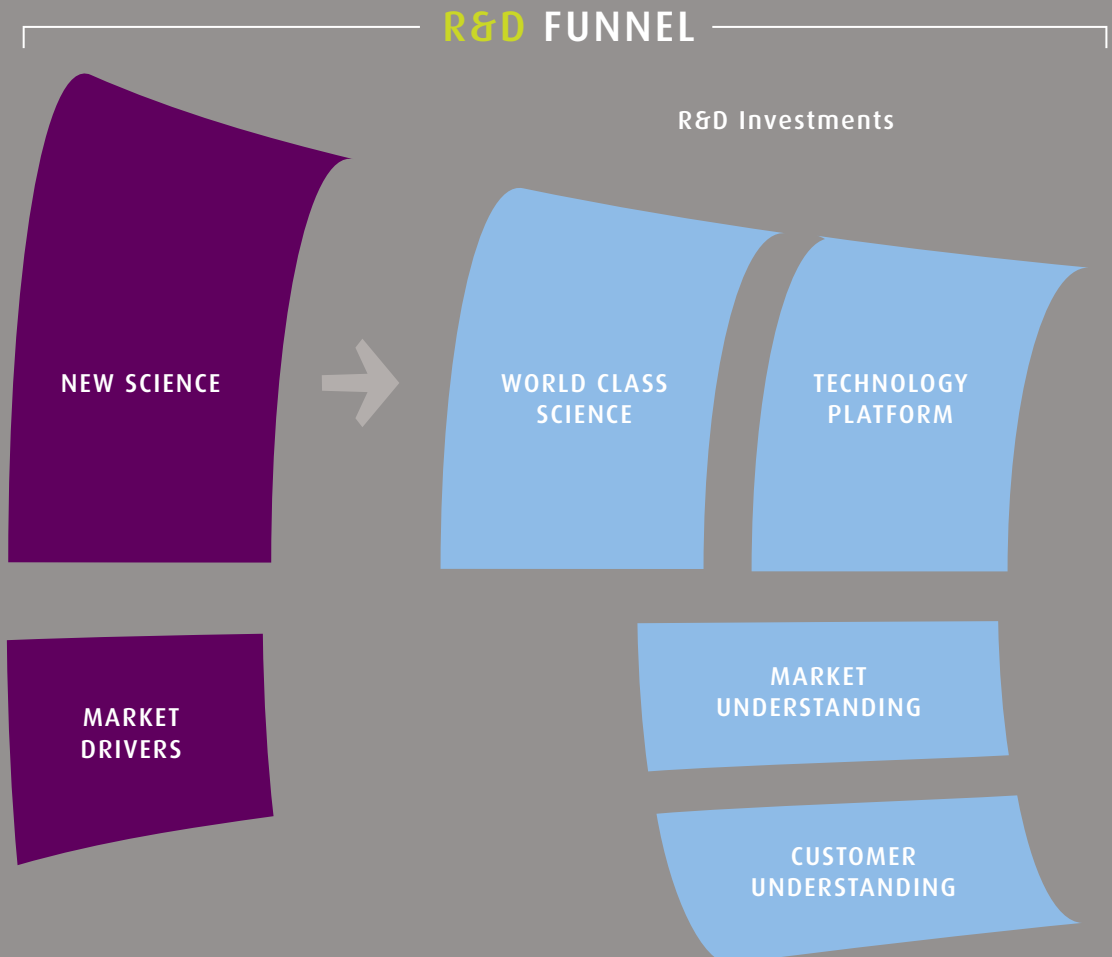


THE BUSINESS MODEL

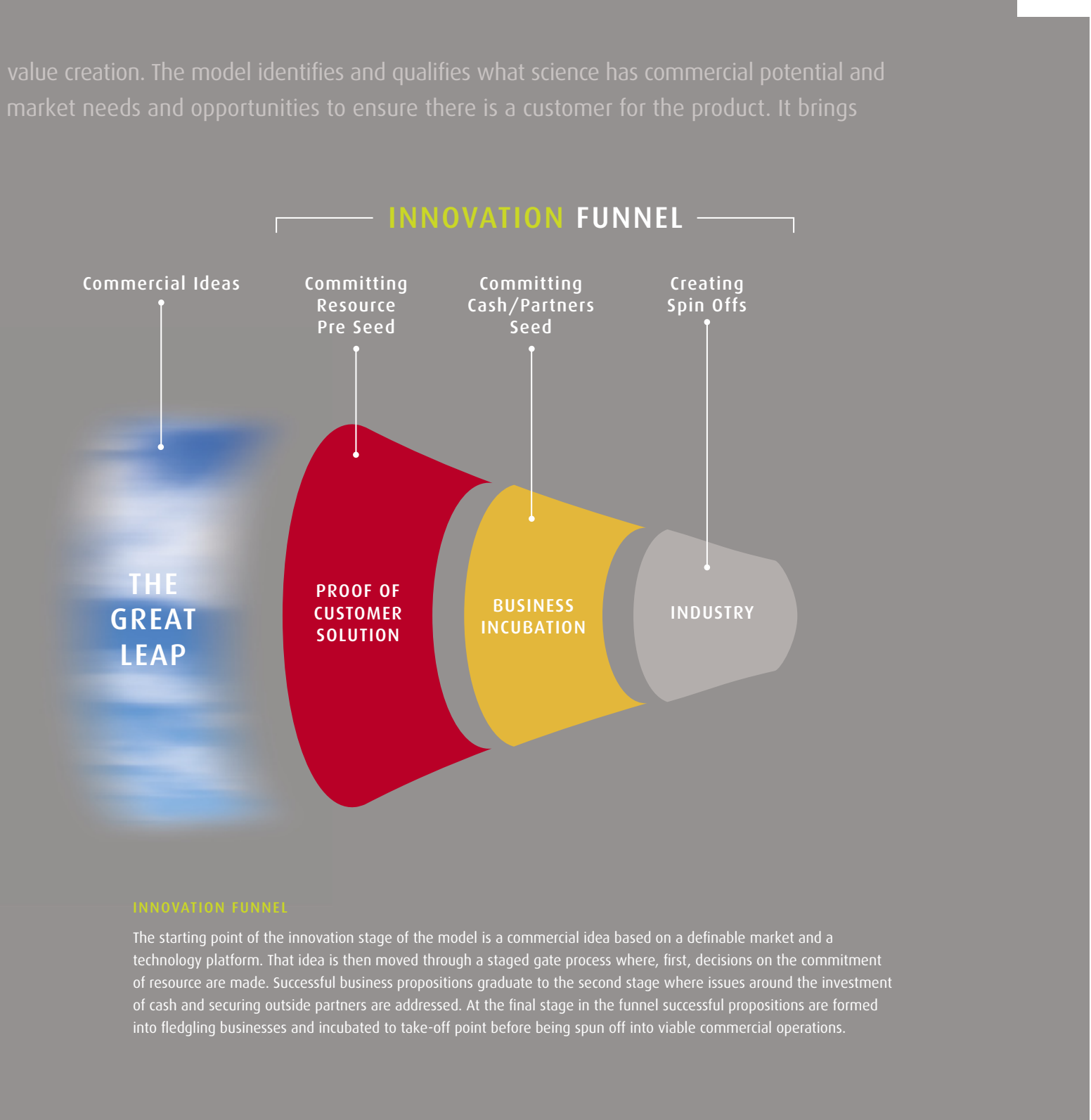
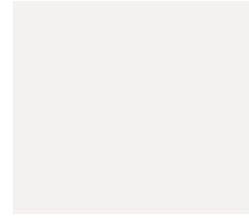
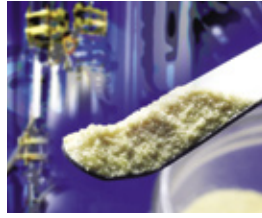
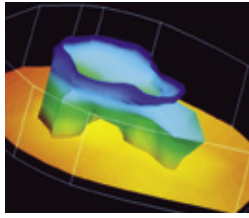
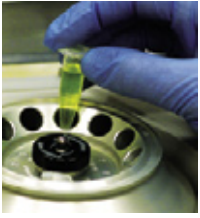
In the last year a business model has been developed and introduced to ensure delivery of creates technology platforms on which commercial applications can be built. It identifies all this together into a business development process called the innovation funnel.



RESEARCH AND DEVELOPMENT FUNNEL

This is the first stage of the business model. New science is fostered in the search for ideas and capabilities, even the rare opportunity for a breakthrough. This feeds into the world class science capabilities of Industrial Research from which a series of technology platforms are established.

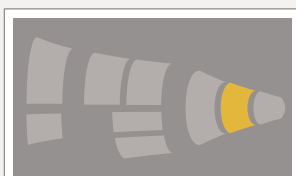
In parallel is a process of market analysis where a thorough understanding of the potential market, and routes to market, for science-based products and services are investigated.





GLYCOSYN CASE STUDY

The opening of the new \$7.4 million GlycoSyn facility in March was another important milestone in the programme of deriving value from science. Over the last decade the carbohydrate chemistry team has built a world class capability in the synthesis of carbohydrates and Industrial Research has now sought to capitalise on this capability in commercial terms.

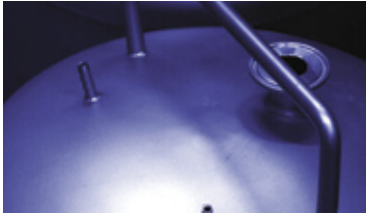


BUSINESS INCUBATION

This investment in a modern, purpose-built facility opens up business potential in the international biotech industry because it can produce sufficient volumes of chemicals for clinical trials of compounds prior to commercial use in human treatment, and is compliant with Good Manufacturing Practice (GMP) requirements.

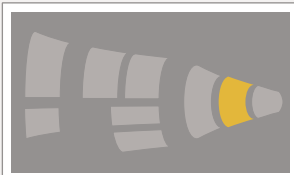
While the initial focus will be on the manufacture of carbohydrate compounds, it is a plant with a very broad capability and could be used for the synthesis of a wide range of compounds.

A particular attraction of this plant to international customers is the linkage with Industrial Research's carbohydrate chemistry team. Some of the processes required to scale up these compounds are complex and require significant scientific input. With the plant located on the Industrial Research site, this is readily at hand.



BIOPHARM CASE STUDY

The Industrial Research business, IRL BioPharm, this year won the double accolade of Biotech Company of the Year in the Westpac Trust Business Awards, and an Exporter of the Year in the Trade New Zealand Awards. This marked the coming of age of Industrial Research's most successful commercial venture.



BUSINESS INCUBATION

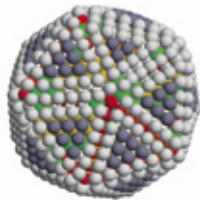
Building on 15 years of scientific experience in carrying out complex fermentation and extraction, and with four years of successful commercial operation now complete, BioPharm is a story of careful planning and perseverance to grasp a real market opportunity.

IRL BioPharm produces advanced compounds for the global biotech/pharma industry most of which are used in newly developed medical treatments. For example, by carrying out complex fermentation processes very specific compounds can be extracted to produce sufficient quantities for use in pre-clinical and human clinical trials in the pharmaceutical industry. These highly potent compounds are particularly used in advanced cancer treatments.

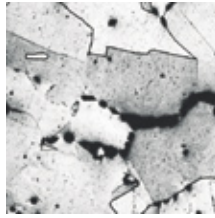
Over the last four years IRL BioPharm revenues have increased from less than a million dollars to over \$11 million per year, of which 97% is export earnings, mostly from North American sales. This fast growing biotech market is eager for the products IRL BioPharm can supply. Target clients are innovative small molecule anti-cancer drug innovators, though orders have been received from a variety of enterprises. Two of the better known international clients are GlaxoSmithKline and ImmunoGen.

IRL BioPharm was early to an innovative and rapidly growing market niche and has established a leading position as an international supplier. It now has an excellent reputation for high client satisfaction, market leading clients, superior facilities and a long term commitment to the industry.

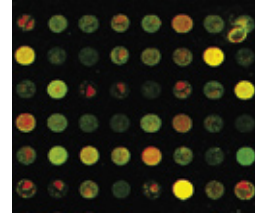
A key to the success of IRL BioPharm is the link between the scientific capability of the science teams at Industrial Research and the production processes in the BioPharm facilities, providing the customer with a sophisticated and reliable product.



■ NANOTECHNOLOGY MODELLING OF METAL PARTICLES



■ METAL FATIGUE



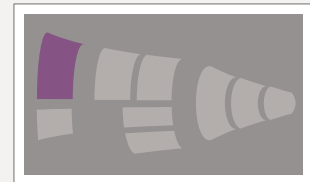
■ IMAGING ELLIPSOMETRY FOR MICROARRAYS

HIGHLIGHTS

NEW SCIENCE

NANOTECHNOLOGY MODELLING

Molecular dynamics software has been developed by the applied mathematics team to model the structure and properties of nanoscale metal particles such as lead clusters. This software enhances understanding of the atomic structure of nanoparticles and is important for fabricating nanoscale devices such as nanowires. These wires could form the basis of a new electronics industry in New Zealand. The modelling project is being led by Industrial Research's Shaun Hendy, one of the world's leading nanotechnology modellers, in collaboration with Dr Simon Brown from the University of Canterbury, the MacDiarmid Institute for Advanced Materials and Nanotechnology and the Measurement Standards Laboratory.

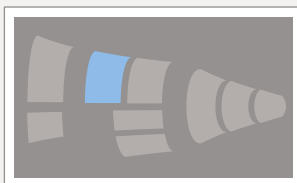


ADVANCED MODELLING OF METAL FATIGUE

The materials performance technologies team is developing new advanced models for metal degradation due to fatigue which will replace outdated existing models. The new models will incorporate information on the underlying structure of materials by considering microstructural parameters, such as grain size and orientation. Such models are needed for further advances in materials engineering to occur which will enhance our understanding and prediction of the failure process.

NEW IMAGING ELLIPSOMETRY

In a five-year project, Industrial Research's Measurement Standards Laboratory is working to design and develop a new optical technique for analysing microarrays of DNA and proteins. Using imaging ellipsometry rather than conventional fluorescence-based techniques for reading microarrays potentially offers several advantages, including greater sensitivity and significantly better performance. The project, which is being undertaken in conjunction with Victoria University of Wellington and two high tech New Zealand companies, is designed to bring benefits for medical and health research and for diagnostic and screening applications.



WORLD CLASS SCIENCE

NEW GEOPOLYMER MATERIALS

Industrial Research is conducting a six-year research programme with \$1 million per annum funding to investigate applications for new geopolymer materials – as an alternative to traditional cement materials and for waste remediation of hazardous substances. The special characteristics of geopolymers include high durability, resistance to chemical attack, an environmentally friendly manufacturing process, and the ability to contain toxic wastes and to be reused. Partners in the research programme include two major New Zealand businesses and the Australian Nuclear Science and Technology Organisation.



■ NEW GEOPOLYMER MATERIALS



■ HTS ELECTROMAGNET



■ GAS TURBINE ASSESSMENT



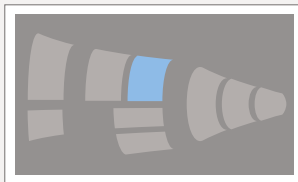
■ FUEL CELL TECHNOLOGY

PHOTOGRAPHIC IMAGING PLATES

Industrial Research has been researching new storage phosphor materials for medical X-ray imaging and non-destructive testing applications with promising results. The new storage phosphor imaging plates, which are based on glass-ceramics, have a distinct advantage over conventional X-ray film with significantly better contrast, faster image processing and the ability to be reused. The latest glass-ceramic material, discovered early in 2003, has a very high light sensitivity. This work is being conducted in collaboration with Victoria University of Wellington and the universities of Paderborn (Germany) and Monash (Australia).

GAS TURBINE CONDITION ASSESSMENT

The materials performance technologies (MPT) team is a key partner in the newly-established Centre for Integrated Engineering Asset Management based in Brisbane, Australia. A research programme into condition assessment of gas turbines is being developed in collaboration with this co-operative research centre. Interest in MPT's new independent condition assessment service for users of gas turbines in Australia and South-East Asia culminated in an invitation to address a gas turbine conference in Australia in June. Gas turbines are used in many industries including petrochemical, power, mining, and offshore oil and gas operations throughout Australasia.



TECHNOLOGY PLATFORM

FUEL CELL SYSTEM DEMONSTRATED

In a world first, Industrial Research successfully coupled together an alkaline fuel cell and a wind turbine in a proof-of-concept system installed at the Australian Co-operative Research Centre for Renewable Energy in October 2002. The 6 kW system developed by the electrotech team demonstrated that hydrogen fuel cell storage could effectively replace batteries in remote areas. Operating in parallel, the wind turbine and fuel cell are seamlessly supplying electricity, smoothing fluctuations caused by wind gusts. Excess wind energy can also be stored as hydrogen, via an electrolyser, and this is the next step for this groundbreaking project.

PHARMACEUTICAL OPPORTUNITY

Collaboration is continuing with the Albert Einstein College of Medicine, New York, to design, develop and manufacture prostate cancer treatment drugs for a rapidly growing market. This opportunity builds on the long-term research relationship between the two organisations which has led to the development of a strong portfolio of patents and a unique drug design platform.

HTS COILS AND MAGNET SYSTEMS

With the development of Industrial Research's on-site manufacturing facility for high temperature superconducting (HTS) coils and cryogenic systems, work progressed on several projects in the lead-up to forming a stand-alone company for magnet production. Phase one of a contract with Long Electromagnetic Inc (USA) was completed with the design developed for rotor coils for a prototype high speed generator. The HTS coils are now being fabricated in phase two. Design and component construction of a 3 Tesla HTS electromagnet was undertaken, one of the first HTS magnets ever in its field range. When completed, it will be used on-site for magnetic characterisation of materials. Energy-efficient, compact magnets in this field range are in demand for use in the semiconductor, permanent magnet and magnetic recording industries, and in particle accelerators and laboratory magnets.

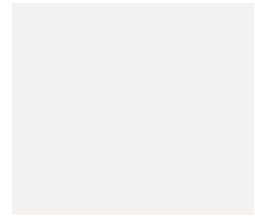




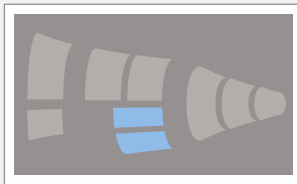
■ ELECTRONIC AMPLIFIERS FOR GUITARISTS



■ TECHNOLOGY FOR CHECKING CARDS AT CASINOS



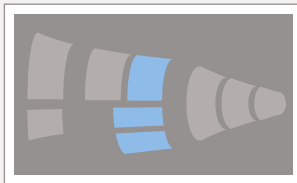
HIGHLIGHTS



MARKET/CUSTOMER UNDERSTANDING

UNDERSTANDING OUR MARKET

Two key components of our business model, market understanding and customer understanding, have received increased focus. A client development team has been established with seven managers each responsible for key clients within industry sectors. In addition, a strategic business development team has been created to review market information and develop business cases.



TECHNOLOGY PLATFORM AND MARKET/CUSTOMER UNDERSTANDING

ELECTRONIC AMPLIFIERS

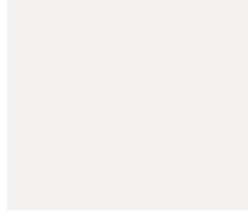
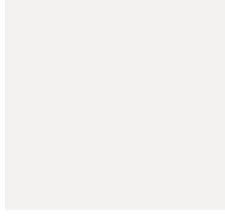
Industrial Research is developing a prototype electronic amplifier, initially designed for guitarists, as an alternative to conventional amplifiers using transistors or valves. The prototype should provide improved sound clarity, and be a more practical product than those using standard circuitry. By splitting the sound signal into four different frequency bands, distorting and recombining them, intermodulated distortion should be reduced producing better sound quality. Preliminary market studies have identified potentially significant demand for such an amplifier which could have applications in other sound processing areas.

DECK-CHECKER® CONTRACT SECURED

Industrial Research won a \$6 million contract to supply 800 Deck-Checker® kits to VendingData™ Corporation in the USA. The Deck-Checkers®, designed and engineered by Industrial Research, authenticate the validity of decks of playing cards using machine vision technology, replacing a time-consuming job for casino staff. Now in its third generation of design, the Deck-Checker® has been refined to use fewer parts, bringing down manufacturing costs and increasing reliability. Following on from this work, Industrial Research is negotiating a contract for a new card shuffling machine for VendingData™, including prototyping, manufacturing and ongoing support.



■ SAWMILL SCANNING TECHNOLOGY
PHOTO COURTESY OF FOREST RESEARCH

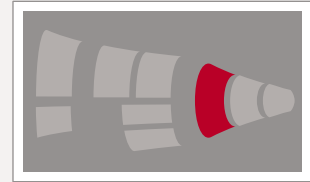


■ TELESCOPE LENS COMPONENTS

PROOF OF CUSTOMER SOLUTION

INSURANCE INDUSTRY CONTRACTS

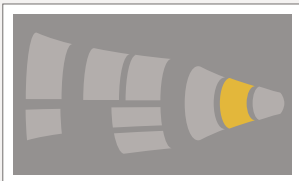
The materials performance technologies team is increasingly recognised internationally as a provider of expert services to the insurance industry using its expertise in corrosion, metallurgy and structural engineering. Several projects were conducted for the industry this year including investigation of a printing press fire in China, assessment of tube failures in a Vietnamese power station, and an investigation into a crane failure at the Three Gorges Dam in China.



NEW MEASURING TOOL FOR SAWMILLS

Industrial Research is working on a joint project with Carter Holt Harvey's fibre-gen business to commercialise a new timber measuring tool developed for sawmills in a collaborative project. The Surveyor STM800 uses a scanner mounted over the saw out-feed to measure the widths of multiple pieces of timber as they are sawn from a log. Up to 12 boards can be measured simultaneously, at 20 times per second with up to 0.1mm accuracy, providing early warning of sawing problems and reducing product downgrade. Early orders for the Surveyor have been received from Australia and Canada.

BUSINESS INCUBATION



AWARDS FOR BIOPHARM

Industrial Research's BioPharm operation was named the 2002 Biotech Company of the Year in the Westpac High Tech Awards and won a Trade New Zealand Export Award for growing foreign exchange earnings to \$11 million in just four years of business.

Trade New Zealand also named BioPharm as the Agritech & Life Sciences Exporter of the Year for its success in producing highly sophisticated pharmaceutical compounds making it an excellent example of the application of leading-edge science to the processing of organic materials.

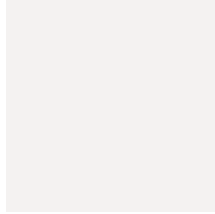
INTERNATIONAL BUSINESS FOR KIWI STAR

KiwiStar Optics, an Industrial Research incubator venture, experienced a big upswing in international business with more than \$500,000 worth of orders received in the first six months of 2003. These included manufacturing lens components for two of the world's biggest telescopes, Japan's Subaru telescope in Hawaii and the multi-national Gemini Observatory. KiwiStar Optics also carried out advanced design work on Gemini's adaptive optic system. Specialised lens design and manufacture has the potential to become a multi-million dollar export business for New Zealand.





■ DR OWEN CATCHPOLE



■ DR GRAHAM WEIR

OUR PEOPLE

STAFF AWARDS

Dr Owen Catchpole was awarded a New Zealand Science & Technology Silver Medal by the Royal Society of New Zealand for outstanding contribution to supercritical extraction science and technology in New Zealand. The supercritical extraction industry is now represented by two commercial extraction plants.

Dr Graham Weir and **Associate Professor Ken MacKenzie** were elected as Fellows of the Royal Society of New Zealand in recognition of their work in applied mathematics and chemistry respectively.

Dr Mark Poletti received an award from the University of Auckland for the best doctoral thesis in the faculty of Architecture, Property, Planning and Fine Arts with his thesis on the "Performance of Multi-channel Sound Systems."

Dr Steve Tallon's PhD thesis entitled "Application of Acoustics to the Monitoring of Gas-Solid Processing Systems" was selected by the University of Auckland as the top thesis in the Engineering Department.

RECRUITMENT

Recruitment was a key focus this year. Finding good quality, qualified people has continued to be a challenge and we put particular effort into recruitment activities to attract suitably skilled graduates from New Zealand universities.

Overall staff numbers have remained fairly constant at 412 FTEs at the end of June 2003.

COLLECTIVE EMPLOYMENT CONTRACT

This year we successfully negotiated and ratified a new collective employment contract with the Public Service Association (PSA). The contract runs for 18 months and covers PSA members.

STAFF COMPETENCIES

As part of the ongoing development of staff, considerable work was undertaken this year on redefining the competencies of the different 'job families' within Industrial Research. This has involved consultations with staff and their managers on what makes individuals successful in their particular jobs, and relating these to supporting the new direction of the company. As part of this work, we are also reviewing career pathways for all staff and determining what is needed for staff to progress in their careers.



■ ASSOCIATE PROFESSOR
KEN MACKENZIE

REVIEWING COMPANY VALUES

With the direction and strategy of the company defined, work is underway on reviewing company values which support this. These values describe the behaviours expected from Industrial Research people to enhance the company and help achieve its goals.

SUMMER RESEARCH SCHOLARSHIPS

Industrial Research's annual summer research scholarship programme employed 20 New Zealand university students this year from November to February. These students worked in a wide range of areas including biopharmaceuticals, automation systems and materials technologies. As well as helping with the practical requirements for their degrees, the programme provides students with valuable on-the-job experience.

HEALTH AND SAFETY

During the year a new Electrical Safety Policy was developed and implemented company-wide covering standards for new electrical equipment, testing of repairs and authorisations for electrical work.

Following a successful audit by ACC we maintained our secondary status in the ACC Partnership Programme, meeting many additional requirements stemming from new legislation.

STAFF WELL-BEING

A stress management policy is being developed for the company to ensure staff's health and well-being is not compromised as a result of work pressures.

The on-site nurse role at Gracefield has been upgraded to a full time position.



■ RANGI TE KANAWA,
MUKA LIMITED



■ HARAKEKE FIBRE PREPARATION



■ POWER PROJECT WITH EAST
COAST HEALTH PROVIDER

SOCIAL CONTRIBUTIONS TO NEW ZEALAND

PROJECT GDP

This year, Industrial Research initiated a project designed to address the R&D gap for small and medium enterprises (SMEs) which represent more than 90 percent of New Zealand businesses.

Under Project GDP we are investigating the feasibility of utilising the skills and resources within polytechnics to provide research and development capability to SMEs, with Industrial Research providing support.

To date, interest has been high with several SMEs keen to be involved in a trial planned in conjunction with the Wellington and Manakau Institutes of Technology. If this trial proves successful, the concept could eventually be expanded nationwide to involve other polytechnics and research institutes throughout New Zealand.

POWER TO THE COAST

A 'Power to the Coast' project is underway to alleviate serious energy infrastructure problems facing the east coast north of Gisborne. Insufficient distribution networks are stymieing new development for local communities and negatively impacting community health.

Industrial Research and research partner Ngati Porou Hauroa (a local health services provider) will receive \$250,000 from the Foundation for Research Science and Technology for up to four years to undertake the project. Its focus is developing innovative alternatives to traditional network electricity supply using demand side management and distributed generation of power from local renewable energy sources. Key issues are to reduce the present costs of supply and relieve stress on the existing infrastructure.

Collaboration is a key note of the project with Eastland Networks (the local electricity distributor) and several Ngati Porou iwi organisations all being closely involved.

HARAKEKE FABRIC

Under a project funded by the Foundation for Research, Science and Technology's Maori Collectives Scheme, Industrial Research is investigating developing a spinnable fibre from the harakeke plant (New Zealand flax), in conjunction with Rangī Te Kanawa of Te Kuiti-based Muka Limited.

The project involves tearing the flax fibre apart and reconstituting it into a spinnable fibre that can be commercially woven. It is hoped that such a fibre could be used to make high value fabric suitable for clothing and create a niche market for the product. The lower quality fibre will be investigated for possible industrial applications.

Some harakeke fibres are almost as fine as linen and have a gloss that cotton doesn't possess. As oil supplies become more limited and the cost of synthetic fibres rises, it is likely that natural fibres will become more desirable and harakeke could be part of that natural fibre spectrum.

TIKITERE GEOTHERMAL FIELD

The potential of the Tikitere geothermal field near Rotorua for producing electricity is being investigated on behalf of the Tikitere Trust in a project led by Industrial Research. Using information and data provided by Geological and Nuclear Sciences, Industrial Research mathematicians are modelling the field to determine its scale and the impact that different sized geothermal power developments would have on both the area, which has deep cultural significance for local Maori, and on an established tourism operation. The project also involves Auckland University mapping Tikitere's thermal features and studying the area's thermophillic bacteria. It is being funded by the Foundation for Research, Science and Technology's Maori Collectives Scheme.





■ NATIVE REVEGETATION OF GRACEFIELD SITE



ENVIRONMENTAL RESPONSIBILITY

CUTTING ENERGY CONSUMPTION

Industrial Research continued to introduce energy saving methods during the year, particularly with the nationwide call for electricity savings from April. With a government sector target of 15%, Industrial Research reached savings of 16.7% in May.

A large part of the company's success in cutting energy consumption has been through educating staff, with regular information disseminated about ways to keep usage down including turning off equipment, lights and computer gear when not in use.

The company's energy and building management system at its Gracefield site allows hourly monitoring of electricity consumption to identify any unusual peaks. A de-lamping programme this year saw unnecessary lights removed from corridors and the cafeteria only lit at night. Air conditioning cycles were shortened and private use of heaters discouraged. Individual teams are also now responsible for meeting their electricity costs based on check meters installed throughout the premises, and any equipment purchased must meet energy efficiency guidelines which include having a variable speed drive on electric motors.

WAIWHETU STREAM RESTORATION

We continued to be active in the ongoing restoration and health improvement of the Waiwhetu Stream which forms the western boundary of our Gracefield site. This year Industrial Research's site manager took up the chairperson role for the Waiwhetu Stream Working Group which also comprises the Wellington Regional Council, the Hutt City Council, Forest & Bird and local residents.

An investigation was begun into how heavy metals and other contaminants in the stream's downstream sediment could be managed, with several options under consideration. We are also working with the Hutt City Council to minimise rubbish and run-off from the Wainuiomata Hill going into the stream.

Since the restoration work began several years ago, the stream's health has shown a marked improvement, with fish life including mackerel, eels and whitebait observed in the portion which flows through Industrial Research's property.

NATIVE REVEGETATION

Last year Industrial Research was nominated for an environmental award for its work in re-establishing indigenous vegetation around its ten-hectare Gracefield site, particularly the banks of the Waiwhetu Stream. Using locally sourced native plants, we are working to bring the Waiwhetu Stream to life and develop the grounds for staff to enjoy with more than 2000 square metres of vegetation re-established in the past five years. This area will be doubled over the next five years. Plantings along the stream have included two flax species to develop a source for local weavers.

HAZARDOUS SUBSTANCES

Industrial Research continued to focus considerable effort on its safety programme. Hazardous substances came under the spotlight with the development of a new Hazardous Substance Containment Application format in consultation with ERMA, designed to significantly reduce the cost and turnaround time for containment applications.

Submissions by Industrial Research for changes to the Hazardous Substances New Organisms Act were successful with amendments proposed that will allow us to manufacture and sell for research purposes new hazardous substances without the need for expensive approvals. Industrial Research also participated in developing a code of practice for Hazardous Substances Exempt Laboratories.





■ HTS COIL TECHNOLOGY



■

COLLABORATIONS

Industrial Research conducts collaborative work with a wide range of institutions both in New Zealand and overseas. In addition to those highlighted below, many other successful collaborations are noted throughout this report.

CENTRES OF RESEARCH EXCELLENCE

Industrial Research is associated with two of the five Centres of Research Excellence established in 2002 – the MacDiarmid Institute of Advanced Materials and Nanotechnology hosted by Victoria University of Wellington, and the New Zealand Institute of Mathematics and its Applications hosted by the University of Auckland.

UNIVERSITY STAFF LINKS

As well as collaborative work with New Zealand universities, some Industrial Research staff are also on the staff at Victoria University of Wellington. Jeff Tallon is a professor in the School of Chemical and Physical Sciences, Shaun Hendy is a senior lecturer at the School, while Ken MacKenzie is on secondment to the university as an Industrial Research Fellow in materials science.

NEW DRUGS TRIALLED

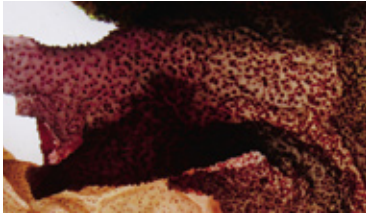
Together with colleagues at the Albert Einstein College of Medicine in New York, Industrial Research's carbohydrate chemistry team recently developed 'Immucillins', an extremely powerful group of enzyme inhibitors which prevent the proliferation of T-cells that can cause numerous ailments such as the skin disease psoriasis and arthritis. These pharmaceuticals are currently licensed to US company BioCryst Pharmaceuticals Inc and are undergoing clinical trials.

HIGH TEMPERATURE SUPERCONDUCTIVITY

Industrial Research's work on developing high temperature superconductivity (HTS) wire, coils and devices is being conducted in partnership with several organisations including American Superconductor Corporation, Long Electromagnetics Incorporated and Meridian Energy. HTS technology promises a revolution in the production, distribution, and use of electric power. Benefits include increased energy efficiency, reduced size and weight of devices, and increased power system stability.

BROADBAND WIRELESS PROGRAMME

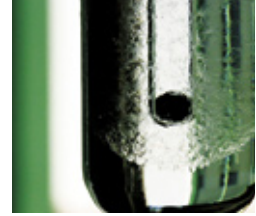
In a long-term collaboration with the University of Auckland, Industrial Research is developing broadband wireless systems for indoor environments, to create wireless offices, and for outdoor-indoor communications. Industrial Research's research engineers are developing signal processing algorithms that will enable devices such as computers, faxes and phones to communicate using wireless technologies, while the University of Auckland is investigating the deployment of wireless base stations to optimise system coverage and reliability. Long-term, the new technologies could provide enormous mobility with high reliability for users.



■ NATIVE RED SEAWEED



■ ANTARCTICA SEA ICE RESEARCH



■ TRIPLE-POINT THERMOMETER

COLLABORATIONS

IMPROVING LIFE-SAVING DRUGS

A five-year \$5.9 million research programme is underway to reduce the negative side effects of drugs that help combat life-threatening illnesses. Industrial Research has partnered with Australian biotechnology company Starpharma Ltd in the programme which involves carbohydrate nanotechnology. Industrial Research also has a joint collaboration with the School of Pharmacy at Otago University and the Cawthron Institute.

TRIPLE-POINT OF WATER CLARIFIED

The Measurement Standards Laboratory was project leader for a just completed long-term collaborative project with the National Physical Laboratory (UK) and the National Institute for Standards and Technology (USA). The project measured the effect of differing isotopic composition on the triple-point temperature of water. The triple-point of water is important for definition of the temperature scale, but is affected by naturally occurring 'heavy' water. The work has resulted in internationally accepted corrections for heavy hydrogen and oxygen isotopes, which will significantly reduce isotope errors.

SEAWEED TRIALS UNDERWAY

In collaboration with scientists at the National Institute of Water and Atmospheric Research (NIWA), Industrial Research is conducting farming trials of a native red seaweed, *Gigartina atropurpurea*, that produces a high quality carrageenan for the food ingredients industry. Such work on temperate species is in its infancy and includes investigating the feasibility of farming the seaweed including the production and survival of spores as a seed stock.

SCHOOL SCIENCE CURRICULUM IMPROVED

A secondary school science teacher was hosted for the 2002 school year by the Measurement Standards Laboratory (MSL) under the Royal Society of New Zealand's Science, Maths and Technology Teacher Fellowship scheme, resulting in improved links between MSL and schools. In collaboration with MSL, she improved the NCEA physics achievement standard by ensuring correct definitions of measurement terms were introduced, developed measurement related classroom resources, carried out research into corrosion analysis of surfaces, and presented a teacher workshop on the role of measurement in the curriculum.

ANTARCTICA SEA ICE MEASUREMENTS

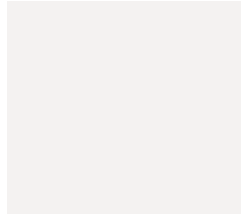
Measurement and data gathering work in Antarctica enhances understanding about how the sea ice interacts with the southern ocean and its climate, and consequently its effect on New Zealand's climate. Industrial Research scientists regularly join expeditions to the region and are currently conducting an extensive winter sea ice programme. This is producing interesting results which will be useful for Ross Sea oceanography work. The programme is in collaboration with the University of Otago, National Institute of Water and Atmospheric Research (NIWA) and Antarctica New Zealand.



■ **ALTERNATIVE ENERGY SUPPLY TECHNOLOGIES**



■ **EDIBLE VEGETABLE COATINGS FROM BARLEY**



■ **MEAT ROBOTICS**

BARLEY UTILISATION

A joint venture with Crop & Food Research is investigating increased utilisation of barley based around a process developed by Industrial Research. This process produces Glucagel[®], a novel carbohydrate which has food functionality uses and is considered beneficial in the human diet. Work is underway on developing edible coatings using Glucagel which has been shown to act as a barrier to the dehydration of vegetables.

SMALL-SCALE RURAL POWER SYSTEMS

Alternative supply technologies are being investigated by Industrial Research and Massey University in a joint study at rural sites. The study into community level integrated distributed energy systems could significantly alter how energy services are provided in remote areas, benefiting both power companies and their rural customers. The study aims to develop and demonstrate economically viable combinations of renewable small-scale energy systems.

HYDROGEN POWER FROM COAL

Working with CRL Energy, Industrial Research is developing hydrogen production and fuel cell technology to deliver distributed electricity supply from coal. Gas 'clean up' technologies will be used to produce environmentally friendly hydrogen fuel. Developing ways of returning the carbon content of the coal to the ground is an integral part of the project.

CO₂ STORAGE GOES UNDERGROUND

In association with the University of Utah and Utah Geological Survey, Industrial Research is modelling underground storage of carbon dioxide in natural reservoirs in a three-year contract with the US Department of Energy. Long term storage of this major greenhouse gas in deep saline aquifers could significantly reduce emissions from sources such as coal and gas fired power stations.

GROUNDBREAKING MEAT ROBOTICS

In a demanding two-year project, Industrial Research worked with its New Zealand project partners to develop a beef 'rip down' robot for the huge US beef market. The robot, which is capable of processing six 1000kg beef carcasses every minute, was installed at one of Excel Beef's US plants. Partners in the work were robot manufacturers Motion Design, tool-makers Allround Engineering and client manager Realcold Group.

OPTO-ELECTRONICS

Using light rather than electricity in 'electronic' circuitry offers great advantages of speed and performance. In collaborative projects with Auckland and Otago universities, Industrial Research is studying the synthesis of a range of novel optically active organic materials. These are expected to have more enhanced light reactive properties than those based on the current generation of inorganic materials. The aim is to develop a new generation of optical devices for use in communication, information storage and optical processing systems.



IRL AND SUBSIDIARIES KEY PERFORMANCE INDICATORS

| | ACTUAL 2003 | SCI 2003 | ACTUAL 2002 | ACTUAL 2001 |
|---|----------------|-------------|----------------|----------------|
| SCIENCE | | | | |
| Papers submitted for publishing | 106 | 350 | 374 | 145 |
| Invitations to scientists to speak at conferences | 30 | 20 | 18 | 16 |
| Conference papers and abstracts | 165 | 175 | 170 | 125 |
| Research monographs, books or popular books | 4 | 0 | 2 | 16 |
| Scientific and technical reports to clients | 663 | 650 | 622 | 682 |
| TECHNOLOGY | | | | |
| Industry workshops | 18 | 5 | 23 | 5 |
| Value of Technology New Zealand contracts | \$1.07m | \$1.54m | \$0.85M | \$1.12m |
| Joint ventures established | 1 | 4 | 4 | 2 |
| Licences granted | - | 4 | 8 | 3 |
| Customer benchmarking survey | - | 0 | 1 | 1 |
| HUMAN RESOURCES | | | | |
| Permanent staff turnover | 13.20% | 7.00% | 6.80% | 8.10% |
| Professional development of scientists (# of staff) | 277 | 290 | 300 | 284 |
| Summer vacation students | 25 | 30 | 50 | 39 |
| Engineering and science scholarships (includes overseas interns) | 27 | 6 | 24 | 18 |
| Percentage of working days lost to work related accidents | 0.06% | 0.01% | 0.02% | 0.01% |
| Staff composition (as FTEs) | | | | |
| - research teams | 290.23 | 321.55 | 306.06 | 276.49 |
| - research support | 52.86 | 62.41 | 60.01 | 61.7 |
| - general support and management | 69.28 | 57.11 | 53.25 | 54.49 |
| Total FTEs at year end | 412.37 | 441.07 | 419.32 | 392.68 |
| FINANCIAL | | | | |
| Earnings Performance | | | | |
| Gross revenue (000s) | 62,483 | 65,077 | 58,654 | 56,282 |
| Earnings before interest, reorganisational costs and taxes (EBIT) (000s) | 2,374 | 3,150 | 3,198 | 3,263 |
| EBIT margin % | 3.80% | 4.84% | 5.45% | 5.80% |
| Net surplus / (deficit) before tax, minorities and equity earnings (000s) | -69 | 1,810 | 1,641 | 2,931 |
| Net surplus / (deficit) after tax (000s) | (546) | 1,202 | 922 | 1,682 |
| Ratio of revenue to personnel costs | 2.16 | 2.17 | 2.13 | 2.18 |
| Return on assets (%) | 3.98% | 5.24% | 6.18% | 7.36% |
| EBIT to average funds employed (%) | 4.96% | 6.61% | 8.12% | 9.62% |
| Return on average equity (%) | -1.95% | 4.14% | 3.38% | 6.35% |
| Financial Position | | | | |
| Current ratio | 0.89 | .74 | 0.61 | 0.80 |
| Quick ratio | 1.04 | 0.8 | 0.58 | 1.02 |
| Times interest covered | 2.33 | 2.25 | 4.13 | 7.14 |
| Equity ratio | 44.72% | 48.35% | 53.04% | 59.77% |
| Gearing (debt component) | 46.49% | 42.29% | 35.66% | 23.93% |
| Crown's nominal investment (Defined as Equity and Crown debt) | 27,741 | 29,597 | 28,283 | 27,320 |
| OTHER STATISTICS | | | | |
| Capital expenditure (000s) | 10,330 | 10,189 | 14,291 | 7,951 |
| Available cash at year end (000s) | 122 | 145 | 329 | 14 |
| Revenue per FTE (000s) | 151.52 | 147.54 | 139.88 | 143.2 |

