

Transferring patented New Zealand technology for commercialisation overseas

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Accordingly, if the Ministry is making technology the keystone of New Zealand's future economic well-being, it would be well advised to become better informed about the technology transfer process, as should the universities and particularly the private sector. (Moore 1999)

In 2011, the Ministry of Science & Innovation commissioned an independent panel to advise how government could enhance uptake of R&D services, including raising the number and quality of successful commercialisation ventures from university and Crown research institute (CRI) research. Responses received from surveys conducted by the panel (Raine *et al.* 2011) showed widespread concerns among companies about ownership and protection of their intellectual property (IP) and the cost of generating IP through publicly funded research providers.

Taken together, the opinions expressed to the panel enable the following conclusions to be drawn.

- Technology transfer (TT) is intuitively understood to be an important techno-economic process.
- The central interrelated roles of patent law and IP licensing are recognised, but not well understood.
- The significant differences between national TT (between domestic parties) and international TT (domestic 'licensor'; foreign 'licensee') are not explicitly recognised.
- The many successful TT initiatives taken to date by universities, CRIs and other New Zealand institutions were individual efforts, undertaken without support from a national framework for cooperation. In this regard it is noted that the hallmark confirming that the practice of technology transfer has matured at the national level is the existence of a professional organisation that publishes a journal and sponsors dedicated conferences. This status has yet to be achieved in New Zealand.

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Technology transfer in New Zealand

Technology transfer is a popular phrase within the science community. This article gives meaning to the phrase by projecting it as an integrated process. The technology transfer process has six interactive phases with key actions and indicators of transfer to distinguish progress through a flow-system model. The process is presented to promote awareness and understanding within the science community, and may enable scientists to take an active role in the successful application of their technology. (Risdon 1992)

Historically, technology transfer in New Zealand has been primarily a domestic field of activity, the focus being the transfer of technology from government-funded R&D institutions into New Zealand businesses. Technology transfer activities in New Zealand are now the purview Callaghan Innovation. A recent initiative in this area is the Technology Transfer Voucher programme, which is designed to meet the needs of the high-value manufacturing and services sectors. Vouchers are granted to New Zealand businesses to be redeemed in exchange for needed R&D services provided by pre-qualified New Zealand R&D partners.

Patents, trademarks, design applications and registrations, collectively referred to as IP, are business assets and, as such, can be bought, sold and licensed. The latest value for Royalty and licence fees, payments (Balance of Payments, current US\$) in New Zealand was \$668,925,400 as of 2010. Over the past 15 years, the value for this indicator has fluctuated between this and \$199,680,000 in 1995. (International Monetary Fund 2010)

The following discussion addresses the special case of technology transfer involving the granting of proprietary rights to a foreign national, under a licence agreement, to commercialise a patented invention based on New Zealand technology. The reasons for taking such an initiative include the following:

- Realisation that the costs of filing, maintaining, and (possibly) defending an international patent portfolio are prohibitive.

- There is a lack of domestic financing to enable building and testing of a product prototype.
- There is a perception that the New Zealand marketplace is too small and immature for product launch and marketability assessment.

Cautionary note re know-how

There is an insidious potential threat to the integrity of a licence agreement that is often exacerbated by geographic separation. This threat arises from failure to adequately understand the implications of the following considerations.

- Know-how is practical knowledge (often tacit) of how to actually build the first embodiment of the invention, typically a prototype.
- Know-how typically resides in the mind of the inventor and/or is protected as a trade-secret by the lessor.
- A patent need not teach, and preferably omits, what is well known in the art.
- A patent specification must enable one of ‘ordinary skill in the art’ to make and use the full scope of the claimed invention without ‘undue experimentation’.
- The meanings of ‘ordinary skill in the art’ and ‘undue experimentation’ are not precisely defined which, as evidenced in case law, often results in disruptive disputation.
- Consequently, if a licence that covers patents does not explicitly allow access to collateral know-how, commercialisation will be frustrated.
- Negotiating a ‘hybrid licence’ covering both patents and trade secrets pre-empts the occurrence of this risk.

Commercialisation – at the coalface

During 1993–2003, as Principal, Techtran Consultants (‘Techtran’), I was retained by both Auckland Uniservices and IRL as a technology transfer consultant. In this context ‘technology’ means any technology-based innovation either patented or deemed to be patentable. As summarised in Table 1, 27 New Zealand technologies were submitted to Techtran during that period for consideration of commercialisation. Of these, 15 were screened out as not being viable propositions (Moore 2003). A marketing plan based on a customised licensing strategy was implemented for each of the eight qualified technologies, resulting in the grant of 11 licences.

In all cases Techtran had direct access to the patent attorney involved. Both Uniservices and Industrial Research used large reputable firms, the resultant patent filings being of relatively high quality. These two IP owners also had the resources to (a) file in several countries, and (b) build demonstration prototypes.

The outcomes from the commercialisation of the two technologies, ‘Variable Room Acoustics System’ and ‘Inductive

Power Transfer’, have been notably successful. The marketing and technology transfer scenario for each of these cases follows.

Commercialisation of Variable Room Acoustics System

‘Theatre’s transformation is music to the ears.’ Thus did Brian Rudman head up his column in *New Zealand Herald* on Monday 11 June 2012 describing his auditory experience on attending the opening night of New Zealand Opera’s *Rigoletto* in the ASB Theatre, Aotea Centre, Auckland. ‘Who says miracles don’t happen?’ he asks, when reporting that twenty-one years after the Aotea Centre was opened it had finally been transformed into the fine-sounding performance space that was promised all those years ago. ‘Last Thursday’, reported Rudman, ‘I turned up expecting once again to hear the singers and orchestra struggling to fill the dull, unresponsive hall with sound. But from the opening rumbles of the orchestra it was obvious that something magical had happened during the interior upgrading over the summer.’

This remarkable improvement has been enabled by an innovative acoustics system, named Variable Room Acoustics System (VRAS), invented by Dr Mark Poletti with Industrial Research Limited (IRL).

VRAS is an acoustic enhancement system for controlling room acoustics electronically. It uses multiple microphones distributed around the room, fed via a multichannel digital reverberator to multiple loudspeakers to provide controllable enhancement of the reverberation time of the room, and microphones above the stage area fed via a multichannel delay system to multiple loudspeakers to provide early reflections.

Commercialisation scenario

In 1994 IRL retained Techtran to commercialise several patented innovations including VRAS. Following the production of a VRAS brochure, Techtran contacted and solicited the interest of senior managers in 50 sound system manufacturers, without success. Consequently, the focus of the marketing effort was shifted to acoustics engineering and development companies, and this resulted in the identification of Level Control Systems (LCS), located in California, as a potential licensee. Techtran visited LCS in July 1996 and briefed their chief engineer, who expressed sufficient interest to justify the execution of an IRL/LCS Letter of Intent to negotiate. In November 1996 Dr Poletti visited LCS for several days of technical discussions that confirmed their engineering capabilities.

In September 1997 a licence agreement was executed whereby IRL granted LCS an exclusive licence covering all possible applications of the technology protected by the VRAS patents. It was conditional on a successful demonstration of a VRAS prototype. Dr Poletti had installed an earlier prototype

Table 1. Licensing statistics for some New Zealand organisations.

	Auckland Uniservices	Industrial Research	Small Business	Individuals	Totals
Number of submissions	5	10	4	8	27
Patented submissions	5	10	3	1	19
Qualified and marketed	4	4	1	3	12
Licences granted	5	6	0	0	11

VRAS in the Adam Concert Room, Victoria University of Wellington. The VRAS algorithms were implemented on the LCS LD88 processor and installed in the Adam Concert Room system in March 1998. This installation was demonstrated to LCS and a revised licence agreement was signed.

Subsequently, systems were demonstrated at a number of trade shows and Audio Engineering Society Conventions. VRAS received a positive market response. For example, it won 'Sound Product of the Year' at a Lighting Dimensions International Trade Show in Florida, 1999. Many systems were installed over the following years.

In November 2005 LCS was acquired by Meyer Sound, and VRAS was re-branded as the Meyer Constellation system. Constellation has since been installed in many countries, including USA (e.g. Zellerbach Hall, Berkeley), Finland (Logomo Hall), Spain, Estonia (Nokia Concert Hall), Austria (MUMUTH, Graz), Switzerland, China, and Chile (Teatro Municipal de Las Condes, Santiago) and has received praise from users. For example, in the words of John Adams, Pulitzer Prize-winning composer, 'Constellation is, to my ears, living proof that skilled engineering and technology can indeed improve the physical spaces where we listen to music.'

To date IRL has received royalty payments from LCS/Meyer Sound in excess of NZ\$1 million. To learn more about the successful commercialisation of VRAS, see: www.meyersound.com/, or www.irl.cri.nz/our-research/information-and-communication-technologies/audio/

At the 2012 New Zealand Research Awards, administered by the Royal Society of New Zealand (RSNZ), Dr Poletti received the 2012 Cooper Medal for his world-leading development of the globally preferred method for tuning concert hall acoustics, now commercialised as the 'Constellation' system. In its citation, the RSNZ noted that the unique feature of Constellation, which is installed in over 100 halls and theatres on four continents, including the Aotea Centre's ASB Theatre in Auckland, is its ability to alter the acoustics of a space and so allow optimal reverberation for differing types of music.

Commercialisation of Inductive Power Transfer Technology

In 1971, Professor Don Otto exploited resonant coupling to inductively power a small trolley at the University of Auckland. In 1990, Drs John Boys, Andrew Green, and Fred Nassenstein at the University of Auckland proposed the use of inductively powered transporters as an alternative to linear induction motor-powered conveyor belts in cold-storage systems and later demonstrated a 180 W prototype of an inductively powered 'rail transporter'. Subsequently, Dr Boys and his co-workers converted the electrification system of a Daifuku industrial monorail carriage from bus bar/sliding contact to inductive coupling. Consequently, Auckland Uniservices Limited ['Uniservices'] granted Daifuku Co., Ltd., Osaka, Japan an exclusive license to apply IPT in material handling systems including cranes.

In 1991, Uniservices retained Techtran to commercialise several patented innovations including the application of 'inductive power transfer' in electrified 'people mover systems', including battery charging. At that juncture it was agreed that,

for marketing purposes, the technology would be named 'Inductive Power Transfer Technology (IPT).

The initial strategy was to solicit the interest of major manufacturers of electrically powered vehicles [rail; road] through direct contact and by advertising in selected trade journals. Senior executives in 66 target companies were contacted and briefed. Of the 28 companies (42%) that responded, only one, namely the Insul-8 Corporation, could be considered as a potential IPT licensee.

The Insul-8 Corporation, located in Omaha, Nebraska, was a member of the Delachaux Group, France. Techtran visited Omaha to assess Insul-8's capabilities and to discuss possible licensing terms and conditions. Subsequently, senior Insul-8 managers were given an in-depth IPT technical presentation in Los Angeles by Dr. Andrew Green. A Techtran/Insul-8 'Letter of Intent' was then executed whereby Techtran recognised Insul-8 as a potential IPT licensee to be considered when a final licensing decision was made.

Market-maker strategy

To ensure leverage when negotiating a licence agreement two or more potential licensees are required. To this end a 'market maker' strategy was initiated whereby potential 'end-users' of IPT-based products would be induced to create market demand. It was decided that the theme park market sector best met the criteria for implementation of this strategy, because:

- The sector has high visibility, is global in scope and economically sound.
- It is composed of a large number of businesses that depend on the operation of electric vehicles powered through devices making sliding contact on busbar, third rail, or 'catenary cable'.
- If inductive coupling replaced sliding contacts, it would obviate some serious safety and maintenance issues.

Consequently Techtran contacted and briefed an executive-level engineer in each of the following corporations: Time Warner/Six Flags – New York; MCA/Universal Studios – Universal City, Los Angeles; and Walt Disney Imagineering – Burbank, California.

Highlights from the marketing scenario that subsequently evolved are as follows.

Six Flags

Techtran contacted Six Flags' VP Engineering in New York City and was informed that Six Flags was committed to utilising LIM technology to inductively power future ride systems in their theme parks.

Walt Disney Imagineering

Being responsible for the totality of Disney's engineering design and development and the building of Disney's parks and attractions worldwide, this organisation keeps its operations highly confidential and does not respond to unsolicited phone calls. Fortunately, Techtran's Principal and Imagineering's Senior VP for Show Time Engineering had been fellow VPs with Xerox Electro-Optical Systems, and Techtran was invited to visit Imagineering. Techtran met with three Disney engineers, signed a Disney Non-Disclosure Agreement and gave an IPT briefing. Subsequently, Dr Boys gave a technical briefing in

California to some 20 engineers from Imagineering. Disney then contracted with Uniservices to perform two IPT demonstration programmes.

The first Disney contract required Uniservices to demonstrate that a battery-powered vehicle from the Autopia ride attraction could be modified to be inductively powered and guided by IPT. Dr Green was the technical manager of this programme. The 50 kW power supply and related equipment were built in New Zealand and delivered to a secured Disney location in California. The demonstration site was a concrete paved surface into which a quarter mile long, square-sided slot was cut [in the form of a quasi-figure-8] into which a customised US-manufactured Litz wire track cable was placed, then connected to the power supply. The battery-powered drive was removed from the Autopia vehicle and the IPT pick-up system was installed. Then, the IPT-powered vehicle was test-driven successfully by several Disney engineers.

The second Disney contract required Uniservices to demonstrate that a 'wheeled truck' on rails could be inductively powered by IPT, safely and reliably, when fully submerged in water. This system was built in New Zealand and demonstrated to a Disney engineer at the University of Auckland. The technical manager was Dr Green. The demonstration was successful.

Detroit Center Tool

Techtran received an unsolicited phone call from a Detroit Center Tool ('Detroit') representative located in Japan who had become aware of the Disney demonstrations. He expressed strong interest in becoming better informed about the IPT technology. Consequently Techtran visited Detroit in Michigan, held discussions with Detroit's CEO and evaluated their engineering and manufacturing capabilities. A Techtran/Detroit 'Letter of Intent' was signed whereby Techtran recognised Detroit as being a potential IPT licensee who would be so considered in future licensing negotiations. Later, Techtran accompanied Detroit's VP Marketing to a meeting with Disney engineers in Burbank, California.

Wampfler AG

Techtran received an unsolicited phone call from the California-based representative for Wampfler USA, requesting information about the Uniservices/Disney IPT demonstrations. Wampfler USA, located in Florence, Kentucky, is a subsidiary of Wampfler AG, Weil-am-Rhein, Germany, and a major supplier of busbar electrification systems for Disney theme parks. Subsequently Techtran contacted the President of Wampfler USA and provided him with an IPT briefing document to be forwarded to Wampfler AG, Germany. Later Dr Boys and Techtran were invited to visit Wampfler AG, where Dr Boys gave an in-depth IPT presentation to their senior engineers while Techtran met with members of the Wampfler AG Advisory Board.

Subsequently Wampfler AG expressed very strong interest in becoming the IPT licensee for people mover applications. However, this interest was conditional upon their being granted some crane application rights already licensed by Uniservices to Daifuku Co. Ltd., Osaka. Consequently, Techtran and Uniservices' President Dr. John Kernohan, together with the General Manager, Wampfler AG, met with Daifuku in Osaka, and negotiated a mutually acceptable agreement re Wampfler AG's condition re crane application rights.

At this point the three IPT licensee candidates (Insul-8; Detroit; Wampfler AG) were fully informed about the successful Disney demonstrations validating IPT technology and the two major 'end-users' of electrification systems for people movers, namely Disney and Universal, perceiving IPT to be superior to electrification by busbar/sliding contact. Following due consideration of the three candidates Dr Kernohan and Techtran negotiated licensing terms and conditions with Wampfler AG in a meeting in Osaka, following which, in May 1996, Uniservices granted to Wampfler AG the exclusive right to apply IPT in people movers including battery chargers.

Wampfler (Germany and USA) - IPT Commercialisation Initiatives

First commercial IPT-powered people mover

During the period that Techtran was marketing the IPT technology for commercialisation, the New Zealand Maori Arts and Crafts Institute ['NZMACI'] initiated a multi-million dollar project (Supervising Architect: Logan Brewer) for the redevelopment of the Whakarewarewa thermal reserve, near Rotorua. This included the installation of an 'environmentally friendly' people mover, for which proposals were solicited worldwide. Uniservices proposed a battery powered bus system based on IPT recharging the batteries while the bus was at the loading/unloading platforms. Techtran reviewed and promoted Uniservices' proposal with Logan Brewer in a meeting in Los Angeles.

Uniservices' proposal was accepted by NZMACI, but the date of award was later than the date of execution of the Uniservices/Wampfler exclusive IPT licence agreement. A potential impasse was resolved by execution of a collateral agreement whereby Wampfler AG assumed contractual responsibility, retained the services of Dr Ross Green (Wellington Motors) as Programme Manager, and subcontracted the engineering design, development and installation of the IPT-based 20 kW battery recharging system to the Electrical Engineering Department of the University of Auckland. During 1996–2007 this battery recharging system was maintained by Wampfler USA.

Following the installation of the Whakarewarewa bus system, Wampfler AG launched its programme to commercialise the application of IPT in people movers through the following two actions.

First, the company hired Dr Andrew Green [IPT co-inventor] to (a) begin transferring the IPT technology and technical 'know-how' from Auckland to Weil-am-Rhein, and (b) establish an IPT R&D department within Wampfler AG.

Secondly, it retained Techtran to develop a marketing strategy for the commercialisation of IPT by Wampfler. At the outset of this assignment, Techtran facilitated meetings between Wampfler AG engineers and the following parties in the USA: Walt Disney Imagineering (discussed possible use of IPT to power submarine ride); Universal Studios (discussed Wampfler building a 75 kW underwater tug); Edison EV (discussed issues in developing large networks of EV re-charging stations); Chrysler Corporation, EV Division (discussed inductive battery charger concepts); Aerovironment (co-developer of General Motors' EV1 electric car, re EV1 inductive charger technology); and Sierra Autocars (examined and drove one of first EV1s delivered in Southern California).

Demonstration railway

Wampfler AG publicised its being awarded the exclusive Uniservices IPT people mover licence by building, at Weil-am-Rhein, a several hundred yard long IPT-energised [100 kW] railway track, one section submerged under water. IPT-powered trucks travelled on the track during a demonstration to an invited audience including representatives from government, industry and media.

IPT-Charged Buses

During 2002–03 Wampfler AG installed a 60 kW IPT-charge system for 20 buses operated by GTT in Torino and a similar 10-bus system operated by AMT in Genoa, Italy. These buses travel 200 km per day without having to return to the depot for charging.

Disney Red Car Trolleys

The Red Car Trolleys transport visitors throughout the Disney California Adventure Park. These trolleys are 26 feet long, 8 feet wide, 11 feet tall and powered by an IPT-charged 12-volt battery system. The batteries are fully recharged at night, providing enough energy for two round trips in the Park. The battery pack can be recharged in six minutes at any one of the scheduled stops.

Conductix-Wampfler

In 2007 the Delachaux Group acquired Wampfler AG and merged it with Conductix to form Conductix-Wampfler. The Conductix-Wampfler IPT people mover commercialisation programme is defined by three product lines: IPT-Charge®, IPT-Rail, and IPT-Road. The 2010 Frost and Sullivan Europe New Product Innovation Award in the electric vehicle charging infrastructure market was presented in recognition of Conductix-Wampfler's IPT-Charge®.

First commercial fully-submerged IPT-powered people mover

The original 'Submarine Voyage' at Disneyland, Anaheim, opened in June 1959 and closed down in September 1998. A key reason for the closure was that (a) the submarine operators and guests were exposed to diesel exhaust emissions on a daily basis, and (b) the toxicity levels of exhaust emissions exceeded the limits set by regulatory agencies.

In 2005, Techtran and Wampfler USA met with Imagineering engineers to consider the possibility of using IPT to power the submarines in an updated submarine attraction. It was readily agreed that IPT met the power requirements and that the two underwater IPT-powered tug experiments (previously sponsored by Disney and Universal, respectively) gave sufficient assurance of reliability and safety.

Consequently in June 2007 a new IPT-powered submarine attraction named 'Finding Nemo Submarine Voyage' was opened. Each of the 8 submarines is 52 feet in length with a displacement of 94,000 pounds. The length of the submarine guide track is 450 metres. The major IPT sub-systems are: primary power supply, 320 kW (4 units @ 80 kW each); on-board IPT pick-ups, 10 kW (2 per submarine @ 10 kW each); and submerged IPT primary: 900 m of encapsulated Litz wire.

This IPT-powered submarine system was designed, built, and installed by Wampfler USA under the direction of Project Manager Eberhard Vonhoff. To learn more about the commercialisation of IPT by Conductix-Wampfler, see: www.wampfler.com and www.conductix.us

Universal Studios

Techtran initiated discussions with Universal Studios during the same period that the Disney/Wampfler scenario was playing out. Following the execution of the Uniservices/Wampfler licence agreement, Universal contracted Wampfler to build a prototype 75 kW underwater IPT system designed to power a 'Jaws-themed' park attraction in Japan. The prototype was built by Wampfler AG and delivered to Universal Studios under the direction of the Wampfler programme manager, Dr Andrew Green. Subsequently, for reasons unrelated to the IPT technology, Universal Studios aborted the proposed attraction.

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