Appl. Univ. Flensburg Appl. Univ. Kiel Appl. Univ. TH Lübeck Appl. Univ. Westküste	2002 - present
Saarland	Saarbrücken	Universität des Saarlandes Kontaktstelle Wissens- und Technologietransfer (KWT)	Univ. Saarland	2002 - present
Sachsen	Dresden	GWT-TUD GmbH Fachbereich Sächsische PatentVerwertungsAgentur (SPVA)	TU Dresden TU Chemnitz TU Freiberg Univ. Leipzig Appl. Univ. Dresden Appl. Univ. Leipzig Appl. Univ. Zittau/Göritz	1996 - present
Sachsen-Anhalt	Magdeburg	ESA Patentverwertungs-agentur Sachsen-Anhalt GmbH	Univ. Halle-Wittenberg Univ. Magdeburg Appl. Univ. Magdeburg-Stendal Appl. Univ. Harz Appl. Univ. Anhalt Appl. Univ. Merserburg IPK – Leibniz IPB - Leibniz	2001 -2021
Thüringen	Illmenau	PATON-PVA Landespatentzentrum Thüringen	TU Illmenau Univ. Weimar Univ. Jena Appl. Univ. Erfurt Appl. Univ. Jena Appl. Univ. Nordhausen Appl. Univ. Schmalkalden	2002 – present

tion) followed by funding from the Wissens- und Technologietransfer durch Patente und Normen program (WIPANO—Knowledge and Tech Transfer by Patents and Norms).

Both of these funding programs provided universities with a financial contribution to cover the costs of patenting and the services delivered by the PVAs. Initially the programs provided 40 percent funding of the total costs, which was later decreased and then transitioned to a complicated system of fixed sums for individual steps in the patenting and commercialization processes. In some cases, the support to the universities was augmented by additional funding from their federal state (*e.g.*, North Rhine-Westphalia).

It was this "base funding" they could use in addition to their own financial contributions to finance the activities of their PVAs. Depending on the agreements with the universities concerning the financing of the patent costs and commercialization activities, PVAs also frequently receive a success fee when a licensing contract generates income for the universities and their inventors, typically in the 10- to 15-percent range.

Ownership of the IP stays with the universities. Universities were, or later became, in some cases shareholders of the PVA. By being a shareholder of the PVA, if the PVA had no shareholders from industry or business the university could procure services from the PVA directly without having to go through a a European tender procedure. This made it more attractive for universities to purchase from the PVA.

By setting up service agreements, the pipelines between the PVAs and their member universities were filled. The PVA's role therefore is as a service provider, performing tasks such as:

- Consultancy for inventors (and their institutions);
- Assessment of inventions (*e.g.*, patentability, commercialization potential);
- Developing patent and exploitation strategies;
- IP portfolio management;
- Licensing negotiation, contracting and post-deal management.

Most of the agreements were exclusive, with the PVA being the sole vehicle by which the university's technologies were commercialized, but some were not and there were cases where a university would cherry pick what it sent to the PVA and kept the best cases for itself.

The successful assignment and licensing deals managed by the PVA are mostly negotiated and signed with a mandate on behalf of the universities. As a result, the income from those contracts in general flows directly to the research institutions. The universities are then responsible for rewarding their inventors and compensating the PVA if they have agreed to a success fee.

Successes

The biggest success story of the German tech transfer community, both in financial impact—over €1 billion in income—and in social impact—the number of new products it enabled—is the licensing of the Fraunhofer mp3-portfolio at the beginning of the 1990s. When the author started out in tech transfer in 2006 at RWTH Aachen, university senior management's first question to him was: "When do you think we will have our first 'mp3' deal?"

Even if the Fraunhofer case is still the best known, there have been many more successful transfers of academic knowledge and technology by German TTOs. A relevant question to tech transfer globally is how to measure success. Is it financial impact or societal impact?

The PVAs license many technologies. Singling out a few successful IP examples:

- Patents that enhance the efficiency of photonic components from TU Berlin were sold by ipal GmbH to one of the market leaders in the semi-conductor industry for more than €1 million;
- Provendis GmbH licensed University of Bonn's IP to Aduro Biotech (U.S.) about new molecules steering the immune system against tumor cells again for more than €1 million;
- LMU Münich's IP was licensed by BayPat GmbH to Recardio Inc., which allows a regenerative therapy concept with its dutogliptin lead drug to minimize and repair heart muscle after injury caused by infarction.

Pros and Cons

The political motivating force behind the change of law in 2002 regarding the professor's privilege undoubtedly influenced the establishment of the central PVA model. Half the PVAs were established in 2001 and 2002. Up to that time there were no comparable models elsewhere. The U.S., Canada, France and the UK had all used central, national TTOs. Without doubt the centralized approach was suitable to facilitate a very fast build-up of IP knowledge for a large group of universities and research institutions. It is hard to imagine several hundred universities and universities of applied sciences trying to recruit IP specialists at the same time and start their activities from scratch.

Especially for smaller institutions which had a less than critical mass of IP, the advantages of a central support structure are clearly visible. Another benefit of the model lies in the bundling of professional IP knowledge and expertise, and also in the pooling of IP into coherent portfolios. It gives potential licensees a more transparent and efficient option in their search for new knowledge, technologies and collaborations. The central digital platform "Invention Store"[1] where PVAs can showcase the technology offers from all universities illustrates this. The PVAs acted as a coordinated voice lobbying for the importance of IP and tech transfer activities and thus its funding. Another gain from the PVAs was they organized the Technologie Allianz, the first national platform for TTOs in Germany. Today TransferAllianz is a national association with even more active members.

For almost every model there is a downside as well as an upside. One of the disadvantages is probably best described as geography. Serving various universities and research institutes from a central office is difficult. Germany is a large country, and IP and licensing managers cannot be on the road for only one or two inventor meetings per day; universities can be 200 kilometers apart. Covering the workload, even with our current digital tools, mainly from a central office, is not helpful when it comes to building long-term relationships of trust with inventors and local university staff. It certainly did not help many PVAs that they were acting as a single service provider for "IP only." Not being integrated in the university system makes it sometimes difficult to take action, for example, when IP is clearly connected to contract research, start-up development or other tech transfer developments. These situations often require an "on campus" insight in the political and strategic developments. This is not possible for external service providers, which are perceived as foreign and "not us." And finally, the funding model isn't very supportive as well; as long as PVAs and their customers—the universities—rely on central funding and cashback via the occasional, rare blockbuster, it will not really help to create awareness about the importance, necessity and value of IP services within the research organizations.

PVA: *Quo Vadis*?

Twenty years down the road, it is probably a good time to again review the development of the PVAs and try to anticipate the future. The importance of tech transfer and innovation is growing day by day: digitization, health and climate change are some of the biggest challenges for our society. German policy makers responded and have already started to put new models and agencies in place (or in preparation): a central SPRIN-D Agency for "breakthrough innovations" or DATI (new planned model for regional innovation ecosystems). SPRIN-D is the federal agency for disruptive innovation that offers a new attempt to create new disruptive innovations in Germany following the U.S. DARPA approach. In addition to SPRIN-D, policy makers came up with the idea of creating DATI (German Agency for Transfer and Innovation) that would support the smaller universities and universities of applied sciences in particular in speeding up their transfer capacities with SMEs and start-ups to strengthen local and regional ecosystems.

PVAs and universities need to find out how to make use of these new developments without losing traction or having their efforts diluted. Not continuing the WIPANO funding, as recently announced by the government, might not even be a bad thing in this situation, as it offers the opportunity for PVAs to be more entrepreneurial: *e.g.*, by offering new services, thinking of specialization, or teaming up with partner agencies. Maybe even this is not bold enough and future times require a truly radical step—perhaps a National TTO with expertise in areas such as legal services, technology assessment and market expertise, a central hub working with spokes at the individual research institutions?

As it moves forward, the PVA system should keep in mind what Abraham Lincoln said: "The best way to predict your future is to create it." ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4254265*.

The Author

Bram Wijlands provides independent technology transfer advice and support within the innovation loop between academia and industry/society. Bram initiated and led RWTH Innovation GmbH at RWTH Aachen University from June 2017 to June 2022, starting an integrated and entrepreneurial tech transfer office from scratch. In the first five years under Bram's leadership, RWTH Innovation grew entrepreneurially to 40 staff members, scouted and supported over 800 inventions and 250 start-ups, created a key account partnership model for business partners and set up two daughter companies: one for equity management (RWTH Innovation Ventures GmbH) and one incubator including a maker space for student entrepreneurship initiatives (Collective Incubator GmbH). He joined RWTH in 2006 and led its internal tech transfer division. He has served on the Professional Development Committee of ASTP and as the co-chair of the Task Force Innovation within CESAER, the network of European Universities of Science and Technology.

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1. *https://www.inventionstore.de/en/.*

Oficina de Transferencia de Resultados de Investigación

By Catalina Bay-Schmith Cortés

Origin

Oficina de Transferencia de Resultados de Investigación (OTRI) was founded in 2005 and provided tech transfer services to five important Chilean universities:

- Universidad Católica del Norte, Antofagasta
- Pontificia Universidad Católica de Chile, Santiago
- Pontificia Universidad Católica de Valparaíso, Valparaíso
- Universidad Técnica Federico Santa María, Valparaíso
- Universidad de Concepción, Concepción

These are complex universities with a large number of faculties, labs and researchers. All have strong R&D programs targeting local industries and regional development, are strongly positioned in their areas of influence, and all are private.

Chile is a long, thin country and the geographic distribution of the five members became a management challenge for a TTO located in Santiago (where the largest and anchor university, Pontificia Universidad Católica de Chile, is located).

Organization

OTRI staff consisted of a small team of four to six—the leader and staff covering expertise in the areas of patenting and IP assessment, grant applications and management, and finance/accountability/HR. There were no support staff in the cities other than Santiago, but each university named a team member of its research and innovation units to be the link between OTRI and the local university. This individual attended monthly OTRI board meetings.

Business Model

The legal or business model arrangement with each university was:

- OTRI staff would visit and review opportunities with researchers and prepare disclosures that were submitted;
- OTRI staff would evaluate each disclosure, sometimes with external expertise (hired or *pro bono*);
- For those disclosures which were accepted by OTRI, they would be legally assigned to OTRI which would seek licensees and negotiate an arrangement ranging from a research collaboration to a license and occasionally a start-up company;
- Any royalties would be split 90 percent to the university and 10 percent to OTRI.

Issues

The focus of each university was different:

- Universidad de Antofagasta had a focus on mining technologies and desert landscape studies (archeology for example, as well as astronomy and telescopes);
- Pontificia Universidad Católica de Valparaiso specialized in food science;
- Universidad Tecnica Frederico Santa Maria specialized in engineering;
- Universidad de Concepción specialized in biomedicine, aquaculture and agritech.

Because of this diversity, OTRI had a lot of different technologies to assess, as well as a lot of faculties to work with.

The major challenges that OTRI faced, besides the logistical ones, included:

- Each university had its own perception of the relevance of the IP and of the importance of technology transfer for the university—remember that these were the prehistoric times for Chilean TTOs—2004 to 2010;
- Each university had a different IP policy (or none at all);
- There were unclear incentives for researchers to become involved in tech transfer activities, and
- At the beginning at least, almost none had a patent portfolio—in fact, in the case of Universidad de Antofagasta, their first patent was applied for thanks to OTRI.

In addition, some of the universities' leaderships looked at commercialization activities with some skepticism and distrust, especially the idea of local companies licensing local technologies and the possible "damage" to the university's reputation because of their involvement in "for-profit" activities.

Fortunately, as time passed and results showed that commercialization was a beneficial activity for all five universities, these negative impressions decreased and today all of these institutions have their own TTO.

OTRI started with a Corporación de Fomento de la Producción (CORFO) grant of $350,000 for the first three years (2005 to 2008) and ended with $170,000 for 2011. CORFO stopped funding the program because they replaced it with a bigger program to finance in-house TTOs for all Chilean universities, working in partnership with AUTM. Other issues were that universities wanted to independently manage their patent portfolios, which OTRI had helped to shape, plus the challenge of being a self-sustaining company whose main clients were universities with tight budgets.

Successes

On the positive side, OTRI received a lot of support from government agencies such as CORFO and CONICYT (Comisión Nacional de Investigación Científica y Tecnológica, now the Agencia Nacional de Investigación y Desarrollo [ANID]). Together with an initial contribution of $400,000 from CORFO, OTRI raised more than $5 million in grants and nearly $2 million more in matching funds (in-kind and private money) from 2005 to 2011. The availability of money acted as a hook to the founding universities and allowed the creation of patent portfolios and the development of local expertise in IP and tech transfer capabilities.

OTRI acted as a seed that planted these topics in the consciousness of the five largest Chilean universities, as well as in the minds of many researchers in the country, and it launched commercialization in Chilean universities.

OTRI's biggest hits were two technologies that have had a significant impact in the mining industry. These were invented by Chilean companies that had hired OTRI as consultants to help in developing an IP strategy for the inventions and to secure development funding from CORFO. One is a drilling device and the other is an image processing software. ■

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The Author

Catalina Bay-Schmith Cortés received her B.Sc in agricultural engineering and MBA from the Pontificia Universidad Católica de Chile. She has more than 20 years' experience in innovation management and technology transfer from academia to the private and public sectors in Chile and was the CEO of Oficina de Transferencia de Resultados de Investigación (OTRI), Chile's first TTO. She was Senior Tech Transfer Manager for the agrifood sector in the TTO of the Pontificia Universidad Católica and is currently Senior Science and Technology Projects Coordinator there, where she facilitates interactions between science faculties and industry.

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Ontario's Drive To Expand Its TTO Infrastructure—The C4 Initiative

By Alexandre Navarre

The Ontario Ecosystem

Dalton McGuinty, Ontario Premier from 2003 to 2013, has been the only premier in Canada who proclaimed himself, with no extra pay, Minister of Research and Innovation (MRI), a responsibility he later delegated after setting his imprint on a number of structuring initiatives. His impulse to bolster innovation in Ontario was unique and perhaps even ahead of his time. A science graduate himself, as he reviewed the innovation ecosystem in Ontario, Dalton McGuinty noted that his province, which is the manufacturing heart of Canada, was deficient in its ability to take advantage of the considerable publicly funded R&D it conducted. This was reflected in the Shanghai and OECD reports that were highlighting the excellence of Canadian research but the lack of correlation with in-situ innovation. So, the first step was to create a new department with its own budget. As part of the many initiatives it started was the encouragement of networks such as Communitech in the Waterloo area, M@RS in the Toronto area that became the site of an industry-university partnership and later of early stage VC funding, as well as the Ontario Society for Excellence in Technology Transfer (which morphed into ONSET, a grouping of all of the Ontario TTOs and one of the four Canadian TTO networks funded by NSERC).[1] Funding was also allocated to the Ontario Centers of Excellence (OCE), whose profile was expanding as it provided funding for SME innovations. Those networks were also organizing events and platforms to exchange ideas and innovation opportunities.

The Genesis of C4

At the time, Ontario universities and MRI were mesmerized by the successes of Research in Motion (RIM) and Open Text in Waterloo, both of which had close ties to the University of Waterloo. In recognition of the potential offered by TTOs in developing the next generation of blockbusters, universities were encouraged to expand their embryonic TTOs. Six South Ontario universities (Western, McMaster, Waterloo, Guelph, Windsor, and Wilfrid Laurier)[2] presented such a proposal to MRI in 2005. It consisted of expanding the main TTOs with specialized shared TT professionals in specific areas (for instance patent and marketing searches, e-commerce, copyrights and the new media, chemical and nano-material domains). About eight such professionals were hired in the four main TTOs and made available on a needs basis to all six TTOs. It was understood that funding would not exceed the initial three-year grant, which allowed the hiring of about eight specialized TT officers.

C4's Operating Model

C4 functioned as a virtual, inter-institutional networked TTO with a developmental function. Its eight professionals were located in the four major TTOs (Waterloo, Western, McMaster and Guelph) but were available and shared among all six institutions. It was expected that upon termination of the program, the TTO offices would then be able to absorb those resources, which was by and large the case. The C4 was also managing an inter-institutional training program to share best practices among the employees of the six TTOs. Such gatherings occurred every four to six months and resulted in a great deal of cohesion among those offices.

The C4 program was managed through an executive committee formed of the heads of the four major TTOs.

In addition, MRI created within the Ontario Research Commercialization Program (ORCP) that funded C4 a proof of concept (POP) competition with an envelope reserved for, and managed by, the C4. Each selected project was given up to $10,000 to allow it to then be eligible to compete in a larger competition, namely i2i (the NSERC Idea to Innovation program or the equivalent health-related POP-CIHR[3] program), whose phases could lead from $125,000 to $350,000 over one to two years. This POP initiative proved very successful in attracting NSERC i2i funding. At the same time, universities were starting their own seed funds

1. NSERC: Natural Science and Engineering Research Council.

2. The author was one of the four founders of the C4 initiative as the then-head of the Western ILO (Industry Liaison Office).

3. CIHR: Canadian Institute of Health Research, one of the three Canadian research funding agencies, had implemented a proof-of-principle 'POP' program to allow health related inventions to be commercialized with stepwise grants up to $350,000, equivalent to the i2i NSERC program in science and engineering.

to supplement and solidify such grant applications. For instance, the Western Innovation Fund (WIF) was endowed with $300,000 per year aimed at helping at least 10 projects annually. The WIF fund, administered through an external committee formed of industry experienced representatives, is still in existence today.

Benefits

C4's virtual operating model was very cost-effective since it didn't have rental or administrative costs and by locating the personnel in the member institution TTOs, and it eliminated the conflict and tension between the MiTTO and the member institution TTOs that other MiTTOs have had to deal with.

Outcome

This unique C4 program was renewed once and, while very successful, was later discontinued due to Ontario budget restrictions around 2010. However, it had significant long-term impacts. It:

- Established a long-lasting sense of community among the C4 members;
- Reinforced the C4 TTOs and their impact by increasing their professional resources by about 25 percent;
- Made them considerably more successful in winning federal proof of concept funding; and
- Improved the overall competency of those offices by sharing best practices. ■

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Alexandre Navarre has had a career dedicated to innovation in industry with Dow Chemicals, with the Canadian Federal Government, and with university tech transfer offices as director (McGill and Western Ontario) and as founder and CEO of one of the French SATTs. He was also Quebec manager of the Canadian Science and Engineering Research Council of Canada (NSERC), a founding member of ACCT Canada and a long-time chair of the Development Committee of the Canadian AUTM section. Actively retired, he currently consults on innovation and IP policy issues and writes articles on innovation challenges.

Tech Transfer In An Inventor-Owned Ecosystem—Innovation Office West And Innovation Office Fyrklövern In Sweden

*By Henric Rhedin**

History of Tech Transfer in Sweden

The legal framework for Swedish technology transfer dates back to 1949 when the government introduced the legal regulation regarding ownership of university-based intellectual property in Sweden. The teacher's exemption was introduced, which stated that if you are a teacher at a Swedish university, you have the ownership of patentable inventions in your legal capacity as a private individual. The reason behind this was to prevent commercial interests from influencing the teachers to spread their knowledge to the students. The teachers should not have obligations of secrecy, etc.; since the government has invested in their knowledge, it should be freely available (Sweden has free university education). In the following decades the teacher's exemption developed into a researcher's privilege following the reasoning that all university teachers are also researchers and completely disregarding the logical reason behind the legal construction.

It should be noted that although many nations had professor's privilege models most, if not all, have abandoned this type of legislation and Sweden is the only country with a strict legal regime remaining. Nations that recently abandoned the model include Germany, Denmark, Norway and Finland. Italy still has some remaining features left but not in the same way as Sweden. Many other countries such as UK and U.S. have never had a teacher's exemption/professor's privilege model.

In the light of U.S. and UK developments in particular, for example the Bayh-Dole Act in the U.S. and British Technology Group in the UK, a more innovation-oriented interest started to grow in the mid-1980s. Examples of early initiatives were initiation of foundations for the purposes of commercial activities that universities were not allowed by law to undertake themselves and were not funded for. In some cases, fundraising provided capital to sustain organizations such as Chalmers Industrial Technologies, initiated in 1984 by Chalmers University of Technology. Other examples were funded by project grant funding or other sources of available funding.

The next structural step in the university-based innovations system came in 1994 when most larger Swedish universities were awarded governance structures (*i.e.*, holding companies) that the universities governed but did not own (in the sense that transactions between the university and its holding company was severely restricted, in principle forbidden). The universities are governed by the Ministry of Education while the holding companies are owned by the Ministry of Industry, adding some coordination challenges to the equation.

The holding companies came to focus on start-up creation since the IP ownership model requires the holding company to negotiate with private individuals rather than assisting universities in utilization. The holding company model developed into taking equity for helping researchers to create start-ups but strictly on a voluntary basis.

Holding companies were established at the larger Swedish universities such as Karolinska Institute, Lund University and Uppsala University. The universities were still not funded for utilization. The Swedish governmental funding is strictly separating education from research funding and activities. In the early stages of technology transfer, the absence of funding for utilization created challenges for universities no matter how eager they were to participate in technology transfer. The larger universities such as Lund, Uppsala, Gothenburg, Chalmers, and Karolinska initiated in the years around the millennium university-based offices of technology transfer using a variety of funding, sometimes project funding, sometimes donations, mostly focusing on the stimulation of utilization and creating deal flow to the holding companies. Sometimes those initiatives were a continuation of the activities started some 20 years earlier.

Some early initiatives at, for example, Chalmers included trying to establish a licensing model with university IP portfolios, but the early attempts were not sustained sufficiently, and the licensing models have not yet been established at international standard scale anywhere in Sweden. Some people, including the au-

*Dr Rhedin contributed to this paper in his personal capacity. The views expressed here are his own and do not necessarily represent the views of his employer.

thor, argues that this is largely due to the IP ownership paradigm that essentially prohibits professional IPR management at Swedish universities.

Additional support for innovation activities was established in the form of proof-of-concept (PoC) funding in the form of grants awarded to the universities. Several programs were initiated around 2005, when smaller grants, on the order of $20,000 to larger grants, up to $500,000, could be applied for. The use of those grants was traditional PoC activities, although in the initial years the center of gravity was on demonstrators rather than commercially oriented activities.

In 2009 the Swedish government initiated funding to establish innovation offices at eight sites. Seven were managed at single universities and one was a collaboration between four smaller universities, the "four clover innovation office." See below for details. In the assignment, the government included coordination of and support to other universities and university colleges in the region. Chalmers University of Technology was one of the selected universities, located in Gothenburg on the west coast of Sweden.

In the light of the professor's privilege and the existence of holding companies the innovation offices business model became to support researchers' efforts to utilize their research and to stimulate utilization. The initial focus on commercial utilization through the holding companies/start-up model later broadened to more general support but licensing is still not existing to any larger extent.

Innovation Office West

A regional collaboration, Innovation Office West, was initiated between Chalmers, Gothenburg University, University West, University of Borås, University of Skövde, Halmstad University, Jönköping University and Swedish University of Agricultural Sciences at Skara. This region includes roughly two million people.

Innovation Office West (IOW), one of the first eight innovation offices initiated in 2009, built on a series of collaboration agreements with the partner universities but also relied on the fact that funding was channeled through Chalmers, both for innovation capacity building activities and later stage PoC funding, although Gothenburg University had direct funding as well in later stages. The innovation offices were funded on an annual basis initially on the order of $500,000 to $700,000 each (for all eight offices, not per university in the support structure) and IOW got $700,000. Although the funding model has changed, the funding has been largely at the same level.

The business model of Innovation Office West built on local support capacity at the partners, with dedicated staff for innovation support activities employed by the partner universities. Government funding channeled via Innovation Office West was made available to this structure to ensure that local priorities, circumstances and strategies could be met. There is still no substantial licensing activities and some partners, but not all, have their own holding companies. Chalmers Holding Company accepts start-ups from any activity that fits its portfolio, while Gothenburg University Holding Company requires a Gothenburg University connection. The holding company at Chalmers could thus serve as a partner for the universities that didn't have this opportunity. The holding company does not have funding from the university and no equity model is necessary since the stakeholders are the private persons that also have a university position.

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The activities for all partners have focused on

i) Advice;
ii) Education of researchers;
iii) Development of common tools and practices;
iv) PoC; and
v) Asset management support (for example, actively assisting in what assets are worth protecting, how to manage databases, contractual support, etc.)

It should be noted that the universities see it as their task to promote and stimulate innovation and utilization of research but take no commercial part in the activities. The holding companies act as separate parties, with a traditional incubator approach where some funding is made available, and office space and business advice is traded for equity. This is on a strictly voluntary basis and many researchers start their spinout companies outside of this structure.

Innovation Office West, like all innovation offices, has also managed PoC funding as a part of the government support. PoC funding has been supplied for early verification activities where researchers can apply for funding in increments of up to $50,000. The funding is given as a grant after application from researchers but the money is paid to the university. The innovation office, in collaboration with the holding companies, reviews proposals from individual researchers and research teams.

The PoC funding is thus decided by the university or by the university in collaboration with the holding company, and the funding is paid to the university but managed by the researcher who applied for the funding. The researchers will own any patentable inventions that emerge. In principle there should be no company formed at this stage, but in practice this has been the case.

Innovation Office West has been successful in certain aspects but has also struggled with certain challenges. The partners have recognized the value of collaboration, in particular for tools and resources, where the strength of the team in terms of competencies available has been a key factor. The smaller universities generally had very little manpower, typically one to three persons per office, which puts severe restrictions on their potential. Also, the two larger organizations, Chalmers and Gothenburg University, have, at least initially, complemented each other, where for example Gothenburg University had an early focus on legal aspects while Chalmers has been more focused on company creation and start-up funding. A major issue has been the long-term build-up of local resources at the partners, where local partners argue for their own resources rather than relying on the other organizations.

There has been an increased deal flow during the more than 10 years of operation but official numbers are not available on an aggregated level and not all partners have used the same metrics consistently. The innovation offices were evaluated once in 2014 where, for example, deal flow was reported. The evaluators found that the collaboration model and support to the smaller partners worked well.

Successful start-ups originating from the system are, for example, Oxeon with roughly 40 employees and Cellink (later BICO Group) with hundreds of employees.

Innovation Office Fyrklövern

The four universities that collaboratively were awarded a joint innovation office—Karlstad University, Linneaus University, Mid Sweden University and Örebro University—are all relatively newly founded universities, a result of Swedish higher education politics in the early 1990s. The concept built on complementarity in faculties, all being smaller in terms of research resources, in particular in comparison to older more established universities, despite the universities being geographically separated, particularly Linnaeus. Two of the participating universities, Mid Sweden and Linneaus have also two campuses in separate cities each, adding complexity to the geographical challenge.

The Innovation Office Fyrklövern (Swedish for "Four Clover") was one of the initially founded innovation offices in 2009 and has been very successful in finding good ways of collaborating and supporting its members. The model builds on a local presence at the six locations supported by strong collaborative leadership in developing tools, sharing practices, and ascertaining that innovation advisors know each other personally to reduce barriers. The four universities have their own internal structures but centralization is under their four respective organizations, not at the level of the collaboration.

In the same way as described for IOW, the start-up model dominates for commercially oriented activities where holding companies are tools in the same way and will have equity models.

One key ingredient is an alignment of university management that has been a focus of the four partners. The presidents of the four universities have actively participated in the work of building the innovation office capacity. A prominent example of this is study trips to other countries, where the university presidents have personally joined in innovation office staff visits to universities in, for example, Scotland, Denmark and Belgium to be educated in utilization and knowledge exchange.

In the 2014 evaluation the evaluators praised the top management engagement and gave very high honors to the establishment of and maintenance of innovation support, partly in light of the geographical challenges and relative scarce resources. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4254279*.

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Serbian Innovation Fund Technology Transfer Facility

By John A. Fraser

History

Serbia was one of the first countries in the Balkans region to embrace the "innovation imperative"—the notion that successful participation in the global knowledge economy requires the ability to adapt and advance new technological and research capabilities that involve public and private collaboration.

Operational since 2011, the Serbian Innovation Fund (IF) has been a pioneering effort to operationalize and institutionalize this imperative—first by increasing the capacity of SMEs and startups and then by making resources available for their growth. It is part of a broader innovation strategy now under development.

The first programs introduced were the IF Mini/Matching finance programs for corporate product financing and the IF Technology Transfer Facility (TTF). See *https://www.inovacionifond.rs/programs/technology-transfer-facility-program*. A broader range of programs is now in place.

Organization

The TTF offered services and financing non-exclusively to the four largest public universities in Serbia to create or accelerate their technology transfer activities:

- University of Belgrade;
- University of Novi Sad;
- University of Kragujevac; and
- University of Nis.

The degree to which the services were used depended partially on whether the university had an existing, staffed TTO. Other research institutions joined later.

The initial team consisted of a TTF coordinator based in Belgrade, a TTF business liaison officer resident in Zagreb, Croatia and John Fraser, who was resident in the U.S. and travelled to Serbia every three months for three to four years to build momentum in the program.

Member Organizations

- The University of Belgrade had an operational TTO and welcomed the help of the TTF;
- The University of Novi Sad had a unique model of responding to industrial needs—the Industry would approach a researcher who would create a start-up company and hire students to address the problem. The start-up would contract directly with industry. University resources were made available to the small company to help. Novi Sad made somewhat limited uses of the TTF services. There were two older such start-ups which had survived and grown to employ hundreds of people in Novi Sad;
- At both the University of Kragujevac and the University of Nis other significant priorities delayed the TTF.

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Original Sources of Funding

Serbia was able to access EU pre-accession funding upon its application to become a member state. Part of the funding was for an Innovation Initiative, and thus the Innovation Fund was created as an independent, not-for-profit organization governed by its own board and ultimately reporting to the Minister of Science. The EU initially contracted with the World Bank to manage the EU funding and the Innovation Fund program. The Serbian government provided some additional funding.

Business Model

The TTF deployed its Commercialization Services (see *https://www.inovacionifond.rs/programs/technology-transfer-facility-program*) non-exclusively. These services were used by the university TTOs to accelerate their activities. On a competitive basis financial support up to €50,000 / project to finance proof of concept, patenting, market studies, etc., was also made available via the TTF. After the initial three-year pilot program of the TTF, the IF staff became Serbian government employees.

Early on there was limited interest in TTF assistance for startup company formation.

The Pluses and Minuses of the Model

- The TTF services are free to the university and any financial support was via grant with no payback terms. No royalties accrued to TTF.
- The conflicts between the university TTO and the TTF services were minimized though joint efforts of all involved parties.

- The stated purpose was to help the institutional participants build up on-campus university TTO services.

Biggest Hits

There were some significant and interesting licenses signed in the first three years of the TTF program:

- A probiotic feed fluid was created at the IMGGE Institute to replace antibiotics for young goats and pigs. Antibiotic replacement is an active EU policy. The fluids are based on bacterial strains gathered over decades by IMGGE at the University of Belgrade and have been extensively field tested. A spinout company (Invetlab) was licensed and production was scaled up with sales across Serbia. A Swiss firm (Phytonet) has acquired rights outside the Balkan region where further sales are being tested.
- A color catcher ball used in laundries to capture loose dye was licensed to a spinout company (DrKnight.eu) from the University of Belgrade.
- A variety of cabbage with nine percent sugar content was optioned to Syngenta which is running field trials. The higher sugar content makes better sauerkraut.

Current Status

The TTF services are available on an ongoing basis, but most institutions take advantage of the TTF funding, not the other services offered. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4254285*.

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The Third Iteration Of Tech Transfer In Chile—The Technology Transfer Hubs

By Ignacio Merino, Anil Sadarangani and John A. Fraser

History

In the early 2000s, the Corporacion de Fomentada de la Produccion de Chile or the Production Development Corporation financed more than 18 Incubators across the country on a competitive basis for an initial five years. Only a few were renewed afterwards. The lesson learned was that a local critical mass of people and opportunities was a necessary pre-condition for sustained, successful entrepreneurial activities such as an incubator or technology transfer offices for each university, etc.

In 2006, the Corporacion de Fomentada de la Produccion de Chile (CORFO) financed a visit by senior AUTM professionals to 20 Chilean universities over two weeks to discuss commercialization and IP policies. It was organized by NEOS Inc.

In July 2011, AUTM and CORFO arranged a series of workshops over 10 days in Santiago where AUTM experts taught a series of intermediate and advanced commercialization courses to classes of 15 or so Chilean TT professionals.

From 2011 through 2013, CORFO financed a contract to have six AUTM experts work with 21 Chilean universities to create or update for each a technology transfer office, a five-year strategic plan, and a one-year operating plan. In addition, a Benchmark Study of Chilean University TT Metrics was conducted.

However, no additional funding was supplied to support these TTOs.

Sources of Funding

In 2010, AUTM had recommended to CORFO that the scale of Chilean universities' research activities argued for a regional approach, rather than each university having its own TTO.

Eventually, in response to many requests for individual TTO financing, CORFO came round to AUTM's viewpoint and created a $28 million competition for "Hubs" to operate for an initial five-year period. Each application had to be centered on a major university TTO and include several smaller university TTOs. Each TTO had to join one of the Hub applications to become eligible.

Eventually, three Hubs were formed by the 25 universities and research centers that participated (HubTec; Hub APTA and KnowHub). Each then submitted its business plan and detailed financing needs. The initial distribution of the universities and research centers in each Hub was based on the current R&D funding and primary areas of research. The member universities were required to fund their TTO's on-campus activities necessary to support their interactions with their Hub.

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Each submission was evaluated, and financing was distributed as depicted in Table 1.

The Hubs submitted revised business plans reflecting the amount awarded. The five-year contracts were effective November 2016 through November 2021 (since extended to April 2023 because of the pandemic.)

The Hubs initially were to specialize in selected market areas (health, engineering and agritech), but since each Hub had multiple university members, a wide range of expertise was needed at each Hub, so specialization by each Hub was abandoned.

All major universities belong to a Hub, and very few universities do not yet belong to one.

Business Model (Revenue Sharing)

The initially proposed model for the Hubs was based on two main concepts:

1. An "on-campus/off-campus" model, where
   - The TTOs focused on the "on-campus" and Chilean activities, and

Table 1: CORFO-Supported HUBs And Funding ($million)

HUB	CORFO Financing To HUB	Internal University Financing To TTO	Total
HUBTEC	7.8	1.1	8.9
HubAPTA	7.4	1.0	8.4
KnowHub	6.9	1.0	7.9

- The Hubs focused on the "off-campus" and international activities.

2. The Hubs' initial mandate was to internationalize the universities' and institutes' research results.

The business model was that any submitted invention disclosure would be evaluated by the Hub and, if the Hub was interested in taking it on, it would be legally assigned to the Hub for Hub resources to be used for proof-of-concept funding and marketing with any eventual royalties split between the Hub and the inventing university.

As discussed below, changes to these initial expectations were necessary based on actual experience.

During 2018, the Hubs started formal operations with dedicated executive teams.

Each Hub offered its services on a non-exclusive basis to the member TTOs. In other words, any member institution could select which disclosures it wished to submit to its Hub. Since the universities wanted their own TTOs to be financed directly by CORFO, many were reluctant to submit disclosures until each Hub had "proven its worth," so a slow start was guaranteed. Initially, the Hubs were only sent disclosures that the TTO had tried and failed to commercialize. The internal TTOs do the work necessary to interface with a Hub—scouting, researcher relationships, IP strategy, and seed funding (public grants), etc.

The Pluses and Minuses of the Model

The Hub governance was by member representatives that formed a board of directors, together with annual assemblies of the members' TTO staffs to discuss and resolve issues. The reluctance of the TTOs to submit disclosures has decreased over time. In 2017-18, during the first year of operations, the Hubs realized that the technologies provided by its universities didn't have the TRL maturity rating to be marketed internationally, so the Hubs had to work very closely with their TTOs in every stage of the technology projects to prepare them for commercialization.

KnowHub and Hub APTA opened their operations to all parties in the Chilean ecosystem (not only their university partners) and focused mainly on supporting science-based start-ups. HUBTEC focused only on services to its partners, mainly supporting early-stage technologies through its technology maturation program, building relationships with industry through its university-industry program and assisting spinoffs from their university partners through its acceleration program.

A big plus was that HUBTEC made all the member TTOs connect, know each other, collaborate, share best practices, and successfully sought RTTP certification which strongly supported international recognition of technology transfer professionals.

A Few of the Biggest Hits

Earthquake-Resistant Devices for Chile's At-Risk Wine Industry.

Pontificia Universidad Católica de Chile

The Chilean wine industry lost an estimated 125 million liters of wine due to damaged wine tanks following the February 2010 earthquake. Natural disasters such as these are an ever-present hazard faced by all production sectors in countries prone to seismic activity.

To combat the risks, a team of researchers at Pontificia Universidad Católica de Chile in Santiago developed three seismic isolation and dissipation technologies for use in wine storage vats. A set of flexible devices are installed on the struts holding up the liquid containers. These devices have been designed to protect storage structures from horizontal and vertical ground displacement triggered by earthquakes. This system can be scaled to the size and weight of the tank requiring support and it is an effective solution for protecting all types of industrial equipment. Tersainox S.A., the stainless-steel manufacturer that licensed the technology, is exploring international markets, including the wine industry in California.

Dialect Platform to Assess and improve K-12 Reading Skills.

Universidad de los Andes

International standardized test results show Chilean reading skills are still poor, with more than 60 percent of K-12 students failing to reach a baseline level of proficiency. In an effort to change this, in 2012 researchers from the Faculty of Education in Universidad de los Andes in Santiago, Chile, Drs. Pelusa Orellana and Carolina Melo, developed Dialect, a platform program to help assess Spanish reading skills in students from kindergarten to twelfth grade. The program consists of automated tests and teaching strategies. The tests, a central part of the program and platform, provide an instant achievement report, which contains an analysis of the student's performances and suggestions of actions that may be taken to help them develop each skill. The student's teacher receives the information to formulate a specific intervention plan throughout the school year. Teachers have recognized that personalized evaluations and strategies to bolster a student's deficient areas help them make better use of teaching time.

HUBTEC supported its customization during COVID in order to perform the test virtually and is now collaborating in taking Dialect to other Spanish speaking countries in LATAM.

In addition to the above stories, an additional 40

Chilean Stories of 'Science with Impact' can be found at: *https://cienciaconimpacto.cl/*.

HUBTEC also runs a successful pilot program of reaching out to innovative Chilean companies to identify how to help them resolve internal economic/technical problems using connections with the Chilean academic members and others.

Current Status

In 2021, the CORFO HUB program was moved to the new Ministry of Science, Knowledge, Technology and Innovation through its National Research and Development Agency (ANID) and discussions begun to consider whether to hold a competition to renew the government financing. In this process, the Hubs started a more formal collaboration process amongst themselves.

During August 2022, ANID launched its call for a two-year financing continuity program in order to consider and design the best way in which the Hubs can implement a sustainability model and extend the program. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4255216*.

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Ignacio Merino has 18 years of experience in entrepreneurship, innovation, investment and technology development. He has cofounded and managed several startups, with operations in Chile, Latin America, Australia and New Zealand and has been responsible for multidisciplinary teams, developing and launching new products and services, and leading the design and implementation of development, marketing and commercial strategies for several technologies in mobile telecommunication services, software/IT, energy, and food/nutrition industries. He has extensive investment and VC experience.

Anil Sadarangani for the past four years has been Director of Innovation at the Universidad de los Andes, where he has been leading the institutional design and strategy of technology transfer and science-based innovation. He has also started an incubator program for students and alumni, and he is the director of a new master's program in sustainable innovation. He is a member of the board of directors of several spin-offs and of UANDES initiatives such as Dia +, Pregnóstica and HubTec Chile. In 2010, while studying for his MBA in the USA, he founded a biotechnology venture that currently has a drug in clinical development.

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Puerto Rico Science, Technology And Research Trust—An Island-Wide TTO In The Midst Of A Global Bioscience Manufacturing Cluster

By David L. Gulley and Carlos Báez

Background

Puerto Rico is well known for its biopharmaceutical industry with 11 of the 20 top global biopharmaceutical companies housed in 31 manufacturing sites in addition to 54 medical device plants on the Island.[1] This cluster produces one-third of Puerto Rico's GDP and one-third of the tax revenue, making Puerto Rico the largest exporter of biopharmaceuticals in the U.S. Universities in Puerto Rico produce the human capital capable of supporting the operations of the local biopharmaceutical industry by graduating scientists and engineers at every level and discipline. However, there are disconnects and gaps in the innovation ecosystem.

Scientific research in Puerto Rico universities is funded in part by U.S. federal agencies such as the National Science Foundation (NSF) and the National Institutes of Health (NIH). According to NSF's most recent data, FY2020 R&D expenditures in Puerto Rico exceeded $111 million, with 68 percent of that, or almost $76 million, coming from U.S. federal agencies.[2] The investment in research has translated into a healthy rate of peer-reviewed scientific literature output. Suárez-Balseiro *et al*. (2020) analyzed the scientific activity in Puerto Rico using bibliometric methods and found that from 2000 to 2015 Puerto Rico produced a total of 18,031 publications going from 666 publications in 2000 to 1,397 in 2015.[3] Despite this, the establishment of technology transfer offices, which hold a pivotal role in taking scientific discoveries to the private sector, did not match the level of scientific output, and thus a significant fraction of discoveries that were being published were not being actively transferred to the market for the benefit of the public.

Recent research reveals that in 2014, when compared against the average of its peers, the TTO at the University of Puerto Rico (UPR) was understaffed (2 vs. 6 FTEs) and underfinanced ($370,500 vs. $1,597,122) resulting in significantly fewer invention disclosures (13 vs. 60), patent applications (14 vs. 65), issued patents (8 vs. 18), licenses (1 vs. 15), start-ups licensed (1 vs. 2.6), and lower income ($0 vs. $3,900,000).[4] This suggested that Puerto Rico universities did not have an adequate supply of resources, tools, and technology management professionals to manage the complex process of shepherding ideas from the lab to the marketplace, as AUTM so eloquently describes the technology transfer profession,[5] and that discoveries in Puerto Rico had a low chance of making it to the market.

To fill this important gap that hampers the realization of the potential of scientific research performed on the Island, the Puerto Rico Science, Technology and Research Trust created the Technology Transfer Office, which, as described below, serves as a regional TTO.

The Puerto Rico Science, Technology and Research Trust

The Puerto Rico Science, Technology and Research Trust (Trust) was created by Puerto Rico's legislature in 2004 (Law number 214-2004) and amended in 2011, 2012, 2017, and 2019, which authorized the Secretary of the Department of Economic Development and Commerce and the President of the University of Puerto Rico to establish the Trust by public deed. The Trust's purpose was to undertake any activity to strengthen scientific research, to make industry innovation viable for the benefit of the economic development of Puerto Rico, and to contribute to the creation and implementation of public policy for scientific research and technology development. Further, the Trust was deeded 70 acres (the "Science City") to manage, operate, and maintain within the Science, Technology and Research District.

1. INDUNIV (Industry University Research Center) 2022 Report *http://www.induniv.org/wp-content/uploads/2022/08/Brochure_Induniv_PuertoRico.pdf.*

2. National Center for Science and Engineering Statistics, Higher Education Research and Development Survey, FY 2020.

3. Suárez-Balseiro, C. A., Maura-Sardó, M., & Holguino-Borda, J. C. (2020). "Análisis bibliométrico de la actividad científica de la Universidad de Puerto Rico durante el periodo 2000-2015." *Revista Interamericana De Bibliotecología*, 43(2), eI5/1—eI5/12. *https://doi.org/10.17533/udea.rib.v43n2eI5.*

4. Walter O. Alomar Jiménez, "Transferencia de tecnología en las universidades: El caso de la Universidad de Puerto Rico," 86 Rev. Jur. UPR 99 (2017).

5. *https://autm.net/AUTM/media/Surveys-Tools/Documents/AUTM_FY2017_Infographic.pdf.*

The Trust's Technology Transfer Office

Article 24 of the 2017 amendment created the Technology Transfer Office (TTO) in order to provide an agile and effective structure to bring scientific and technological discoveries to the public by engaging public and private entities, protecting intellectual property, adhering to respective institutional policies, and ensuring economic benefits align with such policies. The TTO and its university partners cooperate under a set of agreements that recognize each university's ownership of its IP. The relationship is documented under a five-year MOU and implemented through separately executed non-exclusive master agreements:

(1) A Master Option for the TTO to evaluate new disclosures, typically done through the TTO's Inventor Portal, and produce "Screening Reports" that provide a robust evaluation of the disclosure and a set of recommendations for the university. In about two-thirds of the cases, IP protection is recommended and the TTO notifies the university it would like to proceed under

(2) A Master Innovation Management Agreement (MIMAA, for the term of patent rights, and 25 years for all other rights) that authorizes the TTO to provide services for each technology to be managed. Each MIMAA amendment stipulates the percentage of direct costs (*i.e.*, IP protection) to be supported by either party. The university and TTO may share costs equally (and share net revenue at 50 percent) or either party may support 100 percent of direct costs and receive 60 percent of the net revenue. In all cases, the percentage due the inventor per university policy is fully realized before revenue sharing by the parties.

The current university partners (five) and number of campuses (17), which includes four U.S.-accredited medical schools, and the first date of formal cooperation, are:

1. Ponce Medical School Foundation/Ponce Health Sciences University, 2016;
2. University of Puerto Rico (11 campuses), 2018;
3. Ana G. Mendez University (three campuses), 2018;
4. Universidad Central del Caribe, 2019;
5. San Juan Bautista School of Medicine, 2021.

Funding Mechanism

The Trust's annual operating budget includes two direct sources:

(1) A tax on manufacturers operating on the island; and

(2) A share of the excise tax on rum exported from the island.

Puerto Rico's rum production began as a byproduct of the sugar cane industry and now produces more than 80 labels and accounts for about 70 percent of the rum consumed in the U.S. In 2020 the excise tax totaled $471.1 million.[6] The Trust also seeks external funding in the form of grants, cooperative agreements, contracts, and other mechanisms to meet its mandate. The TTO budget, which averages about $1 million annually, is derived from the operating budget and its staff also participate in appropriate external funding initiatives that focus upon lab to market resources.

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TTO Operations

The TTO mission is to "identify, evaluate, protect, market, and transfer the most promising research discoveries from Puerto Rico's universities, institutions, and research institutes to the private sector for commercialization and to benefit the public." Its vision is to "to implement shared risk/shared reward partnerships that deliver best-in-class technology transfer services in order to identify and increase innovation opportunities for Puerto Rico's scientists and researchers, thereby improving Puerto Rico's overall innovation ranking."

The island has only 20 patent attorneys/patent agents registered to practice before the USPTO. Therefore, the TTO established open engagements with seven law firms on the mainland, including some of the largest firms in the U.S., with specializations to ensure a good match with research-based discoveries being disclosed. The shared risk/shared reward model recognizes direct cost reimbursement for patent expenses to the party supporting the costs; inventor revenue-sharing per university policy; and lastly a share of net revenue to the TTO and university proportional to the share of direct cost contributions.

Pluses and Minuses of the Model

The TTO model was designed to be pragmatic, providing expertise and financial resources unavailable on the island and scaling so as to provide opportunities to support all researchers. The most positive aspect for the UPR (the public land-grant university) is that the TTO is authorized to manage patent prosecution, ex-

6. Alcohol Tax and Trade Bureau 2020. Annual Report FY2020.

ecute agreements, and manage finances, avoiding bureaucratic hurdles present in a central office with limited resources trying to work with 11 separate campus administrations. For the smaller private institutions, the most positive aspect is the access to expertise and resources unavailable to them without incurring personnel/operational costs.

The downsides to the model are (1) inconsistent and/or undeveloped policies and practices among the partner universities, and (2) uneven capabilities of professional staff at partner universities. The TTO advises, offers workshops, and provides examples of best-inclass university policies, but decision-making can be slow, staff turnover is high in some, and only two have staff who are dedicated to support technology transfer (UPR and Ponce Medical School Foundation/Ponce Health Sciences University).

Successes

The practice of academic start-ups was generally unknown prior to the founding of the TTO, which has been able to work with its university partners and inventor-researchers to facilitate successful tech transfer. Some examples are:

- The first biotech start-up, MBQ Pharma, located in San Juan, PR, was launched in 2017 based on UPR technology. The company continues its progress, recently being approved by the FDA for Phase I clinical trials for the prevention and removal of pre-existing metastases.
- A second example is Shape Therapeutics, located in Seattle, WA, founded in 2018 to develop next-generation RNA-targeted therapies, including tools such as RNA-editing technology from the UPR. The company raised substantial funding through the Series B round, and continues to develop its pipeline and execute key partnerships.
- A third example, Revive Therapeutics added technology developed at Universidad Central del Caribe (UCC) and St. Jude Children's Research Hospital to their pipeline as part of their strategy focused on the use of medicinal mushrooms, such as *Ganoderma lucidum*, in the treatment of different diseases, including cancer. The company's goal is to advance the research towards IND-enabling studies.

Looking forward, the TTO will continue to target programs and initiatives to assist in building the pipeline, such as EnTRUST, a lab to market accelerator targeting the island's Hispanic-serving institutions, in cooperation with Columbia University and under an NIH NIGMS technology transfer accelerator program, the Southeast XLerator Network, while also building on its internal R&D capabilities such as in the Trust's Center for Tropical Biodiversity and the Caribbean Center for Rising Seas. The TTO's aspirational goal for its partner universities is to perform (in aggregate) at peer standards of U.S. mainland universities, providing best-inclass technology transfer support for the island's scientists and researchers. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4255235*.

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Regional Technology Transfer Mission In India

By Vijay K. Vijayaraghavan

History

Innovation in India has surged, as evidenced by the surge in patent filing over the last decade. Incremental investment in R&D by public research and private enterprises to stay competitive are the driving contributors to growing patent filings. With increased patent filing by public research institutions, their aspiration to transfer technologies to the private sector has evolved over the decade. However, most institutions lacked proficient technology transfer professionals located in independent technology transfer offices. As a result, for several decades, Indian public research results were passed over to a central agency, NRDC, for pursuing technology transfer.

The Department of Biotechnology (DBT), the national body, was instrumental in triggering and nurturing life sciences hubs in the country with funding to public research institutions and private enterprises to commercialize novel technologies. As a path-breaking initiative of DBT, Biotechnology Industry Research Assistance Council (BIRAC) supported enterprises to partner with public institutions to pursue translational research and advance the technologies generated by public institutions for market delivery. Over the past 10 years, BIRAC provided sustained funding for nurturing the partnership, triggering a significant surge in private enterprises pursuing risky, early-stage product development. The synergies of engaging with public research and advancing the early-stage innovations within the innovation ecosystem created clusters of innovation hubs across the country. Several public institutions in these vibrant clusters designated internal professionals to pursue patent filings with the surge in invention disclosures. However, they were less engaged in the technology transfer process.

BIRAC felt the need for establishing technology transfer offices (TTOs) to accomplish value realization for envisioned life sciences innovation for inclusive growth. However, establishing a TTO is a long-term commitment and requires significant investments in resources and people.

BIRAC Creates Regional Technology Transfer Offices

BIRAC, with support from the World Bank, designed a well-funded program for academic bodies to accelerate technology transfer with the creation of regional technology transfer offices (RTTOs). Seven organizations with long years of engagement in advancing public research or private enterprise incubation centers were designated as funding recipients to create the RTTOs. The RTTOs were located within large institutions with commendable pedigrees. In addition, a wide number of institutions (partner institutions) were brought within the ambit of RTTOs to serve their interest in advancing their research results. A professional organization was retained to mentor RTTOs in their launch and accomplish service quality with competent professionals.

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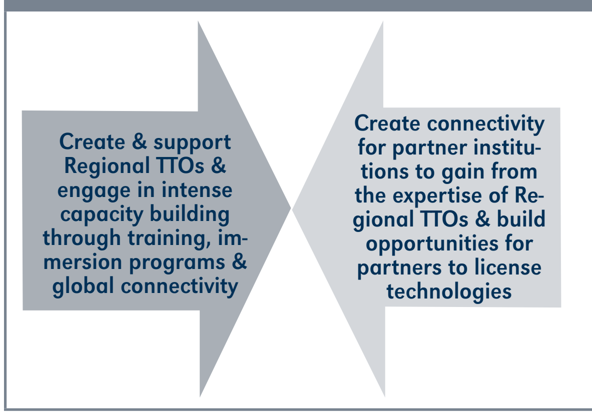
Functions Of The RTTOs



RTTOs engage in a gamut of activities required for advancing inventions to markets. The primary functions of the RTTOs relate to the identification of inventions in partner institutions, patent filing, and technology transfer to third parties or spinouts. Additionally, RTTOs forge corporate linkages for sponsored research opportunities. Finally, six of the seven RTTOs have active incubation programs within their parent institution, with potential engagement in supporting the start-up entities in the technology transfer process.

Structure of RTTO

Each RTTO is structured as a full-fledged technology transfer organization, with six full-time professionals (FTEs) engaged in IP identification, prosecution, IP management, technology marketing, technology transfer, and management of license transactions, with an additional six FTEs for support functions. In addition, access has been provided to modern office management tools and IP management tools to enhance the whole team's efficiency in their engagement process.

Business Model

RTTOs are supported with federal funding for an initial span of three years with the potential of two additional years. Support provided covers the human resource cost, operating costs, and acquisition of productivity tools. RTTOs are expected to gain a critical threshold of revenue in the five years. They will serve beyond their parent entity, engage several other partner entities to enlarge the opportunity and provide critical transaction engagement. Intensive capacity-building initiatives supported relate to international immersion exposure to the professionals engaged by the RTTOs and continuous engagement with partner institutions for providing total solutions to partner institutions in asset creation and technology transfer.

Challenges and Sustainability

The senior professionals engaged in the RTTOs bring varied levels of pre-existing exposure to technology transfer. Some of them have significant opportunities to generate technology transfer for their parent institutions that may provide the core of opportunity. However, the RTTOs are to be assessed for their performance by their success in-licensing the technologies of their partner institutions. The time taken to establish trust and confidence in the partner institutions and the extent of reliance of partner institutions on RTTOs for the IP and technology transfer functions will determine the success and sustainability of RTTOs. If initial success is established, the potential to bring in more partners in the medium term is enormous as more and more institutions aspire to secure value for their innovations through technology transfer within the geographical remit of the RTTOs. However, the attrition of partners is also possible in the medium term, as some may aspire to set up an internal TTO, triggered by encouraging technology transfer opportunities they have witnessed in partnership with the RTTOs. Since India does not have a legislative framework for technology transfer, institutional engagement is driven by the institutional policy of partner institutions. The heterogeneous policy of partner institutions may require RTTOs to engage in tailor-made relationships.

The RTTOs came into existence in March 2020, and some of them have already gained significant ground with partner institutions. Some have a revenue stream from transaction advisory activities while pursuing full-fledged licensing transactions that may trigger revenues in 2022 and on. However, the sustained support from BIRAC will provide a solid ability for the RTTOs to establish their credence and engage deeply with partner institutions that may bring sustainability in the long term. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4255240*.

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The Emergence Of University-Based Innovation And Organized Systems For Its Transfer And Utilization

By Ashley J. Stevens

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This special issue focuses specifically on independent, third-party, multi-institutional tech transfer organizations (MiTTOs), because MiTTOs are frequently the first step in establishing tech transfer from university labs in an industrial ecosystem. This special issue has reviewed MiTTOs in 16 countries, including countries with major university research ecosystems such as Australia, Canada, France, Germany, Japan, Spain, the U.K. and the U.S. One of the questions that we answer in this special issue is: "When was the modern system of the formal, legal transfer of university-based innovation created?" And most importantly, how and with what purpose?

The study shows that there is no single global answer. It emerged at different times in different countries. It first emerged in the U.S. in the early years of the 20th Century, spread only slowly round the world and is still spreading into emerging economies.

Government—national or local—frequently, but not invariably, has driven the development of tech transfer, wanting to see the economic benefits of innovation. Tech transfer has generally been a not-for-profit activity, but there were three, ultimately unsuccessful, attempts to make it a for-profit activity. That said, at least two not-for-profit MiTTOs generated very large financial returns.

Equally, there was no single organizational driving mechanism. In several ecosystems—Canada, Chile, France, the U.K. and the U.S.—a national TTO serving the entire country launched systematic tech transfer. In others—Germany, South Africa—a multi-campus, national research organization was the first tech transfer practitioner, while in others—Australia—tech transfer was initiated by a far-sighted university that was a long way ahead of its time.

I thank the outstanding group of collaborating authors of the different articles in this special issue, whose observations and accounts provided the input to this analysis: José Manuel Pérez Arce, Carlos Báez, Jaci Barnett, Catalina Bay-Schmith Cortés, Tim Boyle, Brett Cusker, Anne-Christine Fiksdal, John Fraser, John Grace, David Gulley, David Henderson, Tom Hockaday, Kosuke Kato, Ignacio Merino, Alex Navarre, Lasse Olsen, Jorun Pedersen, Henric Rhedin, Santiago Romo, Anil Sadarangani, Andy Sierakowski, Adrian Sigrist, Christian Stein, Koichi Sumikura, Randi Elisabeth Taxt, M. Carme Verdaguer, Vijay Vijayaraghavan and Bram Wijlands.

1. What Do We Mean by Technology Transfer?

Throughout this special issue, we use the term "*tech transfer*" to mean the formal transfer of rights to intellectual property (IP) from a generating entity, normally a university or other not-for-profit performer of research, to a user of those rights, normally a company, through a formal legal agreement, normally a license agreement or assignment.

We therefore exclude informal, non-exclusive, transfers of technology through vehicles such as publications, lectures, hiring of graduate students, consulting, etc., although these transfers are significant, have a long history and considerably predate formal legal mechanisms. The pioneering discoveries of Wilhelm Röntgen in X-rays and Pierre and Marie Curie in radioactivity rapidly entered clinical application based on their publications alone and without IP protection. By contrast the electric arc (University of Oslo), insulin (University of Toronto) and vitamin D (University of Wisconsin) were commercialized through IP and formal legal transfer mechanisms.

Particularly in Europe, some of these informal transfer mechanisms are encompassed in broader measures of transfer, known as knowledge transfer, but in this discussion, we limit our discussion to formal, legal transfers.

One of the consequences of this definition is that it is important to have well-understood rules to determine who owns a particular piece of IP, because only the owner of that IP can transfer some or all of the rights to it to another entity that wishes to develop the IP.

As will become clear in this article, changes in the ownership paradigm have frequently been prerequisites for, and have driven, the emergence of tech transfer ecosystems.

2. What Do We Mean by a Technology Transfer Office (TTO)?

A TTO is the office, either within an institution or, as with the organizations discussed in this special issue, outside the institution, that has the responsibility for transferring rights to that institution's IP. In most institutions, this responsibility finishes up being housed in a specialized office with a name that includes words like "licensing" or "technology transfer" or "technology development," etc., but at the outset the responsibility may be given to an individual who is housed in the office of sponsored programs, the office of general counsel, etc.

I use the abbreviation TTO for such organizations throughout this article.

3. How Do We Define When Tech Transfer Starts in a Country?

The commonly accepted definition of when an institution starts a formal program of tech transfer is when that institution assigns an individual to work on tech transfer matters for at least 50 percent of their time, *i.e.*, the institution is assigning 0.5 FTE to tech transfer. This is the definition that AUTM uses in its Annual Licensing Activity Survey in the U.S., and this definition has been used by other surveys.

However, there is no generally accepted definition as to when tech transfer starts in a country as opposed to at an individual institution within that country. Reading the historical accounts of different countries elsewhere in this special issue suggests the following two milestones as potential candidates for when tech transfer started in that country:

1. When the first successful transfer of an academic technology occurred in that country; and
2. When the first organization was established in that country whose mission it was to transfer academic technologies to industry.

In the three countries that pioneered formal tech transfer—in chronological order, the U.S., Canada and the U.K.—there were different relationships between the timing of these two milestones.

The oldest example of a formal, IP-based transfer of an academic technology in this special issue is documented by Taxt *et al*. in Norway, where Kristian Birkeland immediately patented his discovery of the electric arc in 1903 and used it to found Norsk Hydro. This was 10 years before Cotrell patented the electrostatic precipitator in the U.S. However, a tech transfer ecosystem did not develop in Norway for another 80 years.

- **Unites States**

The second country to formally transfer an academic technology through a legal agreement, as we have defined it above, was the U.S., where two events coincided in 1912:

- The development of an important technology, the University of California's (UC) electrostatic precipitator technology, which
- Created the need for someone to manage the transfer commercially.

This collision resulted in the creation of the Research Corporation (RC), which acted as an independent, third-party TTO for UC and managed the university's IP. It was the first TTO serving an individual institution though it was not formally affiliated with it in any way. RC was subsequently given additional IP to manage, and 25 years after its inception, it started managing technology transfer for other universities.

The second successful transfer, vitamin D by the University of Wisconsin in 1926, resulted in the creation of the Wisconsin Alumni Research Foundation (WARF), an independent foundation that was the first TTO closely affiliated with an individual university.

- **Canada**

In both Canada and the U.K., the first successful transfer of an academic technology preceded the establishment of the first TTO by a number of years.

Canada was the third country to successfully transfer an academic technology, with the successful transfer of the manufacture and use of insulin by the University of Toronto in 1923. Insulin was discovered by two medical doctors, Frederick Banting and J.J.R. Macleod and two research scientists, Charles Best and James Collip.[1]

The transfer was managed by an ad hoc committee, the Insulin Committee, which consisted of several of the discoverers, a number of high-level University of Toronto administrators and some senior individuals from industry who sat on the University of Toronto's Board.

The University of Toronto used the patents:

a. To control the quality of insulin produced by different companies; and
b. To make insulin available at low prices by licensing multiple companies non-exclusively.

The Insulin Committee managed the commercialization competently, with Eli Lilly having exclusive rights for a 12-month period in the U.S., Central and South America and paying a 5 percent royalty. Other U.S. companies subsequently received non-exclusive licenses at rates no more favorable than Lilly's. Canadian rights were retained by the university's wholly

1. See, for example, *The Discovery of Insulin*, Michael Bliss.

owned biologics company, Connaught Laboratories, which sold insulin in Canada (the University sold Connaught for $25 million in 1972). The University of Toronto assigned British and British Empire rights to the British Medical Research Council and authorized Nordisk Insulin Laboratory to be set up as a non-profit manufacturer and distributor in Copenhagen.

In the 1930s, the University of Toronto received $180,000 per year in royalties from insulin, a considerable sum at the time, and in total received $8 million between 1921 and 1967.

Perhaps inspired by the University of Toronto's success with insulin, the National Research Council of Canada (NRC) established patent management committees in all of its laboratories and by 1931 was receiving and evaluating up to 130 invention disclosures a year.

In 1947, Canadian Patents and Development Limited was established by NRC and eventually grew to manage tech transfer for all of Canada (national laboratories and a number of universities), including inheriting a major technology portfolio transferred from Germany as part of its WWII war reparations.

- **U.K.**

In the U.K., as discussed further below, the first successful transfer of an academic technology, Oxford's sugar beet drying technology, occurred in 1926, but the technology turned out to be fraudulent. This set back the emergence of tech transfer by individual institutions in the U.K. by decades.

The next successful transfer in the U.K., penicillin in 1944, was mismanaged by Oxford University and the MRC with significant negative economic consequences for both Oxford and the U.K., resulting in the demand for a commercially competent organization to manage such transfers in the future. In response, the National Research Development Corporation (NRDC) was set up in 1949 and served to transfer British academic and government laboratory technologies for 40 years, though its name was changed to the British Technology Group (BTG) after it was merged with the National Enterprise Board in 1981.

- **Germany**

As Stein describes elsewhere in this special issue, Germany was an early adopter of tech transfer, driven by the Fraunhofer organization's creation of its tech transfer office in 1955. Fraunhofer is a unique not-for-profit, multi-campus research organization dedicated to applied as opposed to basic research, so its early implementation of tech transfer is not surprising.

Another major research German organization, the Max Planck Society, started its TTO in 1970.

These developments took place while Germany operated under a Professor's Privilege paradigm. This was changed in 1999, and in 2000 the German government decided to auction UMTS-frequencies for 3G wireless networks to the highest bidder and received billions of Euros. A part of these profits was invested in pushing the boundaries of innovation. The government was convinced that it was losing traction in the international competition of innovation. One of the origins of this was based on the fact that, though German science was world class, translating those results into innovative products and services just did not seem to work that successfully. The solution was to provide Germany with a network of central technology transfer offices for every state, the Patentverwertungsagenturen (PVAs). So, by around 2000, 25 technology transfer companies were founded, of which 18 were MiTTOs with the mission of providing IP protection services, scouting and commercial exploitation to all German universities. Some of them did well, others did not. Their development depended very much on the individual structure, political/state support, and professional development capacity. Wijlands discusses the PVAs in detail.

- **Australia**

The fifth country to start to practice tech transfer was Australia in 1959.

Australia implemented tech transfer in a totally different way from the previous four countries. While the U.S., Canada, the U.K. and Germany were all utilizing national tech transfer offices (NTTOs) covering the entire country, the University of New South Wales set up a wholly owned non-profit company, Unisearch, in 1959. Unisearch's role was to engage with the private sector broadly and to generate revenues from consultancy and commercial training as well as tech transfer for that institution. The first two of these activities were low risk and immediately profitable, in stark contrast to formal tech transfer, which Unisearch soon found was much more costly, had an uncertain probability of success for any individual technology, and a long timeline to a financial return for those technologies that were successful.

UNSW was considerably ahead of its time, and other Australian universities did not follow UNSW's lead for 12 years.

Unisearch was a true pioneer in several respects:

- Being structured as a company wholly owned by and serving only UNSW;
- Its broad mandate—consulting, education and tech transfer—is not dissimilar to the current European concept of knowledge transfer; and
- It's noteworthy that the three fundamental challenges of tech transfer identified by Unisearch early in the development of the profession remain

fundamental issues wherever tech transfer is practiced to this day:

- o It has high upfront costs;
- o The probability of success for any individual technology is uncertain; and
- o It has a long timeline to a financial return;

- **France**

France was the next country to implement an entity to formally transfer academic technologies with the establishment of ANVAR in 1967 as an NTTO serving all of France. It had different iterations that were implemented later, being initially the result of overall SME development and later having a mandate of economic impact, a move that eventually led to the network of SATTs.

- **The Worldwide Roll-Out**

After France there was a hiatus in additional countries implementing tech transfer until the early 1980s, when Norway and Spain started to implement tech transfer. The next wave was around 2000, when a number of countries started practicing it. As I discuss below, the 2000 roll out was frequently driven by changes in the ownership paradigms of academic inventions, frequently requiring new laws to be passed to allow tech transfer to develop.

To put what happened in different ecosystems into perspective, I step back and look at the different IP ownership paradigms, their implications, and the changes in those paradigms that governments made over the years.

4. Who Owns Academic Inventions?

This simple question is critically important in any discussion of tech transfer systems, since only the owner of a piece of IP can transfer the rights to it. No company will invest large sums in developing a technology without assurance that the organization that purportedly transferred the rights to the technology to it in fact had the right to make that transfer.

I therefore next examine the different ownership models for academic IP. I show that most countries initially had either a formal or *de facto* individual ownership system, with the professors owning the IP they created. After WWII, in Canada, France, the U.K. and U.S. there was a transition to the national government owning or controlling the IP, frequently based on funding the research that led to the IP. Finally, starting around 1980, a transition to individual institutional ownership and control started and has emerged as the dominant system worldwide.

a. The Historic Approach

In most countries, the historic default position was that no one particularly cared about commercialization of university IP or even the commercialization of IP from government laboratories. Therefore, there were frequently no rules on ownership and certainly no institutional resources to support commercialization. By default, therefore, if anyone was going to take the IP out of the institution and into the marketplace, it was going to be the professors/scientists themselves.

For example, Boston University (BU) claimed no ownership in the telephone patents received by its Professor of Elocution and Vocal Physiology, Alexander Graham Bell, even though BU supported Bell's work on the telephone by giving him a one-year leave of absence and pre-paying his salary for the following year to allow him to support himself during his leave of absence while he perfected the telephone and prepared and filed his patent application.[2] Bell paid to file his patents himself and found backers to help him establish the first Bell Telephone Company to bring it to market.

In the biomedical field, the community even considered it unethical for physicians to get patents on potentially life-saving technologies. For example, as discussed by Bliss, in 1922, the University of Toronto's patent attorneys insisted that Frederick Banting, an MD, be named as an inventor on the patent application for insulin. Banting only agreed after the university agreed to indemnify and defend him if he was accused of violating his Hippocratic oath.

In 1943, the USDA's only rule on patenting was that government scientists couldn't take out U.S. patents on their government-funded work. The Medical Research Council in the U.K. had insisted that Oxford University not apply for patents on the penicillin work which it had funded. In retrospect, the patentability of Oxford's version of penicillin (penicillin F, produced by *P. rubens*) was probably questionable since the USDA had isolated a strain of *P. chrysogenum* that produced penicillin G, which is both structurally different from, and a superior drug to, penicillin F. However, there was outrage in the U.K. that USDA policy allowed USDA scientists to take out foreign patents in their own names based on their government-funded work, and that the U.K. finished up having to pay royalties on penicillin to Andrew Moyer, the USDA scientist who led the process development effort in Peoria, Illinois. As discussed by Hockaday elsewhere in this special issue, this experience was a major driver in the establishment of the NRDC in the U.K.

That said, in Australia and France, the universities, as institutions, have always owned the IP generated by their professors and employees, as is discussed elsewhere in this special issue.

The situation in Austria is typical of the situation

2. See, for example, *Bell: Alexander Graham Bell and the Conquest of Solitude,* Robert V. Bruce.

that generally held sway in Europe. Before 2004, the IP generated by professors at Austrian universities was owned by their employer, the Federation of Austria, which owned the universities. However, the Federation had no organization to decide what to do with a university's IP; so, in practice any IP that professors requested was almost always granted back to them. Very often professors did not make use of their IP because they had to pay all the costs themselves and there was no financial or administrative support for commercialization from their university. Austria passed a new national law in 2002, which was implemented in 2004, which gave ownership of the IP to the university and now Austria has a flourishing network of TTOs at many universities.

b. Potential Ownership Models

Conceptually, there are only five possible answers to the question of who owns an invention made at a university:

a) The professor and/or students who made the invention;

b) The national government, which frequently funded the research that led to the invention;

c) The institution itself;

d) The external, non-governmental organization that funded the research that led to the invention; or

e) Joint ownership through some combination of options a through d).

Next, I discuss these options and their implications.

i) Inventor Ownership

Inventor ownership, *i.e.*, ownership by the inventing professor, frequently referred to as the "Professor's Privilege" after the copyright exemption from employer ownership of academic writings, is, as discussed above, the first and oldest ownership system and was broadly used in Europe until relatively recently.

A. U.K.

Tech transfer got off on the wrong foot in the U.K. as a scandal at Oxford University in the 1920s had repercussions that lasted well into the 21st century, as discussed by Hockaday.[3]

Brynor Owens was a Ministry of Agriculture scientist who became head of an Institute of Agricultural Engineering that the Ministry funded at Oxford. Owens was a charlatan of heroic proportions and later served four years in prison for forgery and fraud on the International Harvester and Ford companies.

At Oxford, he obtained patents on a supposedly superior method of extracting sugar from sugar beets and sold the patents to a company called Sugar Beet & Crop Driers Ltd. When the company discovered that the patents were worthless, it and two other plaintiffs sued Oxford for £750,000, a colossal sum at the time. In 1939, the suit was settled for £75,000, and Oxford successfully persuaded the government to pay £50,000 of this, but the remaining £25,000 was still many times the government's total annual grant to Oxford at the time.

To prevent a repeat of this fiasco, both Oxford and Cambridge adopted policies in which they explicitly disavowed any interest in inventions made by their faculty and students, even if carried out in university facilities with university equipment, technicians and funds. In other words, Oxford and Cambridge created a *de facto* Professor's Privilege ownership model.

Oxford started to change this policy to claim ownership of its professors' inventions in 1986 when the Thatcher government abolished BTG's right of first refusal to academic IP, but the Professor's Privilege model lasted at Cambridge until well into the 2000s.

B. Overview of the Situation in Europe

Many European countries had formal policies giving ownership rights to the inventing professors, while in others it was the *de facto* system in the absence of any formal, legally prescribed system.

Spain was an early adopter of institutional ownership in 1986, and other European countries started changing to inventor ownership in the late 1990s to early 2000s as shown in Table 1:

Table 1: European Countries Moving From Professor's Privilege To Institutional Ownership

Country	Year
Spain	1986
Denmark	1998
Germany	2001
Austria	2002
Norway	2003
Finland	2007

Some of these changes prompted the creation of multi-institution TTOs.

C. Germany

As Wijland discusses elsewhere in this special issue, six Patentverwertungsagenturen (PVAs), which were MiTTOs, were established prior to the abolition of the Professor's Privilege in 2001. However, the pace of PVA creation accelerated after the abolition, with nine being created in 2001 and 2002 and an additional

3. "University Technology Transfer: What It Is and How to Do It," Tom Hockaday 2020.

three being created from 2004 to 2014.

D. Norway

A similar pattern was observed in Norway, with three MiTTOs being created prior to the abolition of the Professor's Privilege and five subsequently.

E. Italy

Italy went in the opposite direction and introduced Professor's Privilege in 2001 if the research was exclusively funded by the Italian government. If part of the funding was from other sources (*e.g.*, the E.U., local government, corporate, etc.) the university owned it.

F. Sweden

The last stronghold of the Professor's Privilege in Europe is Sweden, where Professor's Privilege remains the rule.

G. Canada

The invention ownership situation in Canada is unusual. There isn't a uniform national system based on a national law. Rather the ownership system is determined within the confines of each province by each individual university and encapsulated in its IP policy. The result is a mosaic, with a split between:

- Institutions with institutional ownership;
- Institutions with Professor's Privilege; and
- Institutions with joint institutional and professor ownership.

A 2021 survey by the Canadian Technology Transfer Professional Group (CTTP) found a fairly evenly balanced distribution of institutional ownership and inventor ownership policies across the country, with joint ownership less common as shown in Table 2:

Table 2: Invention Ownership Policies Of Canadian Institutions

Institutional	Inventor	Joint Institution and Inventor	Total
26	32	14	72

H. Japan

In Japan, the national universities were arms of government until they were corporatized in 2004, and, as such, at the time were unable to own patents. Prior to corporatization, ownership of Japanese academic IP, either by the government or the inventor, was determined on a case-by-case basis, resulting in professor ownership being the effective *de facto* ownership system, as Kato and Sumikura document elsewhere in this special issue.

I. Role of TTOs in Professor's Privilege Institutions

Having a Professor's Privilege ownership model does not eliminate a university's need for a TTO. Large research institutions operating under a Professor's Privilege paradigm generally have a TTO, but the inventors have to affirmatively choose to work with the TTO and have every right to choose to move forward by themselves independently of the university and the TTO. Some MiTTOs were established in Germany and Norway while they were operating under a Professor's Privilege paradigm. However, the TTO must offer particularly good customer service to persuade faculty to choose to work with them and royalty distribution policies at Professor's Privilege institutions are frequently more favorable to inventors than at institution-own institutions. For example, McGill University, which has joint ownership between itself and the professor, allocates 60 percent of income to the inventors if the university commercializes the IP and 70 percent if the inventors commercialize. By contrast, in the U.S., where all institutions operate under an institutional ownership model, inventor shares of income tend to be in the 25 to 40 percent range.

J. Advantages and Disadvantages of Professor's Privilege

The advantage of Professor's Privilege is that the inventor, who knows and understands the technology better than anyone, is maximally incentivized to ensure that it is commercialized, and frequently will doggedly pursue commercialization with considerable determination.

The negative is that the upfront costs of IP protection may deter faculty, particularly junior faculty, from commercializing their IP. Another negative is that each professor who makes an invention has to learn the basics of tech transfer from scratch, will make very common, basic mistakes and will probably have an inflated view of the value and potential of their invention. TTOs, by contrast, rapidly build up a body of expertise and experience in fairly valuing technologies, convincing prospective licensees of that value and commercializing them.

ii. Government Ownership

There are two ways governments can assert ownership or control over IP generated by universities:

- Government funded the research; and/or
- Government owns the university and has an IP Policy that retains ownership of IP to the institution.

Whether the government actually owned title to academic IP or merely gave a right of first refusal to an NTTO which determined which inventions to pursue, patent and license in practice have equivalent outcomes.

Government ownership of universities' IP has had a number of consequences.

- As Kato and Sumikura show elsewhere in this special issue, because Japanese universities were arms of government before they were corporatized in 2004, they could not own patents and so ownership generally reverted to the professors, who would frequently partner with a company to pay for the costs of patenting.

- In other countries, such as Austria, where the government lacked any mechanism to utilize the patents, inventions were generally returned to inventors.
- In France, because universities were part of government, the government could establish ANVAR as a NTTO serving the entire country.
- This was also the case in East Germany pre-reunification, at a time when Professor's Privilege held sway in West Germany.

A. Canada

Canada established Canada Patents and Development, Ltd as an NTTO serving all of Canada in 1947. CPDL requested that all ownership interests be assigned to it in order to provide tech transfer services. It continued in this role until 1990. More recently provincial entities such as Axelys in Quebec have been given a similar mission even though ownership of the IP remains with the universities.

B. U.K.

As Hockaday discusses elsewhere in this special issue, the U.K. had government control of academic inventions from 1949, when the National Research Development Corporation was established and was granted a right of first refusal to all British academic and government lab inventions. This right of first refusal, which was owned by the British Technology Group after 1981, lasted until 1986 when the Thatcher government abolished this right of first refusal and ushered in institutional ownership and management.

C. United States

Government ownership was the primary U.S. system from around 1963 until the passage of the Bayh-Dole Act in 1980. Since U.S. universities are either private, non-profit corporations or are owned by a state government, rather than the federal government, the federal government's claim to ownership of patents came from the use of federal funding to perform the research that led to the invention. Since federal funding is the source of around 70 percent of research funding at U.S. universities, this meant that the majority of U.S. academic IP was owned by the U.S. government.

Efforts to establish a uniform patent policy for the federal government began in 1963 when President Kennedy issued a Presidential Memorandum and Statement of Government Patent Policy. That memorandum, revised in 1971, provided guidance to agencies for assigning title to inventions resulting from federally funded research and the U.S. federal government claimed ownership of all patents resulting from research that had been federally funded.

At that time, most U.S. funding agencies except for the defense agencies used the National Technical Information Service (NTIS) to license their technologies. NTIS had an Office of Federal Patent Licensing with six licensing specialists who negotiated royalty-bearing licenses for government-owned inventions.

The government's policy was to only grant non-exclusive licenses to prevent companies earning monopoly profits on inventions that had been taxpayer funded. Prior to granting an exclusive license, NTIS was required to show:

(1) Federal and public interests are best served by exclusive licensing;

(2) Expeditious practical application of the invention is unlikely to occur under a non-exclusive license;

(3) Exclusive licensing is a reasonable and necessary incentive to attract investment of risk capital;

(4) The proposed terms and scope of exclusivity are not greater than reasonably necessary; and

(5) Exclusive licensing will not tend substantially to lessen competition or result in undue market concentration.

This was burdensome and the delays often caused the prospective licensee to lose interest.

Additionally, NTIS could only grant an exclusive license to a government-owned patent if the intention to grant the license had been advertised in the Federal Register, together with the identity of the prospective licensee. Competitors had 60 days to object to the license grant, and frequently did.

NTIS was reactive, as opposed to proactive in its licensing efforts. Marketing was the responsibility of the owning agency, and as late as 1990, only three agencies listed their available inventions in any databases. NTIS waited for interested parties to learn about the patent, somehow, and request a license.

Another issue was that NTIS only controlled the patents and had no mechanism to give licensees access to the know-how, which resided at the university and in particular with the professor.

NTIS shared royalties with the funding agency, but not with the inventors, as the Office of Federal Personnel Management ruled in 1981 that there was no statutory authority for sharing royalties with inventors. This was remedied in the Federal Technology Transfer Act of 1986 which allowed Cooperative Research and Development Agreements (CRADA's) between federal labs and companies and also launched technology transfer by federal labs.

Because of these issues, in 1975, at the start of the discussions leading up to the passage of the Bayh-Dole Act, a federal interagency committee on patent policy reported that, as of the end of fiscal year 1975, the government had an inventory of about 28,000 patented inventions but had licensed less than 5 percent of them to businesses.[4] This included both royalty-free licenses and where a professor had requested a license to their own invention to start a company.

A Government Accountability Office report in 1991 showed that the licensing rate had increased to about 10 percent of patent applications filed. By contrast, today TTOs license about half of the new patents they apply for each year.[5] The same GAO report found that in the early 1980s, fewer than half of the licenses issued were royalty-bearing. By 1990, over 95 percent of licenses were royalty-bearing.

D. France

France established the Agence Nationale de Valorisation de la Recherche (ANVAR) as an NTTO serving all of France. It continued in this role until 1979.

E. Advantages and Disadvantages of Government Ownership/Control

Governments have not proven to be effective technology managers, reflected in the fact that government ownership/control has largely been replaced by institutional ownership.

Government licensing organizations are necessarily bureaucratic and have obligations of transparency and equity that can be at odds with commercial realities. The U.S. government's policy of only licensing its inventions non-exclusively, intended to ensure that no individual company could get rich from taxpayer-financed research, was a noble and idealistic principle, but ignored the commercial reality that academic inventions are embryonic and early stage and frequently need substantial investments to get them to market readiness. No company would make that investment unless it was guaranteed a period of market exclusivity to ensure it generated a return before it was subject to market competition. The government's policy was the exact opposite of this—after the pioneering company had made the investment needed to show that the technology was viable, competitors could obtain licenses on the same terms without having to take the upfront risk of making the investment.

One of the most important elements of Bayh-Dole was that it allowed institutions the freedom to determine the appropriate commercialization pathway and the appropriate licensing terms for a specific technology. They could grant exclusivity for up to five years (probably modeled on the then policy of the American Cancer Society). Even this limitation was removed in the Stevenson-Wydler Act of 1984, which, as well as giving federal labs many of the opportunities that Bayh-Dole had given to universities, also corrected some of the deficiencies that had been identified in Bayh-Dole during its first few years of operation.

iii. Institutional Ownership

The prevalent model in most parts of the world today is institutional ownership by the inventing research organization. This model was pioneered in the U.S.

A. United States

1. Early TTOs in the United States

As Stevens shows elsewhere in this special issue, prior to 1980, most universities used Research Corporation to transfer their technologies. However, a few institutions established their own individual TTOs well before the passage of the Bayh-Dole Act as shown in Table 3:

Table 3: Early TTOs Established In The U.S

Organization	Year
Wisconsin Alumni Research Foundation	1926
Iowa State	1935
MIT	1940
Kansas State	1942
University of Minnesota	1957

Source: "University Technology Transfer in the U. S.: History, Status and Trends," Jon Sandelin, Presentation at the International Patent Licensing Seminar 2003. Tokyo: National Center for Industrial Property Information and Training (NCIPI), 2003.

One of the drivers for the creation of the Wisconsin Alumni Research Foundation (WARF) in 1926 was to keep the royalties from commercialization of the University of Wisconsin's vitamin D patents out of the hands of the state of Wisconsin. As an independent, not-for-profit entity, WARF had its own bank accounts over which the state of Wisconsin had no control.

2. Institutional Patent Agreements

As discussed above, from the Kennedy administration on, the U.S. government stipulated that any patents based on government-funded research were to be owned by the government.

Although the Bayh-Dole Act is widely credited with having changed this paradigm, it was in fact preceded by a system of Institutional Patent Agreements

4. "The Bayh-Dole Act and Revisionism Redux," Howard Bremer, Joseph Allen, and Norman J. Latker, *BNA's Patent, Trademark & Copyright Journal*, 78 PTCJ 483, 2-19 (2009)

5. See, for instance "Technology Transfer's Twenty Five Percent Rule", Ashley J. Stevens and Kosuke Kato, *les Nouvelles*, XLVIII #1, 44-51, March 2013;

(IPAs), a series of institution-by-institution agreements launched by the Department of Health Education and Welfare (DHEW) in 1963 and by the National Science Foundation (NSF) in 1973. If an institution requested and signed an IPA with one of these agencies, it was able to retain title to inventions funded by that agency if it agreed to staff a TTO to do something with the inventions. By 1976, 75 institutions had IPAs in place. For instance, the Cohen-Boyer patents, the foundational technology of genetic engineering, were invented at Stanford and the University of California using NIH funding and were filed in 1974, well before passage of Bayh-Dole. Stanford was able to solely own and manage the patents through the mechanisms of:

- Stanford's IPA with DHEW; and
- A Joint Invention Agreement between Stanford and UCSF.

3. The Bayh-Dole Act

The Bayh-Dole Act, in 1980, institutionalized IPAs and made their benefits available to all institutions and small businesses as of right. Indeed, part of the impetus for passage of Bayh-Dole was that the Carter administration had stopped issuing new IPAs.

Under Bayh-Dole, recipients of federal funding did not have to reach an agreement with a funding agency in order to own their federally funded inventions. Instead, they could automatically elect to claim title to their inventions and license them under terms they deemed appropriate. In other words, government ownership was replaced by institutional ownership.

One of the inspired aspects of Bayh-Dole was how unobtrusive it was. Of the major conditions it imposed on universities:

- Share proceeds with inventors;
- Require exclusive licensees to manufacture products to be sold in the U.S. in the United States;
- Give a preference to small businesses;
- Give a non-exclusive, royalty-free license to the U.S. government for its own use; and
- Retaining the right by the funding agency to grant a compulsory license in the public interest if the invention was not being practiced; only the last of these, the so-called "march-in" provision, has turned out to have a potentially significant impact.

Looking at the other major conditions:

- It made good sense to share proceeds with inventors so they were incentivized to do everything they could to help with the transfer and ensure the technology's success;
- Waivers are available if U.S. manufacture is not feasible;
- Small businesses turned out to be the natural partner of universities, as large companies frequently were uncomfortable dealing with the embryonic, untested nature of academic technologies; and
- In practice, the government use right turned out to be quite limited, since purchases of goods and services by the federal government are primarily in the defense sector.

The administrative requirements—disclosing federal funding and the government's rights in patent applications and reporting annually to the government on the utilization of technologies—are minor, so the government essentially got out of the way and left universities to develop their technologies.

The compulsory license or march-in provision is potentially more problematic by virtue of its potential to convert an exclusive license to a non-exclusive license at some point down the road after a company had made a major investment in developing the technology predicated on the expectation of exclusivity. This is a genie that, once let out of the bottle, cannot be put back in it and would forever undermine faith in the exclusivity of all academic licenses. Funding agencies, which must approve a march-in request, appear to understand the serious implications of approving one, and although march-ins have been requested seven or eight times, none has been granted to date.

Other countries have not been so hands-off as the U.S when implementing their versions of Bayh-Dole. An act proposed in one country could have required the professor to reimburse the government for part of the funds they had just spent if certain requirements were not met. That act has not been passed.

Another issue is that Bayh-Dole is an unfunded mandate. As it debated Bayh-Dole, the U.S. Senate did not discuss how this new activity would be paid for and provided no new funding to support the heavy upfront costs of technology transfer. It was assumed that the costs would be treated like other administrative mandates imposed on universities' research operations, such as grant administrators in offices of sponsored programs, animal health and safety, conflict of interest, etc., by allowing their costs to be included in an institution's indirect cost base and hence would be reimbursed through grants. However, most tech transfer costs are not allowed to be included in indirect costs and universities have had to pay the costs themselves. For most universities, costs have exceeded net and even gross licensing revenues.[6]

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6. See, for example, "How U.S. Academic Licensing Offices are Tasked and Motivated—Is it all about the money?" Irene Abrams, Grace Leung and Ashley Stevens, *Research Management Review*, 17.1, Fall/Winter 2009;

B. U.K.

As Hockaday discusses elsewhere in this special issue, the U.K. was the second country to transition from government ownership/control to institutional ownership when the Thatcher government abolished the British Technology Group's right of first refusal to British universities' inventions in 1986 and allowed institutions to establish TTOs and manage the inventions themselves, ushering in institutional control in the U.K.

C. Europe

In France, the government has always been the owner of academic IP since researchers and professors are public servants. From 2010 onward new directives were issued to have universities become autonomous and thus responsible for commercializing their IP. Today universities have the responsibility to work with the researchers and decide in conjunction with their Société d'Accélération du Transfert de Technologies (SATT) whether IP created and disclosed by their faculty should be protected. Because the IP is funded by the government, the universities have become an arm of government, so any desire on the part of researchers to own and manage their own IP is avoided. Researchers receive shares in start-ups that are spun out of their inventions and a share of any royalty income their technology generates.

In East Germany, universities owned their faculties' IP, while in West Germany Professor's Privilege was the rule until 2001, when ownership of the IP was transferred to the university.

In Table 1, I show how major European countries started changing to an institutional ownership model starting around 2000, though Spain implemented institutional ownership in 1986.

D. Emerging Economies

Emerging economies started implementing institutional ownership in the late 1990s/early 2000s, as shown in Table 4:

Table 4: Emerging Country Implementation Of Institutional Ownership[7]

Country	Year
China	1996, 2002
Brazil	1996, 2004
Russia	2003
Mexico	2003, 2009
Malaysia	2009
Philippines	2009
South Africa	2010

E. India:

In most large institutions in India, the institution owns the IP, not the professors, though in some smaller institutions, the institution does not have a policy in place or mechanisms to administer patents. In these cases, the researchers have no choice but to do the filings themselves in their own names and at their own expense.

In India, many organizations borrowed policies either from the top Indian Institutes of Technology (IITs), *i.e.*, those in Bombay, Delhi, Kanpur, Chennai or the Council of Scientific & Industrial Research (CSIR, India's largest network of publicly funded labs). These IITs and CSIR established policies such that the ownership of IP was with the institution. This was based on the United States' experience, which many of their faculty who had trained in the U.S. had experienced and reinforced by alumni resident in the U.S. Some Indian funding agencies require the grantee to take responsibility for filing and maintaining the resultant IP, thus ensuring that the institution would take the lead. Much later the government announced a National IP Policy.

"The Protection and Utilization of Public Funded Intellectual Property Bill," the so-called Indian Bayh-Dole Act, was introduced into parliament in 2008, but was shot down and not passed into law. The bill would have mandated similar disclosure and election of title provisions as in the U.S. and mandated a more than 30 percent revenue share to the inventor, but the discloser had to specify in which countries they wished to retain title, which is hard to do at initial disclosure. The bill stated that its premise was to make an institution self-sufficient by incentivizing commercialization of IP, which flies in the face of U.S. and European experience. A particularly onerous requirement was that, if the inventor failed to fulfill their obligations under the bill, they could be fined up to 25 percent or 50 percent of the public funding and renounce their share in the royalties.

F. South Africa

Prior to 2010, the South African government did not claim ownership of state-sponsored research, and institutional IP policies were either non-existent or varied wildly: some institutions allowed inventors to own their own IP even if developed using public funds and some institutions claimed ownership but without having the capacity to exploit the IP. One of the biggest challenges was industry-sponsored research that was

7. Source: "The State of Patenting at Research Institutions in Developing Countries: Policy Approaches and Practices", Pluvia Zuniga, WIPO Economic Research Working Papers, Working Paper No. 4, December 2011.

heavily subsidized by state funds but with the industry partner then claiming full ownership of arising IP with no benefit back to the public purse. Most institutions did not have the capacity or power to assert ownership in this situation.

This situation was rectified by the "Intellectual Property Rights from Publicly Financed Research and Development Act" (IPR Act), which came into effect in 2010 and which gave IP ownership from publicly financed research to the institution.

G. Advantages and Disadvantages of Institutional Ownership

The institutional ownership model has many advantages:

- It results in the development of a consistent set of policies and body of expertise within the institution;
- The institution's researchers can pursue further research without the potential of being blocked by prior art under individual ownership;
- The institution can claim and promote a reputational return from successful technologies;
- There is a possibility of a potentially significant financial return to the institution from successful technologies; and
- The institution can manage the conflicts of interest that the possibility of personal wealth can exacerbate.

Another benefit is that with the multitude of external funding sources for any given researcher, a fair amount of work is required to ensure that IP rights have not been given away in prior grants/contracts. When, in the past, there was disagreement over ownership (usually with a private company), the institutional employer of the academic researcher would be drawn into the dispute. This was a compelling reason that argued for a migration to institutional ownership.

iv. Developer Ownership

Ultimately, of course, technologies need to be owned by (through assignment) or controlled by (through licensing) the organizations that are developing them. That is the objective of tech transfer, and the process, if successful, will generally result in a financial return to the originating institution to incentivize and pay for the tech transfer ecosystem needed to identify, assess, protect and prepare technologies for transfer. It will also give a return to society, which frequently paid for the research, through the availability of new products and services meeting unmet needs.

The author is not aware of any country with a system in which inventions are initially assigned to the organization that wishes to develop the technology, though some institutions (*e.g.*, the University of Manchester in the U.K.) routinely assign their IP to start-ups developing the technology. It's hard to imagine how funding could flow back to the university to support a TTO and pay for patent filings or how competing claims to a technology could be resolved under such a system.

In the U.S., even if a company pays for the research, it generally only receives a license or an option to negotiate a license to IP resulting from the research that will require future lump sum and running royalty payments. Canada and France also use this approach. Companies may protest having to pay extra for the IP after having already paid for the research, but universities generally only charge companies the cost of the research, and the university's only chance to make any financial return is from license payments for the IP resulting from the research. Companies even try to pay less than the full cost by protesting having to pay indirect costs, which they characterize as "overhead."

The Bayh-Dole Act does not allow universities to assign title to their patents without the permission of the funding agency, and the funding agencies simply will not give such permission, believing that an exclusive license gives the developer all the control over the IP they need for effective commercialization. TTOs in ecosystems which lack this legal protection, and institutions operating under a Professor's Privilege ownership model, report coming under pressure to assign their IP to start-up companies to facilitate fundraising. Compromises are generally reached to only assign the IP to the developer when a product is launched or when the company reaches an advanced stage of funding or files to go public, by which time the risk of failure and hence the need for the institution to reclaim the IP will have largely been eliminated.

A. The "Easy Access IP" Model

One model which is close to developer ownership in practice is the Easy Access IP system developed by the University of Glasgow starting in the late 2000s and adopted by Bristol and Kings College London in the U.K. and a small number of other institutions around the world. In this paradigm, some of the technologies owned by an institution are licensed, free of charge, to local start-up companies. The rationale for the system was that most academic inventions have a low value and frequently go unlicensed, and this would promote utilization of technologies while contributing to local economic development. Even though forgoing licensing revenues, the university benefits from providing sponsored research and consultancy services to the start-ups.

Although the financial impact of the Easy Access IP model is the same as if the company owned the technology, the technology is in fact still owned by the university.

B. Japan

In Japan, universities frequently grant co-ownership of patents to companies because Japanese companies frequently collaborate on research projects with the universities. This reduces the university's leverage in subsequent licensing negotiations since the companies already have freedom-to-operate under the patents by virtue of their co-ownership and only need to license the university's interest to secure exclusivity.

C. South Africa

Elsewhere in this special issue, Barnett identifies how in South Africa there were elements of developer ownership prior to the passage of the 2010 IPR Act through companies claiming full ownership of IP arising from industry-sponsored research that had been heavily subsidized by state funds, with no benefit back to the public purse. Most institutions did not have the capacity or power to assert ownership in this situation. The IPR Act stopped this practice.

5. Today

It is broadly recognized around the world that the results of academic research can help rejuvenate local and even national economies by starting new growth industries, and many emerging economies are now attempting to implement formal tech transfer ecosystems. They are finding that institutional ownership is a pre-condition for an institution to create an organization to develop the skills to facilitate transfers to the private sector and are implementing this through laws that are frequently compared with the U.S.'s Bayh-Dole Act. However, as the examples of Canada and Sweden show, institutional TTOs can flourish under Professor's Privilege ownership paradigms as well.

6. A Final Caveat on Technology Ownership

As shown above, institutional ownership has emerged as the dominant system of academic IP ownership around the globe.

However, while certainty of ownership is a necessary condition for successful commercialization, it is not sufficient. Many countries implementing institutional ownership and expecting to see immediate benefits have yet to also implement some of the less visible elements that have contributed to the success of the U.S. and European tech transfer ecosystems:

- Faculty consulting policies that allow faculty to consult for outside entities for up to a day a week;
- Seed funding initiatives (institutionally funded or sponsored) to bring early-stage technologies further up the Technology Readiness Level (TRL) scale to a level of maturity to be able to initiate a transfer to a company;
- Small company research support programs such as the U.S.'s SBIR and STTR programs;
- Government support for the tech transfer function itself, such as the U.K.'s HEIF funding, France's SATT funding and the recently announced Australian government AUD1.2 billion funding for tech transfer; and
- The coupling of incubators and venture capital and angel funding with tech transfer activities in a vibrant innovating ecosystem. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4255245*.

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An Analysis Of The History, Business/Funding Models, Strengths And Challenges Of Multi-Institutional Tech Transfer Offices

By Ashley J. Stevens, John A. Fraser and Alexandre Navarre[1]

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The cognitive psychologist Barbara Drescher famously said: "The plural of anecdote is data." In this article we step back from the individual cases described in the preceding articles to ask and attempt to answer questions about the history, business and funding models, strengths and challenges of multi-institutional tech transfer offices (MiTTOs). We try to draw broad conclusions, quantitatively wherever possible, supported by the experiences of the various MiTTOs described in the preceding articles. This article addresses the following issues:

- The three types of MiTTO organizational structures.
- Which countries have used MiTTOs?
- When were MiTTOs created?
- How long did they operate?
- Was the MiTTO a new entity or an existing entity with a new mission?
- What are the business/funding models that different MiTTOs have employed?
- What are the benefits of MiTTOs?
- When are MiTTOs an appropriate solution to establishing tech transfer?
- What are the operating challenges a MiTTO faces?
- How long should a MiTTO be funded for?
- In what circumstances will a MiTTO have on-going viability?
- Can tech transfer be a for-profit activity?
- Should a MiTTO do more than just tech transfer?
- Is there life after tech transfer for a MiTTO?

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1. Types of Organizations

As discussed in the introductory background article, we identified three approaches to creating MiTTOs:

- National tech transfer offices (NTTOs), which carry out tech transfer for an entire country.
- Regional technology transfer offices (RTTOs), which carry out tech transfer in specific regions.
- National networks of multi-institutional TTOs (NMiTTOs), in which an organized network covering an entire country carries out tech transfer in different regions.

NMiTTOs are the most recent organizational structure. The structure was adopted to provide a local implementation of a national system rather than the single, centralized approach of an NTTO.

From an organizational perspective, we identified 35 MiTTO organizations:

- Thirteen NTTOs
- Seventeen RTTOs
- Five NMiTTOs

They are shown in Table 1.

However, the number of individual MiTTOs operating is much larger than the number of umbrella organizations because the five NMiTTOs are networks of RTTOs covering entire countries.

There were originally 18 MiTTOs in the German PVA

1. Contributed equally to this manuscript.

network, 14 Sociétés d'Accélération du Transfert de Technologies (SATTs) in France while the Department of Biotechnology network in India comprises seven RTTOs, the Norwegian Network currently has eight MiTTOs and the Chilean Hub network includes three organizations. Furthermore, the Quebec SVU program comprised four individual SVUs. In total, therefore, we have identified 83 MiTTOs that have been or are still in operation.

Clearly, MiTTOs have played, and are continuing to play, a major, indeed pivotal, role in the development of tech transfer around the world. We do not believe the importance and scale of this class of organization has been identified before this special issue.

2. Countries That Have Used MiTTOs

Table 2 shows the number of MiTTOs in each country.

Sixteen countries have had at least one MiTTO. The U.S. has implemented the greatest number, eight, of which three were attempts to do tech transfer on a for-profit basis and make a return on investment that were ultimately unsuccessful.

Canada has had four MiTTOs, nine countries have had two and five have had one.

3. Operating History

In Table 1 we also summarize the operating history of the 35 MiTTO organizations. The columns are as follows:

- Precursor—When an organization was first created that later transitioned to an MiTTO.
- Start—When the MiTTO started its tech transfer activities.
- End Tech Transfer—When the MiTTO ended its tech transfer activities but continued with some other mission.
- End—When the MiTTO ceased all operations.
- Duration—The number of years that the MiTTO carried out tech transfer activities.

If there is no year shown in either the "End Tech Transfer" or "End" columns, the MiTTO is still operating. In that case, the duration is calculated from the start date to 2022.

Sixteen of the MiTTOs are currently still operating as TTOs:

- Three NTTOs
- Eight RTTOs
- All five NMiTTOs

In Figure 1 we show the total number of MiTTO organizations operating by decade, and in Figure 2 we show the number of each of the three types of MiTTO organizations operating by decade. In Figure 3 we show the number of individual MiTTOs in operation by year.

Several observations are apparent from these charts:

- As a general observation, the number of MiTTOs operating has steadily increased over time.
- NTTOs were the first type of organization to have been implemented, starting in the 1930s and peaking in the 1980s, when a number of for-profit MiTTOs were in operation in the U.S., some for relatively short periods. The number of NTTOs still operating today is down 50 percent from the peak.
- RTTOs started being established in the 1980s and have been considerably more numerous, peaking at 11 in the 2010s.
- NMiTTOs are the most recent approach, having started in 1986 with the first member of the German PVA network and in 1990 with the first members of the Norwegian network. All the networks that have been created are still in operation.
- The number of individual MiTTOs in operation has climbed significantly, driven by the five networks.

4. Duration of MiTTOs

Table 3 summarizes the number of years each type of MiTTO organization was in operation.

NTTOs show the longest duration, with an average life of 26 years, dominated by those in Canada, the U.K., and the U.S. Indeed, RCT in the U.S., successor in interest to Research Corporation, the first TTO ever to be established, is still in operation after 110 years, though its duration as an NTTO was "only" 72 years.

As discussed above, NMiTTOs are the newest implementation of MiTTOs. There are five networks, and all five are still in operation. While the members of the DBT Network in India and the HubTec Network in Chile all came into operation roughly simultaneously, the same is not true for the members of the German, Norwegian and French networks, where MiTTOs were created over a period of years and joined the network.

In both Germany and Norway, the first MiTTOs were established in 1986 and 1990, respectively, before the law was changed to require institutional ownership of academic IP. There was a substantial increase in the establishment of MiTTOs within a year or two of the law change followed by a trickle of additional establishments until quite recently. All of the Norwegian MiTTOs are still operating; three of the German PVAs ceased operation between 2015 and 2021.

RTTOs have the same duration as the NMiTTOs, with an average of 11 years, three of which have been operating for around 20 years—the network of four Sociétés de Valorisation in Québec, Canada and Tohoku Techno Arch and Techno Network Shikoku Co., Ltd. in Japan.

In Figure 3 and Figure 4 we plot the duration of the

MiTTOs in years, respectively, in five-year increments of duration, and cumulatively.

The largest cohort, 12 or 36 percent of all MiTTO organizations, operated for five years or less, and over half of all MiTTO organizations operated for 10 years or fewer. At the other end of the duration distribution, 11 MiTTO organizations, a third of the total, have operated for 25 years or more, and 16 are currently operating.

The distribution is essentially bimodal. A large number had a short duration, while others lasted a very long time, and around a third of the cohort are still operating. This data is consistent with the accounts in the preceding articles, which make it clear that some MiTTOs served a catalytic role in kickstarting tech transfer in a particular ecosystem and were then replaced by individual institutional TTOs. Whether that limited lifetime and role was the original plan is beyond the scope of this analysis.

It is noteworthy that in Chile, tech transfer started with an NTTO, OTRI, that CORFO, the agency that funded OTRI, ended support in favor of each institution having its own TTO, but after five years realized that the demographics, geography and scale of academia in Chile made this plan unrealistic and has returned to supporting an NMiTTO of three Hubs covering the country.

Additionally, these data need to be put in the context that tech transfer only existed as an organized activity in seven countries prior to around 1990—Australia, Canada, France, Germany, Norway, Spain, the U.K. and the U.S.—so that in the rest of the world, tech transfer has only existed for 20 years or so.

Of the 16 MiTTOs currently in operation, 14 appear to represent a stable, long-term solution to their members' tech transfer needs and appear to have an assured source of funding, either internal or external. It is not clear whether the remaining two, the DBT Network in India and the Hub network in Chile, will be funded for the long term. Both are approaching the end of their initial round of funding and the funding agencies are discussing extending the period of funding.

5. Organizational History

The vast majority of the MiTTOs reviewed in this project were newly established organizations created to carry out tech transfer activity for their member institutions.

However, five were pre-existing organizations that transitioned into MiTTOs:

- Three were single-organization TTOs whose mandate was expanded to serve other organizations:
  - Research Corporation,
  - UniQuest, Australia, and
  - Eastern Cape RTTO, South Africa.
- Puerto Rico Science, Technology and Research Trust (PRSTRT) TTO, which started as an economic development agency and subsequently added a TTO.
- Technology and Innovation Management in Australia, which started as the West Australian Product Innovation Centre.

6. Funding Models

All of the MiTTOs reviewed used one or a combination of the following funding models:

- External funding
- Internal (*i.e.*, member) funding
- Revenue sharing

Next, we examine these models and their implications.

a. External Funding

In this model, the MiTTO carries out all the tech transfer functions for the member institutions using funding provided by a third party, generally with all the revenues generated flowing back to the inventing institutions.

The funding provider is most often the central government, though TULCO in North Carolina in the United States was funded by the Triangle Universities Center for Advanced Studies Inc., whose mission was to support the three universities in the Research Triangle, and the Washington Research Foundation in the state of Washington was funded by a line of credit guaranteed by 35 companies in Seattle. The National Research Development Corporation in the U.K. was an independent public corporation, not a government department, and did not receive annual grants but was financed from government loans under the jurisdiction of the Minister of Technology and was required to balance its books in the long term. The corporation's borrowing powers were initially set at £10 million, which was increased to £25 million in 1965. PRSTRT in Puerto Rico is funded by excise taxes on Puerto Rican rum sold in the U.S. and a pharma /medical device manufacturers tax and funds its TTO out of these revenue streams.

Obviously, an external funding model is extremely attractive to the member institutions, who get all of the benefits of a tech transfer capability without having to bear any of the costs. Equally obviously, the main issue with such a model is sustainability. If the external provider of funds decides to stop providing the funding, the MiTTO will either cease to operate, must find a new funder, or must transition to the second and/or third models.

b. Member Funding

In this model, the member institutions agree to provide the funding for the MiTTO's operations and receive all of the income generated from their inventions.

Institutions generally commit to this model to achieve economies of scale and to be able to share access to specialized skills that no one institution could afford individually.

Several of the MiTTOs that seem to have been most successful (as measured by their duration and on-going operations)—Unitectra and Ascenion—fall in this category.

In four other cases, rather than a new MiTTO being created, a larger institution with an established TTO secured funding to expand its activities to provide tech transfer services to a number of smaller institutions.

- — Research Corporation used the income from the electrostatic precipitator and the vitamin B1 patents to offer tech transfer services to other institutions and received a revenue share from new commercialized technologies.
- — In South Africa, Nelson Mandela University secured external funding to allow it to establish the Eastern Cape RTTO and serve three additional, smaller institutions.
- — Technology and Innovation Management used internal funding to turn West Australian Product Innovation Centre into an RTTO serving Western Australia.
- — UniQuest, also in Australia, was a hybrid of two models, with the eight partner organizations providing some of the funding for UniQuest's activities on their behalf and with UniQuest also receiving a share of revenues from deals.

c. Revenue sharing

In this model, an independent MiTTO provides tech transfer services for the member institutions and keeps a share of the revenue generated to fund future activities.

Tech transfer inevitably takes time to generate revenues, as licensees need to be found, agreements negotiated and products developed, tested and sold by the licensee based on the technology licensed. Studies in the U.S. by the University of California system and Columbia University have shown that technologies take a median of four years just to be licensed. This means that half of the licenses take MORE than four years to be signed, and additional time will be needed for product development, testing and market introduction until royalties are received. Therefore, MiTTOs operating on this model will likely need start-up funding to sustain their operations until income starts to be generated that they will share in, but, hopefully, they will achieve sustainability in the longer term.

Another issue with revenue sharing as a route to sustainability is that it can result in the MiTTO being under pressure to be highly selective in the technologies that are accepted for commercialization. This in turn results in those faculty members whose technologies are not selected feeling disenfranchised and excluded, weakening support for the MiTTO. Additionally, with the benefit of hindsight, the member institutions may resent the share of income retained by the MiTTO.

In Table 4 we show the funding sources used by the MiTTOs we identified. External funding was the source used by over half of the MiTTOs, followed by a share of royalty income. Only five MiTTOs have been internally funded—Ascenion in Germany, Technology and Innovation Management in Australia, Tohoku Techno Arch and Techno Network Shikoku Co., Ltd. in Japan, and Unitectra in Switzerland. As we have noted, this appears to be a successful, stable, long-term model. UniQuest was funded internally but also included a revenue share, as did the SVUs in Quebec and the SATTs in France.

A royalty sharing model was the dominant model in the U.S., being used by five of the eight MiTTOs, including the three attempts at a for-profit model. The remaining two—TULCO and the federally funded Tech Link, which supports federal laboratories—used external funding.

7. The Benefits of a MiTTO

The most common reason for establishing a MiTTO is to kick-start commercialization in the member institutions. By making the MiTTO's services available to the member institutions at no cost, acceptance of tech transfer is generally greatly accelerated.

MiTTOs, particularly NTTOs and NMiTTOs, provide a convenient pathway for government to support tech transfer in an entire ecosystem, either initially to kick-start it, or as an ongoing provider of support.

Obviously, most MiTTOs are created with a commercial orientation and culture, not an academic one. They can immediately introduce this commercial orientation and culture to their member academic institutions, whose internal, traditional academic culture would adapt to commercialization more slowly.

One of the major benefits of a MiTTO is that it provides skills the member institutions could not justify individually and can immediately provide access to a critical mass of personnel, resources and, hopefully, experience.

Another benefit is that a MiTTO has the potential to create more viable start-ups and licenses by aggregating complementary technologies it sees coming from different member institutions.

Finally, an NTTO and even an RTTO will provide an early vehicle to communicate with government about the importance of tech transfer to the government and to lobby for support. Later in the evolution of the ecosystem, this role will generally transfer to a tech transfer association that will have been created as more institutions create their own individual TTOs.

These benefits are summarized in Table 5.

8. When Are MiTTOs Appropriate?

Many of the MiTTOs discussed in the articles in this special issue were established at the inception of tech transfer in their particular ecosystem.

In Canada, France, the U.K. and the U.S., tech transfer got started with NTTOs doing the tech transfer for the whole country. In the U.S., Research Corporation resulted from private sector activity, while CPDL in Canada and NRDC in the U.K. were the result of government initiatives, as were first ANVAR in France and more recently the SATTs. In each country, the NTTO was the primary vehicle for tech transfer for 40-50 years until the 1980s, when legislative changes led to their roles being replaced by TTOs established by individual research institutions. RTTOs in the states of North Carolina (TULCO) and Washington (WRF) were established to jump-start tech transfer in those states and have since been supplanted by individual institutional TTOs.

The German and Norwegian NMiTTO networks were largely established after the ownership paradigm for academic IP was changed to ensure that the benefits of the change were realized. The DBT network in India was established in 2020 and was clearly motivated by a desire to jumpstart tech transfer in India. The Quebec SVUs and the French SATTs have had a similar motivation.

9. What Are the Operating Challenges MiTTOs Encounter?

Tech transfer is a challenging undertaking in the best of circumstances, involving attempting to commercialize early stage, unproven technologies of unknown market potential created by independent, strong-willed faculty members, with inadequate human and financial resources.

Assigning responsibility for this activity to an unaffiliated, external organization only adds to these challenges.

In Table 6 we categorize the challenges identified by the various MiTTOs into four categories:

- Financial
- Strategic
- Operational
- Cultural

Not all of these challenges are encountered by each MiTTO, but the table perhaps explains why 19 of the 35 MiTTOs we identify are either no longer carrying out tech transfer or are no longer in existence at all. The accounts of individual MiTTOs in the articles in this special issue frequently identify the MiTTO as experiencing one or more of the issues listed below.

Some of these challenges are:

- **Sustainability**

In the first of the business models we identify above, the organization's long-term sustainability is outside its control. The third model addresses sustainability through revenue sharing, but as we discuss below, this leads to its own issues. The second model seems to be the most reliable pathway to sustainability.

- **Competition/Exclusivity**

Some MiTTOs do not have exclusive rights or rights of first refusal to the technologies created by their member institutions. Rather, in some cases, the institutions select which technologies to send to the MiTTO and can choose to market specific technologies themselves. In these circumstances, institutions have been observed many times to keep the most promising technologies for themselves and to send the MiTTO technologies that they have been unsuccessful in licensing themselves. Obviously, it is going to be hard for the MiTTO to flourish under such a paradigm.

- **Selectivity**

Selectivity is the flipside of exclusivity—is the MiTTO able to select the technologies disclosed by its member institutions that it wants to move forward with or does it have to take them all? If the MiTTO takes only the most promising technologies, that will quickly breed ill-will in the member institutions, with faculty whose technologies were not selected arguing for another approach. At a minimum, the MiTTO will need to do a solid evaluation of each invention disclosure it receives and provide that to the member institutions to justify why it doesn't intend to proceed with that invention and to build trust and understanding of the MiTTO as well as preparing for successful commercialization.

- **Revenue Sharing Issues**

In the revenue sharing model, member institutions may, with the wisdom of 20/20 hindsight, resent the revenue share from a successful commercialization that is retained by the MiTTO and many times forget the hard work involved in assessing and marketing a full portfolio. They may argue to create an in-house capability to replace the MiTTO at lower cost.

- **Us versus Them**

Research laboratories within universities are essentially independent research centers. Professors raise their own funding through grants and tend to resent constraints imposed on them by the central administration. Their labs are essentially self-governing entities and are distrustful of outside organizations that impinge on their activities and independence. A MiT-

TO, because it is an independent organization, is frequently perceived as "not us" and therefore "them" and the institutional immune system starts to reject it.

As a case in point, even though the University of Washington's TTO rented space in the same facility as WRF, WRF was perceived as being "them" by UW faculty and staff, a factor that pushed UW to start its own TTO.

- **Geographic Issues**

Tech transfer is often described as a body-contact sport, and frequent, in-person contact is essential. If the MiTTO is distant from the member institutions and contact is intermittent, this will be a challenge. This issue is obviously most severe with NTTOs but can be an issue with MiTTOs also. For example, the only one of the French SATTs to shut down was that one in the Massif Central, where it served the largest territory in France covering four regions which had different visions, objectives, and political situations.

Equally, if one or more member institutions are too far away from the others within a TTO network, they may feel ignored and underserved compared with the majority, leading to tensions with the MiTTO.

- **Cultural Differences**

Different member institutions may have radically different cultures, making it difficult for the MiTTO to develop a set of operating practices and a corporate culture that meets the needs of all the members. This was certainly an issue with TULCO, where the three large university members had very different attitudes to interacting with industry when TULCO was established. The SATTs were established partly to change the culture of commercialization within the French university ecosystem.

- **Governance Issues**

The member institutions may feel disenfranchised if they have no say in the governance of the MiTTO, its policies, its personnel decisions, etc. This can be subtle since one representative of the member institution sitting on a board may not necessarily be able to represent the initiative across the normal varied interests internal to their institution.

10. How Long Should MiTTOs Be Funded for?

Most externally funded MiTTOs have been funded for a defined period. The World Bank appears to have provided the shortest duration of funding, for three years to the Indian DBT project, though there has been a one-year, no-cost extension because of pandemic delays and a further extension of funding is being discussed. Biotectra was funded by the Swiss government for three years and was superseded by individual institutional TTOs and one RTTO, Unitectra. In Chile, CORFO initially funded OTRI for three years starting in 2005, with subsequent extensions until 2011. It has subsequently funded the three HubTech MiTTOs for five years starting in 2016, which was the initial funding term for TULCO in North Carolina in the late 1980s. Five years appears to be as long an initial duration as most governments will be prepared to fund an activity, though the French government initially committed to fund the SATTs for 10 years, as did the Quebec Government. Frequently, government has an unrealistic expectation that the MiTTO can be self-sustaining after five or even 10 years of support.

That said, it currently appears that the French government is prepared to partially fund the SATTs on an on-going basis as well as the Quebec Government with Axelrys, the successor to the four SVUs. In Canada, other provincial governments have had programs or grants supporting TTOs as well as the maturation and early-stage development of technologies. Those have recognized the high-risk nature of such activities and stepped-up to compensate for the reluctance of universities to invest in what is deemed commercial activities.

The longest duration of direct government support documented in this special issue is in Norway, where the Norwegian Government has funded the official Norwegian TTOs through the Norwegian Research Council continuously since 1995, although the rules and framework conditions for this funding have changed periodically and are now again in flux after 2023.

The desire to avoid depending on potentially fickle external sources of funds is the motivation for revenue sharing business models, but these come with their own challenges. For revenue sharing models to be successful, they need a critical mass of commercially successful technologies to generate an adequate cashflow to support ongoing operations, and will generally need a grant to fund their initial activities until significant income starts to be received. As an example, Washington Research Foundation's initial activities were funded by a $1 million line of credit guaranteed by 35 companies in Seattle.

11. When Will an MiTTO Have On-Going Viability?

MiTTOs appear to have on-going viability in smaller ecosystems, such as the Hub network in Chile, or when serving smaller institutions in larger ecosystems, such as the Japanese and Swedish RTTOs that serve smaller institutions in the same region. Bulgaria, with a population of only seven million, is currently establishing an NTTO.

12. Can Tech Transfer Be a For-Profit Activity?

The collective experiences and demise of the three organizations reviewed in this special issue that were set up as for-profit entities—University Patents, University Technology Corporation and University Science, Engineering and Technology—seem to conclusively answer the question of whether tech transfer can be a for-profit activity in the negative. University Patents lasted close to 50 years until it finally faded into the sunset, but the other two each lasted less than five years.

On the other hand, two not-for-profits which followed a revenue share business model—Research Corporation Technologies and Washington Research Foundation—were highly successful financially, generating respectively billions and hundreds of millions of dollars in income, and are still operating, albeit not as MiTTOs but as venture funds, investing the surpluses their tech transfer activities generated back into the innovation ecosystem.

What explains the difference between the for-profit failures and the not-for-profit successes?

The answer is probably a combination of luck and critical mass. University Patents started out with a few highly profitable technologies, but had an inadequate technology flow from the relatively small number of universities that it served and failed to replace the profitable initial technologies with equally profitable new technologies when the original patents expired. It eventually started to cut back and be more and more selective in the technologies it took on, starting a downward spiral.

Research Corporation Technologies, as successor to Research Corporation, was in a unique place and had enjoyed essentially monopoly access to U.S. academic technologies for decades. It was good at picking winners, so it systematically replaced its expiring revenue generators with new sources of income. WRF on the other hand was just plain lucky. It came into being just as the genetic engineering revolution was in full swing and quickly came up with a few highly profitable technologies. The history of the issuance of the Hall yeast patents also worked in its favor, as more products were in the market when the patents finally issued.

13. The Economics of MiTTOs

A 2009 study,[2] based on a survey carried out in 2006, showed that 52 percent of U.S. TTOs had operating expenses (personnel, patent and all other costs) that exceeded the gross income they received, and only 16 percent of TTOs retained enough of the income they received after distributions to inventors and for research to cover their operating expenses. Periodic modeling of sustainability carried out using AUTM Annual Survey data, which collects data on patent expenses and reimbursements, staffing levels and income, combined with AUTM Salary Survey data, show that these 2006 results are still broadly applicable today. Tech transfer is quite simply not a predictably and reliably profitable business. The reasons are well known to all practitioners:

- The low overall licensing success rate—only 15 to 25 percent of invention disclosures received getting licensed.[3]
- Having to write off the investment made in unlicensed cases.
- The length of time between disclosure and signing a license, a median of four years in two U.S. studies.
- The finite lifetime of patent protection and hence royalty revenues.
- The need to distribute a majority of licensing income to inventors and colleges and departments.
- Licensing only capturing a small percentage of the total economic impact of a technology—the running royalty percentage plus the lump sum payments—with the more than 95 percent remaining in the private sector that funded the development of the technology.

There are occasional home runs, but they occur in unpredictable places—City of Hope Hospital, Northwestern, UCLA, Emory, New York University, Florida State University, etc. The strategic plan for all TTOs—both MiTTOs and individual institutional TTOs—must be simply to take as many shots on goal and to get on base (to mix sporting metaphors!) as often as possible, by licensing as many technologies as possible, and not treating every invention as a home run and trying to squeeze the last nickel out of it.

MiTTOs that attempted to fund their on-going activities through retaining a share of revenues—Research Corporation, University Patents, University Technology Corporation, WRF, etc.—retained 40 to 50 percent of the revenues. UTC retained the most, 58 percent—16 percent to cover patent expenses and 42 percent to fund UTC's operating expenses and profit—leaving only 42 percent to the university.

This level of revenue diversion seems to have been a driver for institutions to believe they could do the work themselves at a substantially lower cost. This, together with the desire to have more control over their tech transfer activities, appears to have been the driver for most institutions in developed economies to stop using an MiTTO and set up an internal tech transfer capability, which is certainly the norm in most major ecosystems today.

2. "How US Academic Licensing Offices are Tasked and Motivated—Is it all about the money?," Irene Abrams, Grace Leung and Ashley Stevens, *Research Management Review*, 17.1, Fall/Winter 2009

3. "Technology Transfer's Twenty Five Percent Rule," Ashley J. Stevens and Kosuke Kato, *les Nouvelles* XLVIII #1, 44-51, March 2013.

Experience seems to have validated this expectation. There are two broadly followed income distribution models used in institutions today:

- "One-third/one-third/one-third," in which the inventors receive a third, the inventors' college or department gets a third for investment in research and the institution receives a third, with the institutional share being used to partially fund the TTO.
- "Fifteen percent off the top," in which the TTO takes 15 percent of all royalty revenues received to fund its operations with the remainder distributed under the institution's IP policy.

Both of these models leave considerably more of the income for use by the institution than the revenue share retained by most MiTTOs using a revenue sharing model.

14. Should a MiTTO Do More than Just Tech Transfer?

Another interesting analysis is whether the MiTTO just does tech transfer for its member institutions or whether it is also involved in other stages of the innovation ecosystem. In some cases, the MiTTO does more than just tech transfer:

- A major part of the funding the French government provides the SATTs is for technology maturation—*i.e.*, proof-of-concept funding.
- In Norway the government funding of TTOs is closely connected to proof-of-concept funding and early maturation of projects, while four of the eight TTOs are combined with an incubator.
- In India, five of the seven RTTOs are combined with incubators.

15. Is There Life After Tech Transfer?

Several of the MiTTOs whose tech transfer business slowly disappeared as their member institutions took over responsibility for their own tech transfer utilized their share of the revenue stream from their past deals to create early-stage venture funds, several of which continue today, long after the MiTTO's tech transfer activities have gone away:

- In the U.S., RCT and Washington Research Foundation operate vibrant early-stage venture funds.
- BTG in the U.K. transitioned into an operating company, with interventional medical and pharmaceutical portfolios and was acquired by Boston Scientific in 2018 for $4.2 billion.

16. Summary

This review has identified the important role that MiTTOs have played and are continuing to play in the development of tech transfer globally. Some key conclusions are:

- In major ecosystems, MiTTOs tend to play an important role in kick starting tech transfer in the ecosystem and then be superseded by individual institutional TTOs.
- NTTOs appear to have an on-going role in smaller ecosystems.
- The newest model is coordinated networks of MiTTOs covering a whole country.
- Revenue sharing appears to have gone out of favor as a funding model for institutions because it is not seen as a reliable way to fund TTOs.
- Some of the stable, on-going MiTTOs are using an internal, self-funding model. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=4255250*.

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Table 1. Key Dates Of MiTTO Operations					
	Precursor	Start	End of TT	End	Duration
Single NTTOs					
Research Corporation / RCT, US	1912	1937	2009		72
Canadian Patents and Development Limited (CPDL)		1947		1990	43
National Research Development Corporation / BTG, UK		1949	1985	2020	36
University Patents, Inc., US		1964		2010	46
ANVAR, France		1967	1979	2005	26
University Technology Corporation, US		1986		1989	3
University Science, Engineering and Technology, Inc., US		1986		1990	4
Biotectra, Switzerland		1996	1999		3
Tech Link, US		1996			26
Oficina de Transferencia de Resultados de Investigación, Chile		2005		2011	6
Ascenion GmbH, Germany		2001			21
UNIVALUE, Spain		2011		2015	4
National Center for Technology Transfer, Bulgaria		2022			0
Network of MiTTOs					
PVAs, Germany		2001			21
Norwegian Network		2004			18
Sociétés d’Accélération du Transfert de Technologies, France		2011			11
Chilean Technology Transfer Hubs		2016			6
DBT Network, India		2020			2
RTTOs					
Washington Research Foundation, US		1981	1992		11
Triangle Universities Licensing Consortium, US		1988		1995	7
Unitectra, Switzerland		1999			23
Technology and Innovation Management Pty Ltd, Australia	1984	1990	1998	2013	8
Tohoku Techno Arch, Japan		1998			24
Sociétés de Valorisation, Québec, Canada		2001		2020	19
Techno Network Shikoku Co., Ltd. , Japan		2001			21
Consorci de Transferencia de Coneixement, Spain		2004		2010	5
C4 Ontario, Canada		2005		2010	5
UniQuest, Australia	1996	2005	2013		8
Innovation Office West, Sweden		2009			13
Innovation Office Fyrklövern, Sweden		2009			13
Serbian Innovation Fund		2011			11
Eastern Cape RTTO, South Africa	2007	2011		2014	3
KwaZulu-Natal RTTO, South Africa		2014		2019	5
Puerto Rico Science, Technology and Research Trust TTO	2004	2017			5
Axelrys, Canada		2020			2

Table 2. Number Of MiTTOs By Country	
Country	**No. of MiTTOs**
US	8
Canada	4
Australia	2
Chile	2
France	2
Germany	2
Japan	2
South Africa	2
Spain	2
Sweden	2
Switzerland	2
Bulgaria	1
India	1
Norway	1
Serbia	1
UK	1

Table 3. Number Of Years MiTTO Organizations Were In Operation

	NTTO	RTTO	NMiTTO
Number	13	17	5
Min	3	2	2
Max	72	24	21
Average	26	11	12
Median	26	8	11

Table 4. Funding Models Used By MiTTOs

External	17
Internal	5
Royalty share	6
Not Available	2
External plus Royalty	5

Table 5. Benefits Of MiTTOs
Kick-starts member institutions in commercialization
Establishes a pro-commercialization culture immediately
Provides a critical mass of personnel and resources
Provides access to a greater skill set than individual member institutions could afford / justify
Makes services available at no or reduced cost to member institutions, reducing barrier to entry
Allows for aggregation of complementary technologies from different sources
Provides a focal point for lobbying the importance of tech transfer to government at an early stage

Table 6. Challenges Encountered By MiTTOs	
Category	**Issue**
Financial	Scheduled expiration of funding
	Unscheduled loss of funding
	Insufficient external funding to support operations
	Retained revenues inadequate to support operations
	Member institutions resent MiTTO's retained revenue share
Strategic:	Control – a natural transition from an external MiTTO to individual in-house TTOs
	Lack of commitment to commercialization by member institutions
	Change in member institution's objectives with respect to commercialization
	Unrealistic expectations by member institutions of the timelines for commercialization success
Operational:	Member institutions' researchers feel inadequate attention from MiTTO
	MiTTO perceived as too selective in disclosures pursued / rejected
	Institutions keep the best disclosures to market themselves and send inferior ones to MiTTO
	Inadequate effort in training researchers, promoting commercialization and seeking out inventions
Cultural:	Competition between MiTTO and research office established at member institutions
	Conflict of values, culture and priorities between MiTTO and member institutions
	MiTTO too remote geographically from member institutions
	Inadequate communication from MiTTO to member institutions
	Member institutions feel inadequate ability to input into MiTTO personnel and operational choices
	Personnel in MiTTO lack pertinent qualifications and appropriate attitudes
	Researchers uncomfortable dealing with an external entity

Figure 1. Numbers Of MiTTO Organizations Operating By Decade

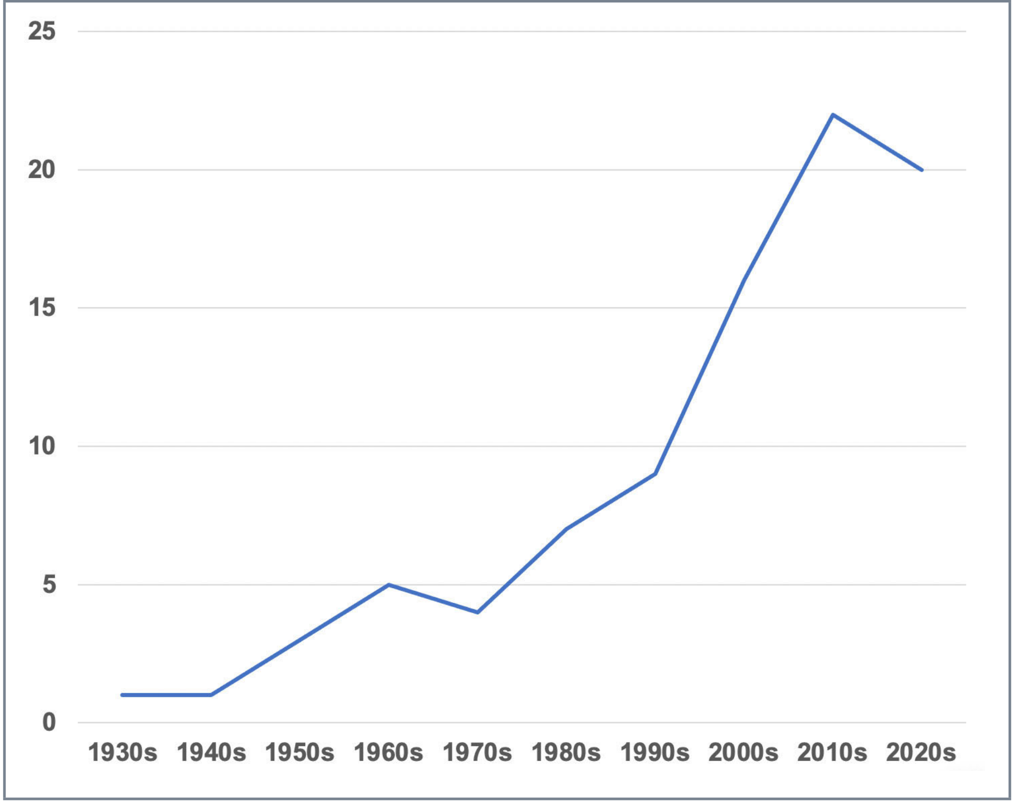


Figure 2. Numbers Of Different MiTTO Organization Types Operating By Decade

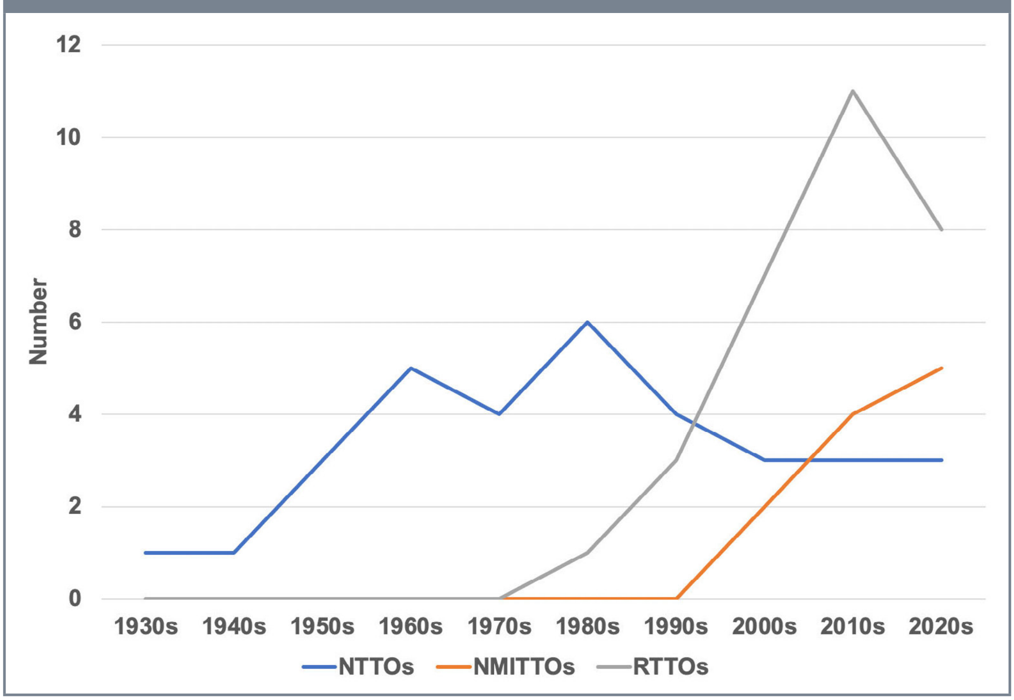


Figure 3. Number Of Individual MiTTOs Operating By Year

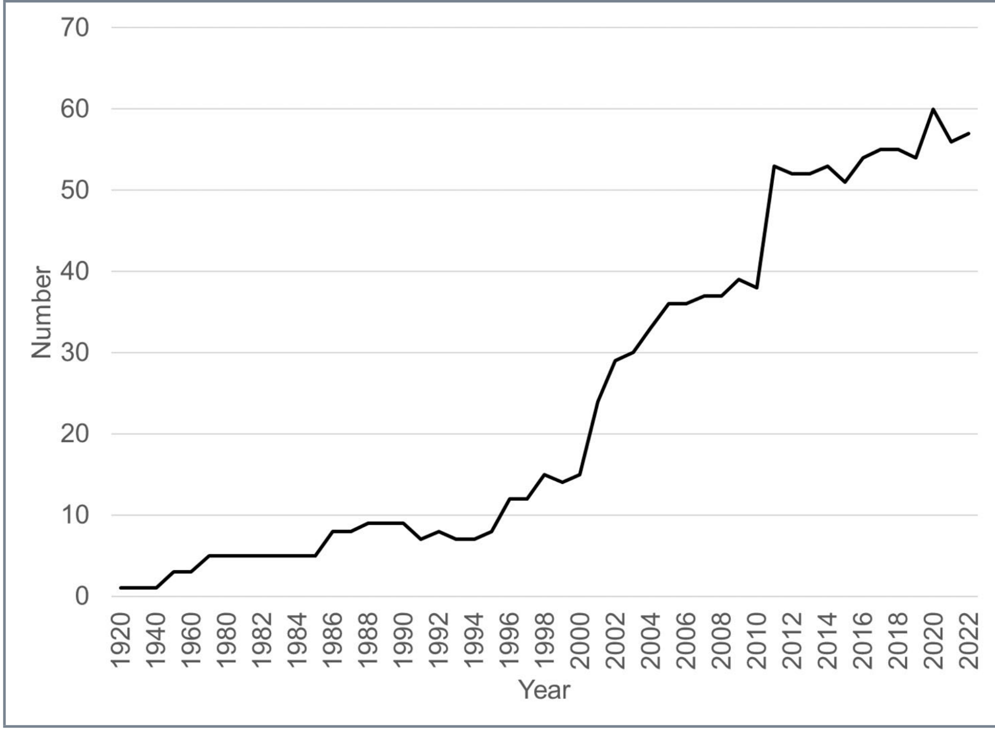


Figure 4. Duration Of MiTTOs In Five-Year Increments

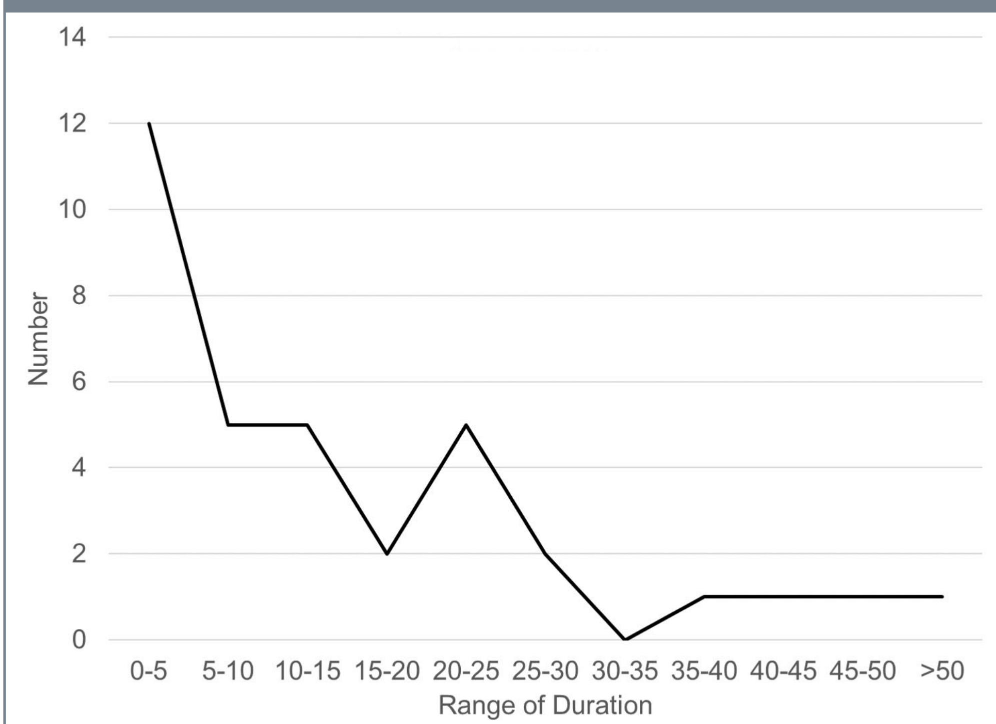
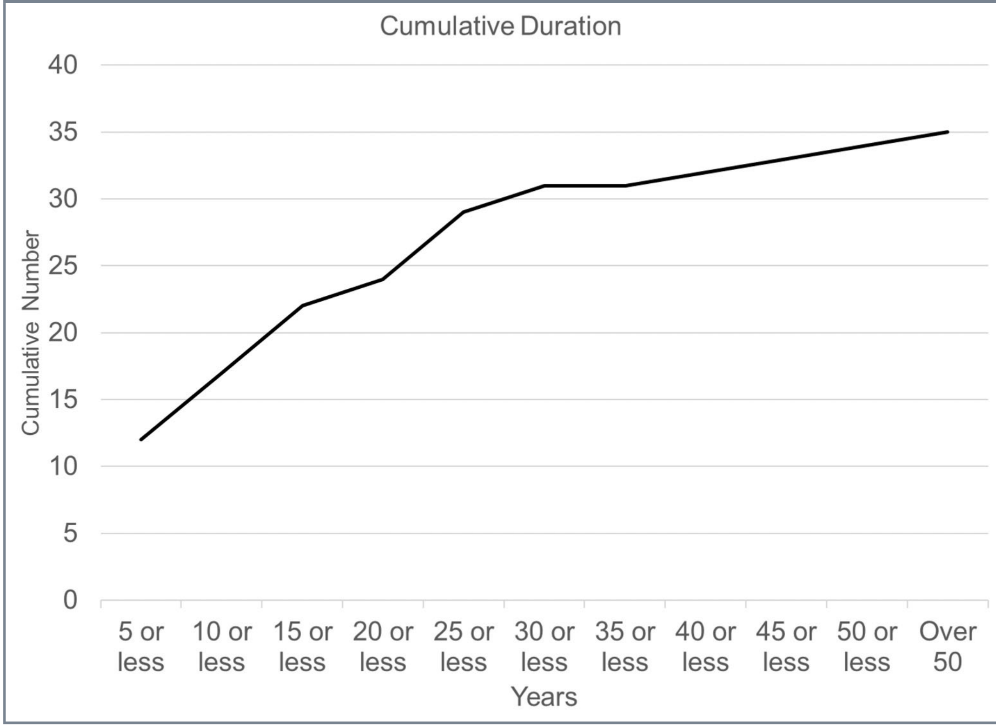


Figure 5. Duration Of MiTTO Organizations, Cumulative



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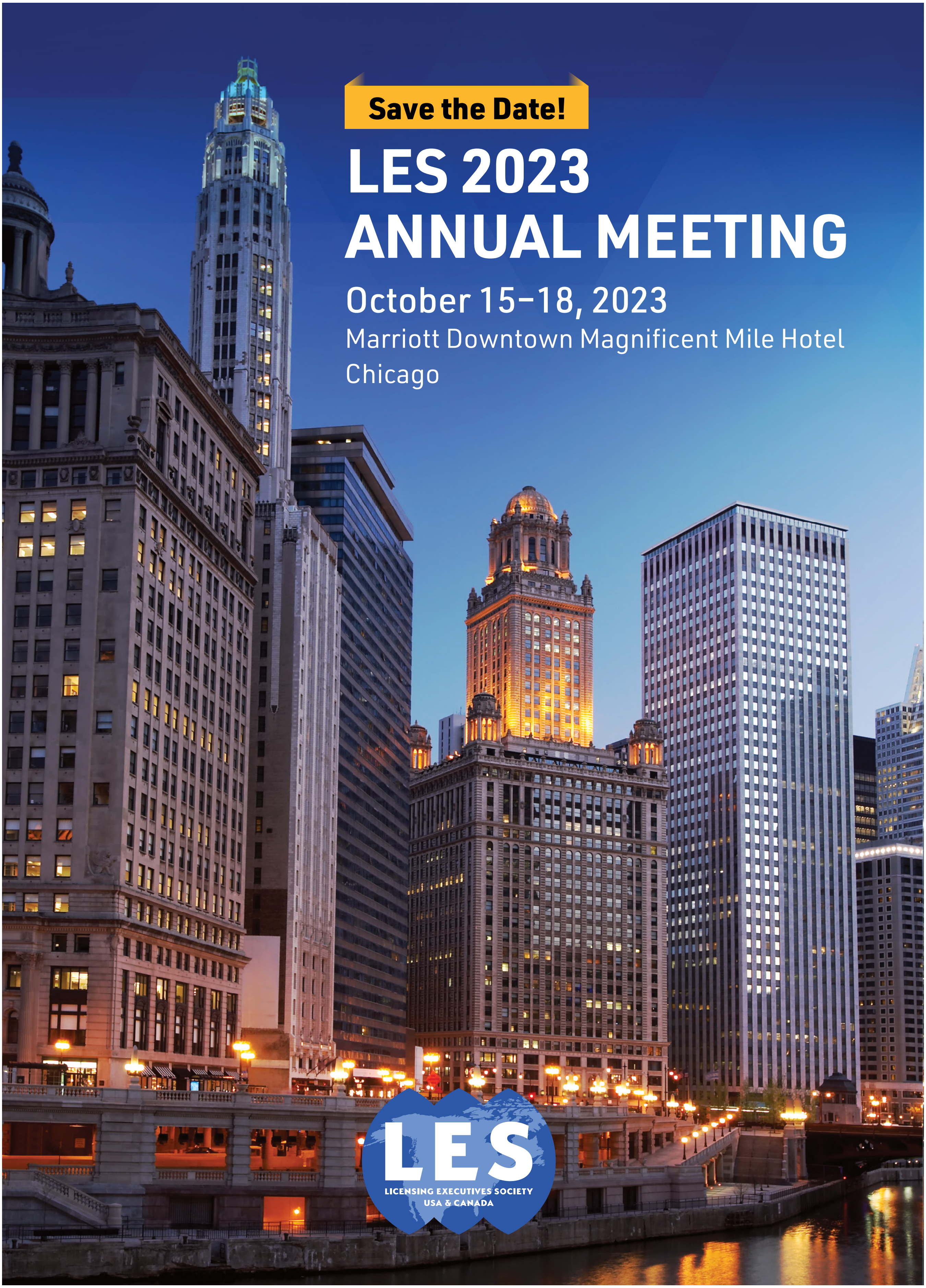
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