Department of Education, Science and Training

Commercialisation Case Studies
From the:
National Survey of Research Commercialisation Years 2003 and 2004

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Introduction

The National Survey of Research Commercialisation (NSRC) for 2003 and 2004 provides quantitative information on the commercial application of research carried out in Australian universities and other publicly funded research bodies. The survey, first conducted for the year 2000 and again for 2001 and 2002, is intended to provide insights into the major areas of commercialisation activity to inform research and innovation policy and management in Australia.

These case studies are provided as a companion volume to the NSRC report. They present qualitative information on the range of commercialisation practices pursued, the challenges people face in bringing research to commercial application, and the strategies employed to overcome them. They provide examples of how discoveries from publicly funded research are being applied in the community to save lives, improve the quality of life, generate wealth, and strengthen the economy by increasing competitiveness and productivity.

The stories behind the statistics help us to better understand factors involved in achieving successful research commercialisation outcomes. Both the NSRC data and the case studies provide evidence that the process of research commercialisation is complex, broad, multi-faceted, risky, and time consuming. These themes are described in more detail in the NSRC report for 2003 and 2004.

About the case studies

Respondents to the NSRC for 2003 and 2004 put forward examples of their commercialisation success stories. Of these 19 were selected for inclusion that were the most descriptive in terms of the factors that contributed to the commercialisation progress to date and the impediments overcome by the people involved in achieving this progress. The novelty and impact of the innovation were also considered, as was the need for a range of science disciplines and commercialisation pathways to be represented.

Coretext Pty Ltd assisted by interviewing participants and preparing the case studies on behalf of the Department of Education Science and Training. The information presented in the case studies is correct as at September 2006.

It should be noted that some of the stories refer to the development of intellectual property which has not yet been commercialised, but which carries significant commercial promise. In addition some of the case studies may have already received coverage elsewhere.

Case Studies

Air-conditioning technology (University of Adelaide)

As desktop computers began their quiet invasion of offices in the late 1970s, workers became aware of an insistent noise previously masked by the clatter of typewriters – the asthmatic hiss of ancient air-conditioning systems.

Tens of thousands of office buildings constructed in the post-World War II building boom have air-conditioning systems that are long past their use-by date.

Even with the advent of improved designs in the late 1970s, a response to the oil crisis and soaring energy costs, office air-conditioning systems remained noisy, costly to run and unequal to the task of maintaining an even temperature, and even tempers, in the modern electronic office.

In the early 1990s, an outdated, noisy air-conditioning system was driving tenants out of a multi-storey office block owned by the University of Adelaide.

Air-conditioning companies and consultants couldn't help as there was no known way to fix the problem, and the cost of buying and installing a complete new system was prohibitive.

One day in 1994, Vladimir Petrovic, a PhD student at the university, sat down to discuss the problem over coffee with his mentor, Emeritus Professor Sam Luxton, Professor of Mechanical Engineering.

The problems of noise, inadequate performance and high running costs were traced to a single source in old-style induction air-conditioning units, the circular nozzles feeding air into the system's heat exchangers and delivering the warmed or cooled air from the exchanger into the building.

Modifying the nozzle design to smooth airflow through the heat exchanger would reduce internal pressure and deliver more air at lower pressure into the building.

A design that could simultaneously reduce air pressure but increase flow rate, which are normally incompatible objectives, would mean greater efficiency, less noise and avoid the huge costs involved in replacing entire, outdated systems. It could yield enormous energy savings as well as reductions in capital and operating costs.

Professor Luxton sketched a design for a novel, star-shaped nozzle on the back of an envelope. With its greater surface-to-volume ratio, it would provide more rapid heating and cooling. By reducing resistance to airflow, it could deliver higher and improved flow rates with no increase in operating pressure, and improve turbulent mixing of the air in office spaces without increasing noise levels.

Dr Petrovic set to work on a prototype, applying the principles of aerodynamics, aero-acoustics, fluid dynamics, and his knowledge of control systems and air conditioning.

His second design delivered dramatic improvements in efficiency and noise reduction. After a relatively inexpensive retrofit that retained most of its original system, ducting and heat exchanger, the unloved building became usable again and tenants moved back in.

Dr Petrovic and Professor Luxton initially regarded the university's problem as a one-off challenge to their expertise as engineers, but their ingenious solution clearly had much wider commercial potential. They decided to assess the size of the potential market for retrofitting air conditioning systems in office buildings around Australia and in the rest of the world. The estimate came to billions of dollars.

In 1994, they obtained a licence from the University of Adelaide for the intellectual property they had developed, and went into business. They founded a private company, Dadanco Pty Ltd, in 1994 and began commercialising their novel technology in early 1997.

Dadanco today has a market capitalisation of $12 to 15 million and the university continues to benefit from the royalty stream.

Dr Petrovic, managing director and chief executive, says the university's experience showed that today's office workers have higher expectations of their working environment than those of 50 years ago. An inefficient, noisy air-conditioning system can be an incentive to work elsewhere.

Moreover, health and safety standards for the working environment are now enshrined in legislation in most developed nations and the cost of compliance can be very high.

Today the company's products include refurbishment kits, retrofit units and new air-conditioning systems custom-designed for modern office buildings.

Petrovic says that initially, it was a challenge convincing sceptical customers that a small, Adelaide-based company had invented a revolutionary air-conditioning technology that could save companies around the world tens of billions of dollars by allowing them to retrofit buildings and upgrade their obsolescent, inefficient air-conditioning systems to world-best performance.

The university's retrofitted building was solid proof that their technology worked. They began winning new contracts. Industry and scientific awards soon followed and as their reputation spread business snowballed.

Among the 160 buildings Dadanco has retrofitted or installed in Australia and around the world are the two Capita office blocks in Adelaide and Perth, the AMP building in Sydney, the MLC Building in Brisbane, the 45-storey Australia Square building in Sydney, and Nauru House, Collins Wales Place and the 44-storey 385 Bourke Street office tower in Melbourne.

Dadanco refurbishment kits, retrofit units and new custom-designed and built air-conditioning systems have been installed in Australia, New Zealand, Great Britain, Sweden, the United States, China, Singapore, Malaysia and Sri Lanka.
The tropical climate in the latter countries places special demands on air-conditioning systems because of the high temperature and humidity of the primary air inflow.

Dadanco recently launched a second component for the retrofit market, the Inffuser, which it describes as a breakthrough technology suited for buildings where significant energy savings can be achieved with minimal investment. The Inffuser increases the temperature of the air delivered into a building by mixing warm air from within the building with a low- to medium-temperature primary airflow from outside.

Architects are now designing new buildings around Dadanco proprietary technology, such as the new, three-storey office building at Brindabella Business Park adjacent to Canberra International Airport – the first office building in Australia to obtain a five green-star rating for energy efficiency.

Dr Petrovic says the reduction in greenhouse gas emissions for a typical 20,000 square metre office block is equivalent to taking 150 to 200 cars off the road, with air-conditioning units contributing to this reduction.

Nutrients from waste (University of Western Sydney)

In a story akin to selling ice to Eskimos, Australian researchers have pioneered a process to add value to the waste produced in cheese-making and licensed it to a French company.

The cutting-edge technology separates the lactose contained in whey, a by-product of cheese production, and purifies it into valuable pharmaceutical-grade lactose for use in medicines and health supplements.

The process was pioneered by University of Western Sydney (UWS) researchers, Food Science Australia (FSA), Australia's largest food research and development organisation, and Dairy Australia, the dairy industry services association and licensed to French company Applexion (part of Groupe NovaSep) in 2005 for an undisclosed amount.

Asia Pacific area manager for Applexion, Jean de Lataillade, says the partnership could lead to Australia becoming a world-leader in this type of technology, but is also important for cheese manufacturers and cheese lovers globally.

"As a nation of cheese lovers, it seemed only natural for France to become involved in this venture," he says.

One of the key researchers behind the project, UWS research scientist Dr Rosalie Durham, says cheese production creates a lot of waste.

"The production of one kilogram of cheese requires 10 litres of milk, leaving nine litres of whey." She says that although some whey is converted into high-value products, much more is sold cheaply or discarded as waste, usually as animal feed or on to fields, an economic loss.

"Australia's dairy industry produced 3.6 million tonnes of whey in 2005. This volume is increasing as worldwide cheese production trends upwards, making this technology of increasing importance to the worldwide dairy industry," says Dr Durham, who developed the technology with UWS Associate Professor Jim Hourigan and FSA's Dr Robert Sleigh.

One of the dairy industry's greatest challenges is maximising financial profit from whey components, something this process allows for. Through 10 years of research, the team developed, patented, tested and refined to pilot scale the technology to make high-purity lactose from whey.

The ion exclusion lactose technology separates the lactose contained in whey and recovers other soluble whey minerals and calcium salts, maximising the value of the whey generated from the cheese-making process. A key aspect of the process is the reuse of salt and water from the whey to operate the process.

Dr Durham says the advantage of the technology is twofold – the recovery of valuable nutrients and the reduction of waste.

"Our technology gives the Australian dairy industry, and dairy industries worldwide, the opportunity to recover valuable components from their manufacturing waste and potentially generate millions of dollars from what they are throwing away," she says.

It can also reduce chemical use, says Mr Lataillade.

"In a related application, it reduced chemical consumption by 50 per cent. It therefore allows for the doubling of capacity without increasing chemicals consumption," he says.

Mr Lataillade says the technology will appeal to Australian dairy companies because it is a home-grown invention.

"More importantly having a team of researchers in Sydney able to guide them in the validation process will appeal to Australia's dairy industry."

UWS's Dr Hourigan says the technology could also lead to the expansion of existing factories.

"Expansion of some of large cheese factories has been somewhat limited by the inability to effectively dispose of the tonnes of whey permeate generated daily. By adapting their existing processes, companies will be able to meet tougher environmental regulations and zero discharge standards that require them to recover and re-use all valuable components in food processing waste," he says.

Sensing the potential of the Australian research, Applexion made an offer to license the technology, securing an exclusive worldwide licensing deal in 2005.

It is commercialising the invention in conjunction with its patents in the same area and will design, build and sell the dairy processing technology. The company has already undertaken extensive pilot-scale testing and is building industrial-scale plants for dairy clients.

The agreement is a strategic decision for Applexion. The technology expands its world-class capabilities in process and product development and in turn-key systems for food and pharmaceutical ingredients.

Estimating potential worldwide markets is difficult, says Mr Lataillade. "We need to see how it develops during the few next years. The price of lactose is now at record high figures so this brings more opportunities."

The technology has been widely recognised. In 2003, it won the Environmental Sciences Technology Sector Award at the Australian Knowledge Commercialisation Forum and Fair of Ideas. Then in 2005, the group won the Dairy Industry Association of Australia – Australian Innovation Award.

Australian researchers are now working to further the application of this technology in the dairy industry and also adapt the technology to extract valuable substances from sugar, wine, soy, fruit and vegetable processing waste.

Speech processing strategy (Bionic Ear Institute)

Globally, tens of thousands of hearing-impaired children and adults have had the world of sound opened for them by Australian bionic ear company Cochlear Ltd.

The revolutionary device, developed in Melbourne by a team led by Australian researcher Professor Graeme Clark, commands a majority of the global market thanks to research that allows it to maintain a technological edge over its rivals.

As clever as it is, the bionic ear, or cochlear implant, shares a problem with all conventional hearing aids: users cannot clearly perceive human voices in noisy environments – a busy street, classroom, factory production line, or a social gathering.

Researchers at the Bionic Ear Institute in Melbourne have developed a new speech-processing software suite called Spike-based Temporal Auditory Representation (STAR) that more closely replicates the way the human ear responds to sound and codes the resulting information for the brain's auditory centre.

Dr David Grayden, a senior research fellow with the institute, says a dozen adults with cochlear implants have already pilot-tested a basic implementation of the STAR software, using a take-home device that allows them to experience STAR in everyday life.

The volunteers were given time to familiarise themselves with the different presentation of auditory information, then tested in noisy and quiet environments to measure any improvement in their ability to perceive speech.

Dr Grayden says many "bells and whistles" can be added to the basic software to improve its performance, but even without these enhancements, some of the adult volunteers have demonstrated an improvement in their ability to perceive speech in noisy environments.

Others have not shown any improvement, perhaps because of a dislike of the higher frequencies involved, or their unfamiliarity with the new system, he says.

"But everyone performed as well with STAR as they did with the current clinical implementation. We're optimistic that children will do better, because their brains still have the plasticity required to make use of the extra information."

Dr Grayden says STAR is based on a model of the way human hearing actually works, where current strategies take a more engineering-driven approach to stimulating the auditory nerves.

"Existing strategies divide sound into different frequency bands, and electrodes stimulate the auditory nerve at a pre-determined rate based on the spread of frequencies," Dr Grayden says.

"Existing software represents all sound, including speech, at a fixed rate. The STAR software stimulates the auditory nerve at the same rates as the important pitches of the incoming sound. If there is an incoming 500 Hertz (cycles per second) sound, the electrodes stimulate the auditory nerves at a frequency of 500Hz. If the sound changes to 800Hz, the software stimulates the auditory nerve at 800Hz. In noisy environments, the speech and noise signals are mixed across the frequency bands, making it hard for the brain to distinguish the peaks representing speech from those representing background noise," he says.

The effect of this is reduce the listener's ability to detect the rising and falling frequencies characteristic of speech, making it difficult for them to detect and 'track' speech amid the clutter of background noise.

"The STAR software is an attempt to replicate how the basilar membrane of the cochlea vibrates and stimulates the auditory nerves to signal in phase with the incoming sound. It allows the cochlear implant user to lock on to the sounds of speech," he says.

The provision of this time-dependent information is particularly important for speakers of Asian tone languages, where the meaning of a word can vary with the relative pitch at which it is spoken.

Current software does not yield this time-varying information very well, making it difficult for a speaker of a tone language like Mandarin or Cantonese to detect speech and to make sense of what they are hearing.

"A lot of work has been done with Cantonese children. Cantonese has seven basic tones, but with current strategies, children with a cochlear implant detect only two or three, so they learn to speak with only those that they hear. The ability of the STAR strategy to lock on to the pitch of a voice may help these children to better hear the tones in their language."

The Bionic Ear Institute is a not-for-profit institute, focused on research into human hearing and developing improved software and hardware for the bionic ear.

Dr Grayden says it may be 2009-10 before STAR is ready for implementation. Cochlear Ltd will be the institute's first choice as licensee, but the company will evaluate it against its own alternative speech processing strategies.

There is no guarantee that Cochlear will adopt STAR. Dr Grayden says Cochlear's leadership in the global market is due in large part to the fact that new technological advances must compete to be included in new versions of the bionic ear and only the best are selected. But he believes STAR has particularly good prospects because it is biologically inspired. It most closely replicates the way the human ear and brain process sound, and further improvements on the basic system are in the development pipeline.

A report prepared by Access Economics for the Cooperative Research Centre for Cochlear Implant and Hearing Aid Innovation estimated the real financial cost of hearing loss to the Australian economy in 2005 at $11.75 billion, or $3,314 for each of the 3.55 million Australians with hearing loss or impairment.

The bionic ear is typically implanted in children with severe to total hearing loss at a very early age. As the technology improves, it becomes easier for them to pursue a conventional education and participate fully in the workforce, with substantial savings to the economy.

Web-based intelligent decision support systems (La Trobe University)

A Ballarat-based company has blended modern technology with old research to devise, and commercialise, artificial intelligence that anticipates how people think and make decisions. Software created by JustSys provides tools that help with expert advice and information on highly complex issues, including legal disputes and career choices.

JustSys was launched in 2002 with the University of Ballarat and La Trobe University minority shareholders. Majority shareholders are researchers Dr Andrew Stranieri, Associate Professor John Yearwood and Dr John Zeleznikow. Over its first four years, JustSys (and partners) have achieved sales of almost $1 million.

Managing director Dr Andrew Stranieri says the software is the result of his research at La Trobe University in the 1990s. It was based on the work of British philosopher Stephen Toulmin who uncovered a new way of explaining the decision-making process, theorising that people do not follow formal logic in their reasoning.

Dr Stranieri extended the philosopher's insights into how people make decisions, taking these studies further at the University of Ballarat in collaboration with Associate Professor John Yearwood of the School of Information Technology and Mathematical Sciences.

"Many decisions are not black and white," Dr Stranieri says. "They require a degree of discretion or judgment by decision-makers. JustSys captures reasoning that involves discretion. Our software allows experts to describe their knowledge using stories and flowcharts. We then rapidly build web-based decision support systems based on the flowcharts," he says.

Applications already developed to pilot stage or beyond include tools for deciding who receives legal aid, training intensive care nurses, getting ethical clearances for research proposals, advice on copyright law, and predicting Family Court property settlements as a way of encouraging quicker and cheaper out-of-court settlements.

One of several fully implemented applications is TAFE Options, which gives career advice, particularly for potential TAFE students (see http://options.tafevc.com.au).

Most web sites that provide career advice pitch hundreds of questions at the job seeker to build a psychological profile that is matched to suitable jobs. Most users find the questions tedious and some can be intimidated.

JustSys designed a system that provides useful advice easily, without intimidation. TAFE Options gives conventional careers advice and asks about 'soft skills', such as willingness to accept shiftwork. It has been piloted successfully and was formally launched in 2005.

TAFE Options was developed for the Office of Training and Tertiary Education (OTTE), which provides a range of education and training programmes and services in Victoria, as part of the Victorian Department of Education and Training.

OTTE senior project officer Owen Hatchard says Options is a cutting edge product.

"There are other sites that do similar things, but none of them provide the range of advice found in TAFE Options. It has a great deal of potential," he says.

The tender to create TAFE Options was won by a consortium of JustSys, the University of Ballarat, and i4-talent, which provides software for those seeking new employment opportunities.

In 2001, an Australian Research Council Linkage Grant (then called SPIRT) allowed Dr Stranieri and Dr John Zeleznikow at La Trobe to create a prototype decision system, GetAid, for Victoria Legal Aid. GetAid has proved as accurate as specially trained staff at making legal aid determinations.

Sensing an opportunity, Dr Stranieri and other researchers drafted a proposal for commercial development of the software by a company formed for the purpose.

"The proposal was accepted and we began steps to form the company with an all-important first customer in place," Dr Stranieri says.

"For rewriting GetAid we wanted to draw on collaborative research with the University of Ballarat, some of which had been done under an Australian Research Council SPIRT Australian Postgraduate Award grant. We invited the University of Ballarat and La Trobe University to take a minority shareholding in JustSys. Both agreed."

Information City Victoria (now Information City Australia) accepted JustSys into its incubator programme, supplying mentoring and some capital for 12 months.

To help with cash flow, Dr Stranieri retained a variable, fractional appointment at the University of Ballarat's School of Information Technology and Mathematical Sciences, while he promoted JustSys to secure new contracts.

After four years at the helm of JustSys, Dr Stranieri is in a good position to assess the pros and cons of researcher involvement in commercialisation.

"When researchers immerse themselves in the commercial world, they gain a better understanding of market limitations," he says. "This experience sharpens the applied research they do. Researchers also learn about entrepreneurship, contract negotiation and commercial judgment. These skills will prove valuable as university–industry collaboration grows."

Dr Stranieri says that by maintaining close ties with universities, companies can jointly bid for contracts and grants that are difficult to win by either party alone.
The cash flow issues that dominate the early years of many IT companies can be moderated if researchers adopt variable fractional appointments with a university.

Falls risk calculator (Prince of Wales Medical Research Institute)

Physically, emotionally and financially, falling over is costly. Relatively few children and young adults are admitted to hospital as the result of falls, but the figures grow exponentially with age.

For people aged 65 years and over, falls are the leading cause of injury-related hospitalisation, accounting for 14 per cent of emergency admissions and 4 per cent of all hospital admissions in this age group. For those aged 65 to 85 years, falls also account for 40 per cent of injury-related deaths.

As the world's population ages, the social and financial costs to the community are likely to increase. An Australian Government report found the ageing of Australia's population will have a significant impact on the health system. By 2051 the total health cost attributable to fall-related injury will increase almost three-fold to $1,375 million a year if age-specific falling rates remain unchanged.

Falls also take an emotional toll, resulting in activity restriction and fear of falling, reduced quality of life and loss of independence.

Falls and their associated impacts is an area that Associate Professor Stephen Lord, from the Prince of Wales Medical Research Institute, has spent years researching.
He says his work in geriatrics taught him that the big three issues affecting this group are dementia, incontinence and falls.

"I took the easiest option and decided to work on falls," he says.

Associate Professor Lord set out to develop an assessment tool that could calculate a person's 'falls-risk' so that strategies could be developed to manage this risk.

Following 10 years of research and development, Associate Professor Lord and his team have developed a falls-risk calculator. Called FallScreen, it helps discriminate between fallers and non-fallers using a physiological rather than a medical approach.

He says the physiological approach is important because attributing risk to a specific medical diagnosis is problematic.

"The relative severity of conditions may vary considerably among individuals.
Declines in sensory motor function associated with age, inactivity, medication use, or minor pathology may be evident in older people with no documented medical illness."

The calculator uses a web-based normative database so that individual patient results can be compared to normative values at the time of their assessment.

Associate Professor Lord says FallScreen's purpose is to help target fall prevention strategies accurately to maximise their benefit.

FallScreen has been used in outpatient clinics by physiotherapists to assess risk and develop management plans. It tests vision, tactile sense, strength, reaction time and balance, and strategies are based on these assessment results.

Preliminary evidence is showing that it is working. An evaluation by Dulwich Hospital in London found that through FallScreen assessment and consequent management plans, which may include building muscle strength, patients' risk of falling had reduced by 20 per cent.

Interest in FallScreen started via word of mouth, with researchers very keen to trial it. It is being used by researchers in the United States, Canada, Italy, Chile, China, Denmark, Finland, Norway, Sweden and the United Kingdom as well as by numerous researchers in Australia.

Hospitals and outpatient clinics have followed suit, with 60 hospitals and clinics in Australia using it and another 40 worldwide.

FallScreen is one of the first products commercialised by the Prince of Wales Medical Research Institute and it has decided to direct-market it itself.

"I'm not sure how you would describe our business model," says Associate Professor Lord. "We sell the kits directly and advertise little. Most sales have occurred through clients approaching us having seen the findings published in scientific journals, or via word of mouth."

To date, sales have been one-offs, however the institute plans to release upgrades in 2007. A five-year, renewable licence is required to use the internet programme associated with FallScreen.

Associate Professor Lord says that, despite a lack of formal marketing, revenue has been steady and growing.

"Most clients require the short-form assessment tool, which costs $4,000. Projections are for continued steady sales of about 10 to 20 each year," he says.

However, it is the cost savings that could result from risk calculation that are especially important. In 1998-99, the direct costs resulting from falls, such as hospitalisation, ambulance, emergency department presentation, non-hospital medical care, non-hospital allied health care and non-hospital pharmaceutical costs, totalled $333 million or 62.8 per cent of direct costs of all unintentional injury categories.

"Clearly all initiatives aimed at reducing falls injury have the possibility of having a huge impact on health care savings," Associate Professor Lord says.

He calls FallScreen an excellent example of applying physiology to a public health problem and transferring research findings into clinical practice.

Synthetic rock (ANSTO)

In late 2001, the British Nuclear Fuels Group (BNFG) approached the Australian Nuclear Science and Technology Organisation (ANSTO) with a problem – how to handle five tonnes of impure, plutonium-rich nuclear waste from Britain's Sellafield nuclear-fuel reprocessing facility in Cumbria.

The legacy of early fuel-development research at the world's first commercial nuclear power plant, the intractable wastes could not be economically treated to separate the plutonium from calcium fluoride, silica and alumina residues.

No technology was available at the time to immobilise this compositionally diverse, long-lived waste. With its 26,000-year half-life, plutonium waste can remain radioactive for several hundred thousand years.

The international nuclear industry will be taking a keen interest when ANSTO and BNFG subsidiary Nexia Solutions opens a new non-radioactive pilot plant in March 2008 to demonstrate the immobilisation of Sellafield's plutonium wastes in a composite material consisting of crystals of the synthetic ceramic synroc in a durable glass matrix.

Developed by the late Australian National University geochemist Professor Ted Ringwood in 1978, synroc is a synthetic rock, or ceramic, consisting of a matrix of highly stable, naturally occurring titanium minerals in the Earth's crust.

The same titanate minerals have naturally and safely sequestered uranium, thorium and other radioactive elements for billions of years.

ANSTO researchers have developed different formulations for synroc to accommodate the chemistry-radioactivity profiles of a variety of nuclear wastes.

ANSTO nuclear waste-disposal expert Dr Bruce Begg said that, since 2001, a series of validation trials has given BNFG confidence in the viability of the synroc-glass technology.

"We now have an agreement to work together towards obtaining regulatory approval for the Sellafield plant, and also on the way we will deal with the intellectual property and licensing issues," Dr Begg says.

Because the project is a world first, there was no way to predict whose intellectual property would be embodied in the new plant when its design was completed and had received regulatory approval.

ANSTO and Nexia, the BNFG subsidiary, agreed to conduct a review to assess whose intellectual property had ended up in the final plan, then develop a licensing agreement for the company that Britain's new Nuclear Decommissioning Authority (NDA) has commissioned to treat the plutonium wastes.

The wastes are currently stored in sealed drums on the Sellafield site.

ANSTO and BNFG have also agreed to construct and commission a full-scale, non-radioactive line in the United Kingdom as a local demonstration plant where members of the international nuclear industry can see how the synroc-glass technology works.

Established in 2005, NDA is now the official owner of all nuclear wastes in the United Kingdom. It does not classify plutonium as a nuclear waste, but as a zero-value asset, requiring plutonium-bearing material to be stored for potential future use.

"But it's very clear that the Sellafield plutonium residues are too impure to consider reprocessing them to recover the plutonium, which resulted in the decision to evaluate other disposal options," Dr Begg says.

"And that has opened a debate over what constitutes nuclear waste. The outcome could be that considerably more material will now be identified as waste."

"Having successfully demonstrated a product to treat intractable plutonium wastes, we may now see a number of other actinide streams – radioactive metallic elements – in the United Kingdom be considered as waste and looking for a disposition pathway."

NDA is developing a timetable to clean up all radioactive sites in the United Kingdom, including several at Sellafield.

The wastes will be powdered, mixed with the materials for the synroc-glass matrix, packed into canisters, then compressed by a hot isostatic press in an inert argon atmosphere. The result will be a dense, monolithic solid.

"We're striving to combine the flexibility of glass to accommodate impurities, with the superior aqueous durability of ceramics, which will lock up the plutonium," Dr Begg says.

ANSTO has confirmed most of the non-radioactive impurities end up in the glass matrix, while the plutonium concentrates by a factor of 100:1 in the crystalline zirconolite synroc phase.

No decision has been made in the United Kingdom on where or how the containers of immobilised wastes will be stored.

ANSTO researchers have demonstrated the durability of the glass-ceramic waste form in simulated groundwaters representing two potential United Kingdom waste repository sites. Dr Begg says the results confirmed the outstanding ability of the waste form to lock up plutonium.

He says there is a huge market for the ANSTO nuclear-waste immobilisation technology in the United States, and the total global market is worth hundreds of billions of dollars.

Dr Begg says the opportunity to apply the technology in other markets is very real, and ANSTO is putting considerable effort into demonstrating and commercialising it. It will be important to develop partnerships with complementary nuclear engineering companies to implement the technology.

"In the UK, we're working as ANSTO, but in the United States we're looking at operating through our wholly owned subsidiary, ANSTO Inc, and establishing its own shop front. Within ANSTO, we've set up synrocANSTO as a business unit focused on waste technology."

Polynovo (CSIRO)

A revolutionary polymer technology developed by scientists within CSIRO could mean the end of long and agonising recoveries for patients following surgery for joint repair or replacement.

A collaborative research team, comprised of scientists from CSIRO Molecular and Health Technologies division, the Industrial and Technology Research Institute of Taiwan, and Polynovo Biomaterials Pty Ltd, a subsidiary company of Xceed Biotechnologies Ltd, has developed a novel tissue engineering technology to treat damaged cartilage.
The technology is particularly applicable to knee joint injuries, a common occurrence in an active and ageing society resulting in close to 30,000 knee joint surgeries being performed each year.

One component of the knee joint that is particularly prone to damage is the cartilage, comprised of the shock absorbing menisci that sit in between the femur and tibia, and the articular cartilage, a thick covering at the end of the knee bones that minimises damage to the bones by providing a near-frictionless surface on which the bones can slide.

Scientists at CSIRO recognised the shortcomings in polymer technology available for patients needing treatment for damaged cartilage and set out to develop a material that would address the unmet clinical needs of existing biodegradable polymers with the ultimate goal of commercialising the technology.

By using both the biological and chemical expertise within the team, researchers have devised a two-pronged approach to treating the injured knee, overcoming many of the limitations of previous options for treating damaged cartilage, such as the short life expectancy of a total joint replacement and the lack of joint stability following surgery, which can cause a long and uncomfortable recovery period.

The first component uses proprietary cellular techniques to grow a large number of healthy chondrocytes for autologous chondrocyte implantation in a very short period of time, about 10 days. By using a combination of growth supplements, bead matrices, and optimised cell densities in a bioreactor, culturing conditions promote rapid growth of chondrocytes, while still maintaining their cartilage specific phenotype – an aspect that has proven difficult for current chondrocyte implantation methods.

To complement the cellular treatment of damaged cartilage, the second prong of the technology incorporates the patented polymer system NovoSorb™, novel grades of polymer that function as synthetic scaffolding to offer support and stability to a recovering knee joint.

The uncured polymer is mixed with expanded healthy cells from a person's body and then injected into the site of damaged cartilage using minimally invasive keyhole surgery.

The work originated within the CSIRO Biomaterials and Regenerative Medicine Theme, unified behind the goal of developing and evaluating new materials and devices for applications in tissue repair, replacement and regeneration. Proving to be an extension of the necessary research expertise already demonstrated from within, CSIRO decided to fund the development of NovoSorbTM under the direction of Dr Thilak Gunatillake and other key scientists.

Dr Charles Lindall, who led the commercialisation of NovoSorbTM, says that a substantial investment in the fundamental science created confidence in the product, instigating the decision to establish PolyNovo, a spin-off company that provided the necessary resources to further develop NovoSorbTM.

By exploiting NovoSorbTM's versatility and novel features compared to existing biodegradable polymers, PolyNovo is able to optimise its product for specific medical device opportunities.

Dr Lindall explains that by establishing PolyNovo and leasing lab space and equipment to the spin-off company, CSIRO was able to ensure the productivity of the researchers from the outset.

In the two years PolyNovo has been operating, it has demonstrated indisputable success, creating an exclusive relationship with medical device giant Medtronic to co-develop biodegradable stents, and forming a joint venture NovoSkin to develop skin generation products with eminent plastic surgeon John Greenwood, a burns specialist who practices in Adelaide, South Australia.

PolyNovo is part of the Centre for Medical Bionics, a group that is funded by a Science, Technology and Innovation grant and aims to develop products for nerve regeneration. PolyNovo maintains a collaboration with CSIRO to further develop NovoSorb for cell delivery in cartilage repair. PolyNovo's management and board determine other strategic partners with whom they will work.

Although it will still be a few years before products that use the biodegradable polymer technology become commercially available and generate income, PolyNovo's funder and 60 per cent equity holder Xceed Biotechnology is confident that the technology will yield significant value.

CSIRO initially sold its half-share of PolyNovo to Xceed in return for a $5.1 million investment into the company. Xceed has since invested a further $3 million and has an option for a further $2 million. As such, CSIRO will benefit from the value uplift of the technology with ongoing success, with the return on the technology to be seen when PolyNovo is listed on the Australian Stock Exchange or sold to a major medical device company.

Most recently, PolyNovo was part of the research partnership that won the award Partnering Prize at the 2006 Commercialisation Expo in Melbourne, a prestigious award sponsored by Innovation Xchange, further highlighting the importance of PolyNovo's technology.

Trinam (Ludwig Institute for Cancer Research)

Since the human genome was sequenced, the world has been holding its breath waiting for the first gene-based medicines. One of these gene-based technologies is already in phase II clinical trials and has the potential to dramatically improve the success of kidney dialysis. Australian scientists from the Melbourne Branch of the Ludwig Institute for Cancer Research have played a pivotal role in the development of this product by discovering the therapeutic gene.

Patients with kidney failure must undergo haemodialysis, a mechanical cleansing of their blood, at least twice a week to remove harmful wastes that can build up when the kidneys are not functioning properly.

Because it is not possible to repeatedly insert large needles into the patient's natural blood vessels, many have a plastic tube called a haemodialysis access graft permanently implanted between an artery and vein in their arm or leg. Dialysis needles can then be inserted into this tube to connect the patient to the dialysis machine.

Unfortunately, more than half of these access grafts block up within a year of being implanted due to the overgrowth of muscle tissue in the join between the graft and the blood vessel. Further surgery is required to implant another access graft, which inevitably blocks up again, often faster than the first.

As well as causing patients considerable discomfort and possibly death, access failure repeat surgery is extremely costly.

Molecular biologists Associate Professors Marc Achen and Steven Stacker and colleagues from the Melbourne Branch of the Ludwig Institute for Cancer Research have been exploring a family of genes and proteins called vascular endothelial growth factors. These growth factors play a major role in cancer and other conditions such as rheumatoid arthritis but most importantly, one of these, VEGF-D, promotes the growth and development of blood vessels and lymphatic vessels.

"I was one of the first people to isolate the DNA encoding VEGF-D, and Steven Stacker and I collaborated with Professor Kari Alitalo and colleagues in Helsinki, Finland, to determine how VEGF-D works in vascular biology," Associate Professor Achen says.

These discoveries were some of the milestones that triggered an international effort involving scientists and doctors from Finland, Europe, the United Kingdom and the United States. United Kingdom healthcare group Ark Therapeutics initiated and drove the drug development programme.

The result of that joint effort is Trinam®, a unique gene therapy and delivery mechanism, which could significantly reduce blockage of access grafts.

Trinam® is a combination of the VEGF-D gene, packaged in a virus called an adenovirus, and a small biodegradable collar delivery device made of collagen. After an access graft is implanted, the collar is fitted over the vulnerable join between the access graft and vein, and the virus carrying the VEGF-D gene is injected into the space between the collar and blood vessel. The adenovirus carries the gene into the smooth muscle cells, which then become a short-term "factory" for production of the VEGF-D protein.

This method ensures delivery of the VEGF-D genes to the target site, which is the smooth muscle cells lining the blood vessels, rather than being flushed away into the bloodstream.

Dr Nigel Parker, chief executive of Ark Therapeutics, says VEGF-D is fundamental to the healing of the join between the graft and the vein because it controls the amount of smooth muscle cells that grow when a big blood vessel suffers damage.

"Most grafts block because the healthy vein starts to heal and join to the graft but that healing process doesn't switch off and muscle cells grow and grow and block the join. If you put more VEGF-D in, it encourages the vein to heal nicely without blocking," he says.

First results from a phase II clinical trial at a low dose of the gene therapy in humans showed it helped the grafts last up to four times longer than patients had previously experienced. The company is now awaiting results from the higher dose in the phase II trial. The product has also been granted Orphan Drug status by the United States Food and Drug Administration and Orphan Medicinal Product designation in the European Union, which give tax credits for research and special exclusive marketing rights.

If Trinam® succeeds in making it to market it will be one of the first generation of gene-based medicines to enter the arena, Dr Parker says.

"What you see here is really the effect of the power of international communication, in that some research was done in Australia, further research was done in Finland and then you have a British company licensing through the London Office of the Ludwig Institute for Cancer Research. Then development is subsequently carried out in Europe and then the United States while accessing cash to fund it from the London capital market."

Macrophonage migration inhibitory factor (Monash University)

For decades, scientists around the world have struggled to develop effective treatments for debilitating inflammatory diseases such as rheumatoid arthritis, colitis, multiple sclerosis and asthma.

Collectively these diseases affect tens of millions of people worldwide. The annual expenditure on the current range of anti-inflammatory drugs used to suppress them is estimated at more than $25 billion.

The market for rheumatoid arthritis drugs alone is worth about $5 billion globally, and industry expectations are that this could grow to $12 billion by 2011.

That's why work being undertaken by Melbourne-based drug discovery and development company Cortical is attracting strong international interest. Cortical is aiming to commercialise a whole new breed of drugs that will revolutionise the treatments for many inflammatory diseases.

Cortical was established in 2003 on the basis of pioneering work undertaken by researchers at Monash University, who identified a specific inflammatory stimulant that could play a major role in rheumatoid arthritis patients, and developed synthetic compounds to target and block this inflammatory stimulant.

Known as the macrophonage migration inhibitory factor, or MIF, researchers found that by using different compounds to block its activity, they could directly inhibit inflammation in animal studies.

Cortical, which now holds the intellectual property and patents on the Monash-developed technology, is now in pre-clinical trials to create new anti-inflammatory drugs that can ultimately be used by humans.

"The approach that we're taking is a bit different," says Cortical chief executive Dr Su-Peing Ng. "The current drugs that are on the market are what we call large molecules, which often have to be injected. These are expensive and can have unwanted side-effects. The approach that we're taking is to develop small molecules, which can be made into tablets or other simpler routes of administration than injections."

Cortical raised $3 million in its first round of venture capital financing, including $1 million from GBS Venture Partners (formerly Rothschild Bioscience Managers Ltd) and $1 million from Start-up Australia Ventures Pty Ltd.

The company has until recently been working with United States-based biotechnology company Genzyme Corp, but is now seeking new partnerships in the biotechnology and pharmaceuticals sectors to take its drug research activities to the next level, including human clinical trials.

"Quite often with smaller companies, one route to commercialisation is to form a partnership with a larger company that has access to a much larger scale of research activities and also has direct access to the markets themselves," Dr Ng says.

"That remains a valid route to commercialisation and we are actively pursuing new partnerships. But now that we have advanced the technology further, we believe that the terms of the partnership will reflect the higher value that has been put into the technology."

Dr Ng says the first human clinical trial, probably in the next 12 months, will most likely be in Australia, although that will depend on whether a new partnership is formed and which location makes more sense at the time.

Cortical, which is in the process of developing improved inflammatory inhibitors, has so far designed and synthesised more than 1,000 compounds, which have undergone various stages of testing.

"It will be out of that testing process that one or two compounds will be selected to ultimately go into human clinical trials," Dr Ng says. "The objective of all the testing is to ultimately ensure that all the compounds that are put forward for the human clinical trials have been tested for safety and efficacy in animal studies before they can go into human studies."

Dr Ng says it is quite clear that there's still a lot of unmet need in terms of inflammatory diseases, and most of the physicians treating these diseases would welcome better and safer therapy for their patients than currently exist.

"Many of the drugs that are used today have nasty side-effects but they're used because there is no alternative," she says. "We're trying to hit two nails by developing a drug that minimises the inflammation and also minimises the unwanted side-effects."

Dr Ng says Cortical's activities have attracted considerable attention at international conferences as well as in Australia.

"It's certainly attracted the interest of many other academic laboratories internationally and it's also attracted the interest of major pharmaceutical companies as well. We're looking for more funding and partners to help in the commercialisation.

"Drug development is a very expensive activity. If you count the cost of failures, some major studies have said it costs about $800 million and 12 to 15 years to take a drug all the way from the bench to the bedside. Most companies, certainly smaller biotech

companies in Australia, wouldn't have access to that level of funding. It's necessary to leverage partnerships with major pharmaceutical or biotechnology companies internationally that do have access to that sort of capital and resources."

Ovarian cancer detection (Prince Henry's Institute of Medical Research)

Ovarian cancer is frequently called the 'silent killer' because often there are no symptoms until it reaches an advanced stage. It is the fifth most common cause of death from cancer, yet if detected early the chances of recovery are high. A rapid diagnostic kit developed by scientists at the Prince Henry's Institute of Medical Research and Diagnostic Systems Laboratories (DSL) promises to make early detection easier.

The simple blood test detects levels of inhibin, a protein hormone produced in women by granulosa cells of the ovaries and by the sertoli cells of the testes in men. Inhibin has been found to correlate to reproductive disorders, including Down Syndrome, premature ovarian failure (early menopause), male infertility and, most recently, ovarian cancer.

An easy test for determining levels of inhibin would be undeniably useful as infertility affects 10 per cent of women at reproductive age. (Almost half of the problems causing reproductive difficulties for couples are attributable to male infertility.)

Additionally, about 25,000 women are diagnosed with ovarian cancer every year, of which only 25 per cent will survive longer than five years after the diagnosis due to typically late detection of the disease.

Inhibin controls the production of the follicle stimulating hormone (FSH), an important reproductive element in the development of eggs in women and sperm cells in men.

The importance of inhibin in reproductive disorders and diseases has been recognised for decades, but researchers had failed to develop a diagnostic test that detects inhibin with the necessary specificity and accuracy. There are several forms of inhibin proteins, each associated with various aspects of reproduction or reproductive diseases.

The earliest kits detecting inhibins often failed to discriminate between inactive and active forms, so provided little useful diagnostic information. The emergence of a test that specifically recognises active inhibins, using the common Enzyme-Linked Immunosorbent Assay (ELISA) technology, proved promising, yet was labour intensive and time consuming. DSL and Prince Henry's Institute have developed a rapid diagnostic kit, Total Inhibin, which accurately and specifically detects levels of inhibins much more efficiently than the currently available tests.

Tom Verghese, DSL's director of strategic marketing, says the new test will greatly improve the ability to diagnose ovarian cancers.

When used in conjunction with another common diagnostic test that checks for CA-125, which is a marker indicating disease states, Total Inhibin can significantly increase the accuracy of early detection of cancerous cells. Unlike testing for CA-125 alone, determining total levels of inhibin enables detection of cancerous granulosa cells and mucinous carcinomas. In fact, a recent study demonstrated that testing for both of these markers increased successful detection of ovarian tumours to 95 per cent – almost double that of testing for CA-125 alone.

"Total Inhibin will serve an unmet need to date in ovarian cancer testing. It will diagnose mucinous and granulosa cell tumours in serum with high accuracy.

When combined with the current standard test for CA-125, these two tests detect the majority of ovarian cancers with high specificity and sensitivity," Mr Verghese says.

Mr Andrew McCallum, who oversees commercialisation of products developed by the world renowned Prince Henry's Institute, a leader in hormone research, says commercialisation was not an original aim of the research and development of Total Inhibin, but once scientists were aware its profound importance, they moved quickly to develop it as a commercial product.

At the time of invention in 2002, Prince Henry's Institute had joined forces with Monash University Institute of Reproduction and Development (now Monash Institute of Medical Research), and St Vincent's Institute of Medical Research to develop the product to the stage were it could be patented and subsequently licensed to a small biotechnology company, which became Inhibin Pty Ltd. Soon after, DSL acquired Inhibin Pty Ltd and further continued the collaboration with the Australian research institutes.

"DSL was already marketing other Inhibin products, which were licensed from Inhibin Pty Ltd, which cross-licensed the Inhibin patents from the Monash parties," Mr Verghese says. "DSL eventually acquired Inhibin Pty Ltd and is now a partner with the Monash parties, including Prince Henry's Institute."

Clinical trials are under way for the Total Inhibin test, and it is already being purchased for research use by academic institutes who recognise the importance of using cutting-edge technology where possible. A broader launch of the Total Inhibin diagnostic kit is expected later this year.

The Inhibin A assay, which was also licensed from the same parties and fully commercialised in the United States in 2001, continues to gain acceptance by the clinical community for its role in assessing risk of Down Syndrome during pregnancy. More than 60 per cent of all pregnant women in the United States are screened using the Inhibin A assay from DSL. Similar uptake is expected for the Total Inhibin assay in due course. At present, the Total Inhibin kit is available in a microplate format from DSL with even greater efficiency anticipated with the eventual availability of the combined tests using Access technology, an automated testing platform from DSL's parent company Beckman Coulter.

In the four years since the Inhibin related products were licensed, these products have been gaining more and more popularity, enjoying at least 10 per cent increase in growth each year. For Prince Henry's Institute, this growth spurt has translated into more than $250,000 in royalties.

Viral Vector Delivery Platform (Queensland Institute of Medical Research)

Isolated from Culex mosquitoes in far north Queensland in 1960, Kunjin virus has been transformed by medical science into a potentially potent defensive weapon against infection and cancer.

Brisbane biotechnology company Replikun Biotech Pty Limited spun out from the Queensland Institute of Medical Research (QIMR), the University of Queensland and the Queensland Department of Health in 2005 and is developing the technology as a versatile, self-replicating delivery system for vaccines and immunotherapies.

Replikun chief executive Dr Shane Storey says the Kunjin RepliconTM platform technology can also be applied to gene therapy to produce recombinant protein products in industrial-scale cell culture systems.

The global market for vaccines and gene-therapy systems is estimated to be worth $22 billion.

Kunjin virus is a harmless cousin of West Nile virus, which has caused an epidemic of human encephalitis and killed thousands of birds across North America since 1999.

Dr Storey says Kunjin virus, in contrast, is rarely isolated from man and is not associated with severe disease, making it an ideal starting point for a vaccine delivery system.

But virologist Associate Professor Alexander Khromykh, formerly of the Sir Albert Saksewski Virus Research Centre and now based at the University of Queensland, noted the rare ability of the Kunjin virus to replicate vigorously in cells without triggering their inbuilt anti-viral defences, which would normally induce death by 'cellular suicide'.

This ensures extended exposure of vaccine antigens to the immune system, stimulating cell-mediated immunity, crucial to fighting rapidly infectious viruses and most cancers.

Associate Professor Khromykh deleted several genes involved in the infectious process, without interfering with the Kunjin virus' desirable properties. He also showed the redundant genes could be replaced with therapeutically useful genes like antigens, creating a self-replicating vaccine vector that functions as a plug-and-play 'cassette'.

QIMR's Associate Professor Andreas Suhrbier confirmed the KunRep System as a potentially versatile technology platform for creating new vaccines or producing high-value proteins. His QIMR team has tested about 20 genes and his experiments showed the replicon can accommodate a large range of gene sizes.

Plug in a gene, or genes, from a pathogenic virus or a cancerous cell and the Kunjin Replicon programmes the host cell to display the alien antigens on its surface, in full view of the immune system. This encounter primes the immune system to attack the patient's cancer or to react vigorously in the event of infection by the real virus.

Dr Storey says his company has made terrific progress since it was established in 2005, after years of complex negotiations between the three research institutions involved. The most impressive feature achieved between early 2005 to mid-2006 was laying the groundwork for two businesses based on the technology.

"The first business is a licensing business, based on our belief that the Kunjin Replicon technology will prove the essential component in all modern vaccines and immunotherapies. We have invested significant resources in developing a strategic plan for achieving this goal. We've spent a year in partnering activities targeted at other pharmaceutical and biotechnology companies and we expect some of them will now

want to use the Kunjin Replicon to develop better vaccines of their own," Dr Storey says.

"Our second business is about products for the infectious disease and oncology markets. We have three products in development aimed at these markets. Our oncology product, KUN-GMCSF, won a $1 million Commercial Ready grant, which has helped enormously."

Venture capital company, Start-up Australia, has also invested $1.875 million in the young company.

The technology that has made the businesses possible was developed in 1997.

"It came out of a web of collaborations involving three independent research institutions – Queensland Health's Saksewski Centre, QIMR and the University of Queensland," says Dr Storey.

"Between them, they established a relationship that provided Replikun with a clean, exclusive, worldwide licence to commercialise the IP portfolio," he says.

"We've done some important studies this year to assure ourselves, from a technical viewpoint, that the products we develop with this platform technology will be able to clear the fairly significant manufacturing and regulatory hurdles that face novel vaccines," Dr Storey says.

"The technology and products looked fascinating at the laboratory level, but we wanted to make sure that they could be transferred to the commercial environment. A good example is manufacturing yield and cost of goods – it's incredibly important to understand that before embarking on a product development campaign and entering the clinic.

KunRep Systems is not the first viral vaccine vector, but Dr Storey says pharmaceutical companies are always on the lookout for novel, high-efficiency vectors.

Many conventional vaccines require large amounts of antigen to generate an effective immune response, which ramps up costs, complicates delivery, and raises safety issues.

"Our key selling point is that no other vector combines such high expression rates of antigens and proteins, yet doesn't kill its host cells. We are now getting interest from companies that have wonderful looking antigens, but have had no success in turning them into products."

Dr Storey describes KunRep vectors as "single-round-infectious, virus-like particles" that enter cells and release a self-replicating RNA vaccine called a replicon.

The cell's protein-synthesis machinery makes antigen as the replicon replicates harmlessly in the intracellular fluid; it cannot integrate into the host cell's DNA or escape from the cells.

Commercialisation is at a 'very early stage', but the company is now confident of its potential. "We've been very active looking through our technology portfolio and deciding which products are most attractive and likely to succeed in the shorter term," Dr Storey says.

"We've chosen two, an oncology immunotherapy and an HIV vaccine candidate, that should nicely demonstrate the competitive advantages of this platform technology.

"The HIV vaccine has shown excellent efficacy in pre-clinical testing."

Replikun has also been wooing potential partners to apply its proprietary technology to their own vaccines.

Biosignal (The University of New South Wales)

In 1994, two researchers from the University of New South Wales noticed that an Australian seaweed growing in Botany Bay, Delicia pulchra, was usually free of bacterial colonies known as biofilms.

Professors Staffan Kjelleberg and Peter Steinberg discovered that the seaweed employs natural chemicals, furanones, to keep itself free of biofilms. The furanones disrupt the cell-to-cell signalling systems that are vital for bacteria to form colonies and maintain biofilms.

Given that up to 60 per cent of hospital-acquired human infections such as pneumonia, urinary tract infections (UTIs) and persistent wounds are believed to emanate from biofilms, and that every year the growth of biofilms causes billions of dollars in damage to industrial surfaces, energy loss and the contamination of food products, the potential applications of coatings derived from Delicia pulchra are enormous.

To commercialise this remarkable discovery, the University of New South Wales, through its commercialisation arm, Unisearch, (now NewSouth Innovations) took the initiative and formed the start-up company, Biosignal, in 1999. The start-up quickly became a self-sustaining company.

Today, Biosignal has eight research and development partners, including one of the world's largest chemical companies, Swiss-based Ciba Specialty Chemicals, and local giant BHP Billiton.

Biosignal's chief executive, Michael Oredsson, says that the company's strategy has been to focus on short to medium-term projects such as medical devices listing on the Australian Stock Exchange in 2004 with products in development that would get to market within three years.

"Our strategic aim is to get a range of partners in key product fields," Mr Oredsson says. "Biosignal's technology is platform technology and our products are relevant to competitive, very large global markets, so our aim is to partner early where short- and medium-term opportunities exist and reap a royalty as quickly as possible."

The beauty of Biosignal's 'platform' technology is its very broad range of possible applications, from anti-bacterial contact lenses and medical devices such as catheters, to drugs for lung infections and UTIs, which are at the pre-clinical stage of development. Biosignal is also working with Santos and BHP Billiton on ways of preventing the microbial corrosion of metals, an issue faced by offshore oil and gas pipelines.

In terms of commercialisation, Mr Oredsson says Biosignal has tried "not to do too many things, but to try and cover as much ground as possible as quickly as possible".

Biosignal's lead product, due to be brought to market in 2008, is an extended-wear contact lens with a thin but permanently attached coating of anti-biofilm compounds. Bacterial infection is a serious issue in the $US5 billion-a-year contact lens market. Parallel development of an anti-bacterial daily wear lens is also underway and may be launched sooner.

The truly great potential of these seaweed-derived compounds is that they achieve an anti-bacterial effect without killing the bacteria. Biosignal's stated mission is "to provide an effective defence against bacteria without generating bacterial resistance". Indeed, such products will reduce infections caused by medical devices, such as catheters and contact lenses (the treatment costs of which are estimated at billions of dollars) and reduce the use of antibiotics, thereby decreasing the risk of antibiotic-resistant strains of infections.

Internationally, Biosignal's most important partner is Ciba Specialty Chemicals, one of the world's largest chemical companies. Biosignal has a co-development and worldwide licensing agreement with Ciba for industrial applications of the seaweed-derived compounds in the fields of industrial plastics, paper, paints, fibres and coatings. The aim in some of these markets is to attach or co-polymerise Biosignal's proprietary molecules to provide a protective coating for these materials. Ciba is funding an 18-month joint development programme using Biosignal's anti-bacterial technology, paying royalties to the company for the licensing of the technology.

Several of Biosignal's eight partnerships, including three with prominent international medical device companies, have stemmed from the company's ongoing relationship with the Boston-based biotech consultancy Puretech Development, which began 18 months ago.

"Puretech had given us 'feet on the ground' in the United States," Michael Oredsson says. "It has been a good interim solution in place of having an office in the United States. However, most of the benefits have yet to fully materialise from this relationship. It's a medium to long-term strategy because some of the medical products take a long time to progress to market."

In Australia, Biosignal has pursued a slightly different path to commercialisation, partnering with Australian Surgical Design Manufacture Pty Ltd (ASDM) and the Institute for Eye Research (IER) in developing coatings for medical devices. This collaboration was made possible by a $1.5 million Australian Government Industry Cooperative Innovation Programme (ICIP) grant, the largest of the 15 grants awarded in December 2005. In awarding the grant, Industry Minister Ian Macfarlane said the grant underlined the collaborative nature of the project and would ensure the collaboration continued to the point where the idea was commercialised.

Biosignal raised $5.1 million in its 2004 float and has held further capital raisings, for $1 million in August 2005 and $3.5 million in June 2006.

Mr Oredsson estimates the annual revenue potential of Biosignal's contact lens and medical device coatings at more than $100 million, with several other products in the Biosignal pipeline offering significant additional revenue potential. The market for medical devices is substantial, with catheters alone estimated at about $US7 billion a year and, although market release might not be till 2011, the potential long-term revenue from therapeutic drugs for Biosignal is estimated at about $1 billion a year.

Monoclonal antibodies in asthma treatment (Walter and Eliza Hall Institute of Medical Research)

Asthma plagues the lives of about 300 million people around the world and the condition is poorly controlled, despite doctors' best efforts. In some countries, asthma deaths are even on the increase.

However, research by Australia's Walter and Eliza Hall Institute of Medical Research (WEHI) and biotechnology company Zenyth Therapeutics is leading to a novel treatment that has the potential to prevent the development of severe and persistent asthma rather than simply treating the symptoms.

In one of the largest agreements made in Australian biotech history, WEHI and Zenyth researchers are working with global pharmaceutical giant, Merck & Co, to develop a novel drug that aims to block the proteins that play a key role in the development of asthma symptoms such as inflammation, airway reactivity and mucus production.

The global asthma treatment market is estimated to be worth more than $US7 billion and, with asthma rates increasing, could reach $US13 billion by 2012. The commercialisation of this as-yet unnamed therapy could lead to global sales well in excess of $US1 billion.

Its development has come about following research by the former Cooperative Research Centre (CRC) for Cellular Growth Factors, which was established in 1991 as a collaborative venture involving WEHI, the Ludwig Institute for Cancer Research, CSIRO, the Biomolecular Research Institute and commercial partner AMRAD Operations, now known as Zenyth Therapeutics.

CRC researchers discovered two cytokines (hormone-like proteins that act as messengers for the immune system) that cause asthma symptoms to develop. These cytokines are known as interleukin-13 (IL-13) and interleukin-4 (IL-4). Research also suggests IL-13 is involved in more long-term changes associated with chronic asthma, such as thickening of the muscle layer in the airways and increasing sensitivity to asthma triggers.

Researchers theorised that if they could interfere with the action of these cytokines by blocking the receptors they bind to, it may be possible to stop the biological process that leads to the disabling asthma symptoms.

Studies in mice had already shown that blocking IL-13 led to suppression of asthma symptoms associated with the cytokine, so the hunt was on to find a way to stop the action of the cytokines in humans, according to Zenyth's director of business development, Dr Serge Scrofani.

In 1996, researchers at WEHI discovered a particular receptor component, the IL-13Rα1 subunit, which is vital to the action of IL-13 and also plays a role in the action of IL-4. This provided a target that could enable interference with the action of IL-13 as well as some elements of IL-4 activity.

"Given the evidence supporting the roles of IL-13 and IL-4 in asthma, if you could develop an antibody that blocked their action through the IL-13Rα1 subunit, then you could presumably have something that could ameliorate the disease better than if you blocked only IL-13 or IL-4 individually," Dr Scrofani says.

Using transgenic mice engineered to produce human antibodies, researchers from WEHI and Zenyth generated monoclonal antibodies that bind to IL-13Rα1 and block IL-13.

During the period 1995 to 2002, when Zenyth was filing patents covering IL-13Rα1 and antibodies to IL-13Rα1, a commercialisation agreement was signed between Zenyth and Merck. In August 2005, the lead candidate from the field of antibodies was selected for late pre-clinical development and phase I clinical trials.

About nine per cent of people with asthma have a chronic form of the condition, which is poorly controlled using other forms of treatment such as bronchodilators.
The antibody may provide a significant advantage over another biological asthma treatment, Xolair, because it is likely to be able to treat both allergic and non-allergic forms of the disease. In addition, Dr Scrofani says the monoclonal antibody may also have applications in other inflammatory respiratory diseases and even cancer.
With so much potential, researchers and patients will be holding their breath to see how the drug fares in human trials.

Melanoma treatment (University of Newcastle)

The development of the melanoma oncology agent CAVATAK™ is an excellent example of how cooperation between academia, public research bodies, private industry, investment companies and government can achieve great things in Australian science.

In this case, the result of such cooperation is an agent that uses a relatively harmless human virus to attack melanoma cells. It can also potentially be used against a range of other cancers, including prostate, ovarian and breast cancer.

It all began at a dinner party in 2000, when a researcher from the University of Newcastle was discussing his ideas for a melanoma oncology agent with the chief executive of a major building society. Their discussion led to the development of a research proposal involving the Hunter Medical Research Institute and TUNRA (The University of Newcastle Research Associates) – the commercial arm of the University of Newcastle.

The key to this research is the common human virus Coxsackievirus A21, which is often symptomless or at worst, causes cold-like symptoms. To infect humans, the virus attaches to the outside of a human cell using two receptor types on the cell surface called ICAM-1 and DAF, then enters the cell. Once inside, the virus rapidly replicates and eventually triggers the death of the cell.

Researchers discovered that these particular receptors occur in very high numbers on the surface of metastatic melanoma cells, far greater numbers than on normal tissue cells. This provided them with a way to selectively target cancer cells for destruction while avoiding any damage to normal cells.

In the process, more copies of the virus are created and spread to attack other melanoma cells. This approach of using a virus to preferentially target cancer cells, called viral oncology, has been around for some time but is only now gaining global momentum.

Once the enormous potential of CAVATAK™ became clear, TUNRA took over commercialisation management of the project. First, it formed a partnership with a pre-seed venture capital company called SciCapital to create a company called ViroTarg. Under this banner, they successfully applied for a Australian Government Biotechnology Innovation Fund Grant, which was further supplemented by a grant from the New South Wales State Government.

This funding boost enabled further development of CAVATAK™ and the promising early results of this work brought the project to the attention of Viralytics, a listed Australian anti-cancer biotechnology company. A commercial agreement was signed that licensed the technology to Psiron for further research and clinical development in exchange for a series of milestone payments and share allocations. TUNRA's managing director, Professor Ron MacDonald, estimates the deal is worth about $10 million.

"The commercialisation process, from the point of view of TUNRA, has been a very successful one in terms of the returns for the University that have been generated," he said. "It's one of the most successful commercialisation deals that has been done in the university sector in the past couple of years."

And it could get even bigger. The cell receptors that CAVATAK™ targets are also found in large numbers on other types of cancer cells. On successful completion of human trials, CAVATAK™ may prove to be a treatment in its own right or a combination treatment for a range of cancers, including, but not limited to, melanoma, breast cancer and prostate cancer.

Psiron executive chairman Bryan Dulhunty says the potential of CAVATAK™ in terms of treating cancer and for providing a financial return to Viralytics shareholders are very exciting.

The research results so far are promising and already studies have been published in a number of international peer-reviewed scientific journals. In vitro studies have shown that human melanoma cells are highly susceptible to rapid destruction by CAVATAK™ while blood lymphocyte cells are unaffected. Studies in mice show that the oncology agent rapidly reduces the tumour burden not only at the site of injection, but also elsewhere in the body.

At the moment, the agent is injected directly into the tumour site, but Mr Dulhunty said the "holy grail" would be if it could be effective when injected into the bloodstream. This would enable it to target widespread tumours and also limit the spread of microscopic cancers through the bloodstream.

Psiron has just completed its first human phase I trial, in which three patients with advanced metastatic melanoma were given a single injection of the oncology agent, which is currently manufactured at the University of Newcastle. Gaining ethical approval for such a trial was a major milestone in the development of any medical product. Preliminary results suggest the agent is safe in humans, which opens the door to larger human trials in treating melanoma in Australia and around the world.

Opioid Formulation Q8003, Q8008 (University of Queensland)

Living with chronic and acute bouts of severe pain is so common that pain is becoming a substantial cause of disability. Health professions are concerned enough to look into improving pain management strategies even as pharmacologists attempt to refine the performance of pain-killing analgesics.

While opioid drugs such as morphine still provide the most effective relief for moderate and severe pain, side-effects such as nausea and respiratory depression can limit their use.

In the course of studying opioid chemistry to overcome its limitations, Professor Maree Smith, head of the Pain Research Group at the University of Queensland, succeeded in producing a novel opioid formulation now known as Q8003IR.

Tests have indicated it takes less of the new compound to achieve pain relief compared to standard opioids, providing a commensurate reduction in side-effects.

In seeking to further test the new analgesic, Professor Smith was able to turn to UniQuest, the commercialisation company set up by the University of Queensland. Over 20 years, UniQuest has created about 50 companies to develop the university's technologies. In the past five years alone, UniQuest and these companies have raised more than $100 million in capital.

"The novel composition of the opioid molecule had good commercial potential," says Mr David Henderson, UniQuest's managing director. "We patented the discovery and obtained financial support from the Lynx Group to do some early trials. After some collaborative research with Sigma, the patent went into a new start-up company we created, called QRxPharma."

Under the licensing agreement, the university has taken up equity in QRxPharma in lieu of royalty payment. University policy ensures that Professor Smith is entitled to a share of the dividends and proceeds from share sales that are received by the university.

Several more patents were added to QRxPharma's holdings, providing it with a portfolio of promising 'pipeline' developments, which in turn helped the private company raise $10 million to progress testing of its lead product and its other earlier stage products.

"Because of the opioid composition of the drug and the trials done to date, the company has already received approval from the United States Food and Drug Administration to go to a phase III trial, the final test before formal marketing approval," Mr Henderson says. "The company is looking at two formulations, an injectable form for immediate pain relief and tablets for sustained release of the analgesic."

Because the biggest pharmaceutical market is in the United States, QRxPharma targeted the American regulatory body even before approaching Australia's Therapeutic Goods Administration.

"The cost of clinical trials is so large that drug companies frequently seek approval in the largest market first where they can start to recoup their investment," Mr Henderson says. "Only then do they move to the smaller markets."

If all goes well during the trial, the drug could reach the American market by 2008-09, but another round of capital raising will be required to fund the phase III trial.

Taking QRxPharma public is one option for the company. In 2007 it began to raise funds for Phase III clinical trials of Q8003IR. .

"For a private company, investment in biotechnology is coming primarily from the venture capital community," Mr Henderson says. "Biotechnology requires some fairly long-term investments, but they are suitable for pension funds."

He adds that although biotechnology requires longer time frames than more traditional investments, the returns are also larger when a company launches a successful product.

"QRxPharma is very bullish and expects that its analgesic will be very successful. We don't have sales projections yet but there is an enormous market need for effective pain relief with reduced opioid side-effects."

Also in the pipeline are cardiovascular products at the pre-clinical trial stage. These include a recombinant peptide derived from brown snake venom with applications in controlling bleeding due to trauma and surgery.
There is also a new coagulant.

In the quest for new discoveries, QRxPharma is helping to fund a broader 'venomics' research programme. Its goal is to develop pharmacologically active recombinant peptides from the genome and proteome of Australian venomous snakes. The project is the recipient of an Australian Research Council Linkage grant.

"The Australian biotechnology scene is maturing all the time," Mr Henderson says. "It's still a fledgling industry but it has a global reputation for the quality of its R&D work and it is increasingly being supported by the capital markets."

He reports enormous changes over the past 20 years.

"The whole climate and attitude of the universities towards commercialisation has changed very significantly. We are also seeing Australian companies become more mature, with products about to go into phase III trials, whereas 10 years ago there were no companies in that sort of situation."

Australian Orthopaedic innovations (University of Western Australia)

After blood, bone is the most frequently transplanted human tissue with orthopaedic surgeons around the world performing an estimated 500,000 bone-graft operations each year.

Between five and 15 per cent of those patients who receive structural transplants subsequently develop a bacterial infection. The risk varies with the complexity of the procedure, the surgeon's skill, and the microbiological environment.

The graft is impermeable and after implantation has no blood supply, so any infection in the interior of bone is inaccessible to injected antibiotics. Another costly operation is required to replace the infected bone and amputation is a last resort if infection recurs.

However, Adelaide-based biomedical company Australian Orthopaedic Innovations Pty Ltd (AOI) is commercialising a potential answer to the infection problem. Conceived by orthopaedics professor David Woods, his research team at the University of Western Australia and the Royal Perth Hospital, the Bone Chemical Supplementation (BCS) process involves 'loading' the bone with antibiotics that will slowly diffuse out of a mineralised matrix of the bone over several weeks, suppressing bacterial infections while a graft 'takes'.

The University of WA has patented Professor Woods' process.

AOI executive director Dr John Ballard says commercialisation of the technology is still in its early stages and developing an appropriate business model has been a challenge.

AOI negotiated an upfront licensing fee and royalty payments to the university in 2003 and made a further licence payment in 2004. It expects to file for Therapeutic Goods Administration (TGA) registration within 12 months and, if successful, expects to launch it towards the end of 2007.

Surgeons use bone grafts to repair limbs shattered by road accidents, to replace bone segments damaged by cancer, or as splints to support fractured bones temporarily while they heal.

Multi-resistant strains of bacteria haunt surgical wards and operating theatres in hospitals around the world. Preventing infection is a key issue for orthopaedic surgeons, so AOI is anticipating rapid uptake when the technology is launched.

United States orthopaedic surgeons alone perform more than 200,000 bone graft operations every year, and AOI estimates the global market for the BCS device and consumables could be worth $500 million a year.

Bone grafts sourced from cadavers are 'non-self', technically allografts, but the heavily mineralised bone proteins do not provoke a rejection reaction from the recipient's immune system.

After obtaining permission from the hospital's ethics committee, Professor Woods' Perth team has trialled the BCS process in more than 30 patients. In all cases, the grafts have remained free of bacterial infections.

The technology employs broad-spectrum antibiotics whose molecules can be electrically charged. Gentamicin is the standard, but others can be used. Electrodes placed inside and outside the bone create an electrical potential that draws the charged molecules into the bone's mineral structure, a technique called iontophoresis.

Australia's state-run bone banks harvest bones from cadavers with permission from coroners. After cleaning, the bones are radiation-sterilised then returned to the bone bank for distribution.

"We're also trying to validate the process en route to Therapeutic Goods Administration (TGA) registration," Dr Ballard says. "That meant running experiments in consultation with the TGA, and then coming up with a prototype."

Based on its discussions with the TGA and bone banks, AOI is testing a prototype disposable plastic chamber with inbuilt electrodes, produced by Melbourne-based technology design and development company, Invetech Australia. The unit plugs into a slightly modified off-the-shelf power supply.

"We're doing it as a disposable unit simply because hospitals want it that way," Dr Ballard says. "It has to be simple enough for anyone at a bone bank to use. That's been a challenge for Invetech and us.

"It still needs some refinement, but we've already given demonstrations to the Queensland and Victorian bone banks to see if they would use it."

Dr Ballard said the company has been dealing individually with Australia's State Government run bone banks. In the United States, where bone banks use large, privately operated, centralised facilities under federal jurisdiction, one catch-all demonstration may suffice.

After obtaining Therapeutic Goods Administration registration in Australia, the company will have to integrate its antibiotic-loading process into the established processing and supply system.

Dr Ballard says antibiotic loading will be carried out before the bone undergoes radiation sterilisation, rather than just before surgery. Bone banks will deliver the impregnated bone to hospitals, ready to use.

The company estimates the product will provide substantial savings to the national health budget as it costs from $50,000 to $60,000 to treat a bone-graft patient with a post-operative infection.

Tumour suppressor (University of Western Australia)

The diverse class of genes called tumour-suppressors are known, paradoxically, for their role in causing cancer. They are of great interest to pharmaceutical companies trying to develop new cancer drugs and therapies.

Perth-based biotechnology company BioPharmica has secured the intellectual property rights to a tumour-suppressor gene, HLS5, which shows promise as a diagnostic for a variety of cancers, and as a target for novel cancer drugs.

Tumour-suppressor genes don't actively cause cancer. Their normal role is to monitor cells for mutation overload and activate an inbuilt suicide mechanism before a cell can turn cancerous. But if one of these cellular guardians is inactivated, the safety check fails, the cancerous cell survives and can spawn a solid tumour or leukaemia.

Discovered by Professor Peter Klinken's cancer-research team at the West Australian Institute for Medical Research Institute, HLS5 is no ordinary tumour-suppressor gene. It exhibits certain properties of tumour-suppressor genes, but BioPharmica director Dr Sam Gallagher says it has particular characteristics that increase its potential as a therapeutic target for multiple disorders.

The company has filed provisional patents in Australia, the United States and Europe covering its use as a target for diagnosing and treating cancer and disease.

BioPharmica, which listed on the Australian Stock Exchange in 2005, invests in discoveries made by Australia's medical research institutes and universities.

"We look all across Australia for projects to invest in on a collaborative basis with the institutes," Dr Gallagher says. "They show us their projects under confidentiality agreements and we determine whether they fit our portfolio."

"It's important that they have uplift from, or ownership of, their intellectual property, which means the project can stay within the institute until it is ready for commercial development."

"We work closely with the commercialisation departments of the universities and institutes to provide a development route. The development phase can take a lot of money and time, and the researchers do not have to become involved unless they wish to do so."

Dr Gallagher says BioPharmica is particularly interested in potential 'theranostics', which are molecular targets used both to diagnose and treat diseases.

"The HLS5 tumour-suppressor is certainly a molecule of interest, showing potential above expectation," she says.

Professor Klinken's team identified the gene during research into leukaemia, and has since shown that it is involved in several key regulatory processes in human cells and in immune-system regulation.

In these roles, variants of the HLS5 gene influence individual susceptibility to diseases such as AIDS and Huntington's Disease, and the rate at which these diseases progress.

Dr Gallagher says the emerging picture of the gene's role "could hardly have worked out better" in terms of its commercial potential for a company that is specialising in personalised medicine and targeted therapies.

"You can predict all you want, but the biology constantly provides surprises," she says.

Professor Klinken's team has been investigating the HLS5 gene itself, and exploring the genetic pathway that it regulates. It hopes this approach will identify other genes in the pathways regulated by HLS5 that could be interesting therapeutic targets in their own right.

Dr Gallagher says the company is increasingly excited about HLS5's potential as new findings emerge from the Western Australian Institute for Medical Research.

Professor Klinken's team has delayed publishing details of its function until the IP is secure, and will then publish several papers concerning its mechanism and potential as a target for a range of cancers, Huntington's and AIDS.

The WAIMR researchers have found HLS5 reduces the formation of tumours in laboratory mice. A recent pilot study has shown that the gene is mutant or deleted in more than half the tissue samples from patients with breast, colon, prostate or lung cancer consistent with a tumour suppressor role.

Dr Gallagher says northern hemisphere researchers are showing increasing interest in Professor Klinken's research into the cellular links and pathways involving HLS5. When it has secured all relevant patents, BioPharmica will broaden its collaborations with Australian and international research groups.

Rather than restricting licensing and collaborations to the cancer field, BioPharmica will actively seek collaborative opportunities in neurodegenerative and infectious diseases.

HLS5 has attracted more than $1 million in research funding from the National Health and Medical Research Council, the Cancer Council of Western Australia, the National Breast Cancer Foundation and the Medical Research Foundation of the Royal Perth Hospital.

For the past two years, with funding and support from the WA State Government, AusBiotech and AusIndustry, BioPharmica has mounted a well-patronised exhibit at North America's largest biotechnology expo, BIO.

"BIO has certainly opened doors for us that would have been very hard to open otherwise," Dr Gallagher says.

"The market for diagnostics or therapeutics based on HLS5 or its associated pathway is potentially very large, but difficult to quantify because of the nature of the gene," she says.

More than three million people died of AIDS-related illnesses in 2005. One in every 10,000 people in Western nations has, or is at risk of, Huntington's disease. The incidence of cancer, which is predominantly a disease of aging, is also rising with the 'greying' of Western populations.

Hep E diagnostic kit (Macfarlane Burnet Institute)

Being able to test for Hepatitis E virus (HEV) quickly and easily is helping to better detect and contain outbreaks of the disease, especially in remote areas or in-field locations.

A test developed by scientists at the Macfarlane Burnet Institute for Medical Research, under the guidance of Associate Professor David Anderson, has already been used to stem outbreaks in Africa and Asia.

The rapid diagnostic kit for detecting HEV infection is simple to use and takes only minutes to deliver a result. Unlike other tests typically used to diagnose HEV infection, which require an intravenous sample of blood and lengthy and costly laboratory processing, the Burnet kit requires no more than a drop of blood from a finger prick and can be performed at the 'point-of-care' such as in a doctor's office or a nurse's station in the field.

The 'point-of-care' testing afforded by the Burnet kit translates to more efficient detection and containment of an outbreak, for an estimated one-fifth of the typical cost of an HEV diagnostic kit, an important advantage for controlling a disease for which outbreaks are typically associated with economically depressed regions.

Nearly two decades of research at the Burnet Institute focused on hepatitis viruses has led to the identification of virus specific antibodies and characterisation of important parts of the virus that react with these antibodies, making them ideal tools for sensitive and specific diagnostic tests. By using a novel reverse flow technology in combination with these HEV specific tools, scientists were able to develop a robust and rapid diagnostic kit.

HEV causes a self-limiting infection of the liver and most typically affects people in developing countries (cases have also been reported in the United States and the United Kingdom) with a particularly high occurrence in tropical areas such as South-East Asia and northern Africa. It spreads through faecal-oral transmission, and from contaminated or poor water quality and inadequate sanitation practices.

Although infection with HEV typically resolves itself within a few weeks without pharmacological intervention, it is fatal in about two per cent of cases and about 20 per cent of infected pregnant women in their third trimester. There is no vaccine or successful treatment of HEV. Containing the infection and preventing it spreading offer the most successful means to controlling infections, making a rapid diagnostic tool vital.

Commercialising the diagnostic kit was not the Burnet scientists' primary aim, but it was realised early in their research that the production of the antibodies used in the kit may be useful diagnostically and therefore ideal for commercialisation.

Researchers at the Burnet Institute worked with Select Vaccines Ltd to commercialise the kit (Select was an important financial contributor to the research costs of Associate Professor Anderson's laboratory) and in 2004 the technology was licensed to Genelabs Diagnostics, a Singapore-based diagnostic company.

Following successful transfer of the technology to Genelabs, now part of the leading diagnostic company MP Biomedical, the United States Army independently assessed the efficacy of the kit, further confirming its accuracy and simplicity.

The kit could not have gone on the market at a more opportune time. 2004 was the year of the most recent HEV outbreaks, so the kit has already played an important role. The outbreaks occurred in Chad and the Sudan, and were responsible for more than 8000 cases, resulting in more than 100 deaths. The rapid diagnostic kits were donated to these regions, helping prevent an even worse outbreak. Donated kits were also part of the relief aid following the tsunami that devastated parts of Asia at the end of 2004.

Although the rapid diagnostic kits have not generated substantial revenue yet, that is expected to change with further marketing. The kits have CE Marking (Conformité Européenne) registration, meaning they meet the requirements for being marketed in Europe, and further fieldwork is under way in China to support registration there.

The technology used in the HEV diagnostic kit is now being used to develop similar kits to rapidly determine levels of CD4 T cells in patients who have HIV/AIDS, a project that aims to improve the efficiency with which these diseases are managed in developing countries. Development of a rapid diagnostic kit for detecting Hepatitis A virus (HAV) infection has also stemmed from the HEV diagnostic kit and this in turn has been licensed by Select Vaccines to Rapid Medical Diagnostics Corporation in the United States for sale worldwide.

Mudpack software (University of Adelaide)

Stretching more than 5000 kilometres around the coast from Cairns in north Queensland to Port Augusta in South Australia, the eastern Australian power system connects the power grids of Queensland, New South Wales, the Snowy Hydro Scheme, Victoria, South Australia and Tasmania to deliver electricity to market customers.

Interconnections between state-based power grids were developed over many years to realise the National Electricity Market (NEM) in 1998.

It is crucial that the many generators feeding the grid, some of them thousands of kilometres apart, are kept in synchronism, says University of Adelaide research engineer David Vowles, who works in a team that developed software to keep the system in harmony.

"The damping forces acting on the shafts of generators connected to the grid are inherently weak," he says. Consequently, unless specialised stabilising controls are deployed, small disturbances on the grid can result in growing power oscillations. "This is known as small-signal instability and can result in wide-spread blackouts, such as those that occurred in the western United States in August 1996," he says. (Blackouts in later years cannot be attributed to small-signal instability.)

To prevent small-signal instability, specialised stabilising controllers called Power System Stabilisers (PSS) and Power Oscillation Dampers (POD) are fitted to generators and other power system equipment to enhance the damping performance of the system.

Essentially, they stabilise the system by introducing additional damping forces on to the shafts of generators.

Yet, the design of these controllers is quite specialised. Realising there was a need for software to facilitate controller design, the Power System Dynamics Group, led by Associate Professor Mike Gibbard in the university's School of Electrical and Electronic Engineering, started developing the Mudpack software package in the late 1980s.

The interactive software package is used to investigate the small-signal dynamic performance of multi-machine power systems and incorporates specialised facilities to both design and coordinate stabilisers.

Mudpack, which is maintained on a continuing basis by the team, is used by and licensed to the National Electricity Market Management Company Limited (NEMMCO) and a number of Australian and international power companies.

"For example, the Electricity Trust of South Australia used the software to design stabilisers required for their generators prior to South Australia's interconnection with Victoria in 1990. Mudpack was also used by Queensland-based Powerlink and its consultants to tune both PSSs and PODs prior to the interconnection of the Queensland and New South Wales power systems in 2000," says Mr Vowles.

More recently, modules have been added to Mudpack for the analysis of the HVDC-Light interconnection, called Murraylink, between South Australia and Victoria; Wind Energy Conversion Systems in Tasmania, and the Basslink interconnection between Tasmania and Victoria.

Mudpack has also been acquired by commercial organisations such as the National Electricity Market Management Company Limited (NEMMCO), and the Tasmanian Transend Networks Pty. Ltd. Internationally it has been acquired by ABB Utilities, Sweden and ABB Consulting, USA.