

## RESISTANCE IS USELESS

*Siemens cable deal proves tipping point for superconductor industry*

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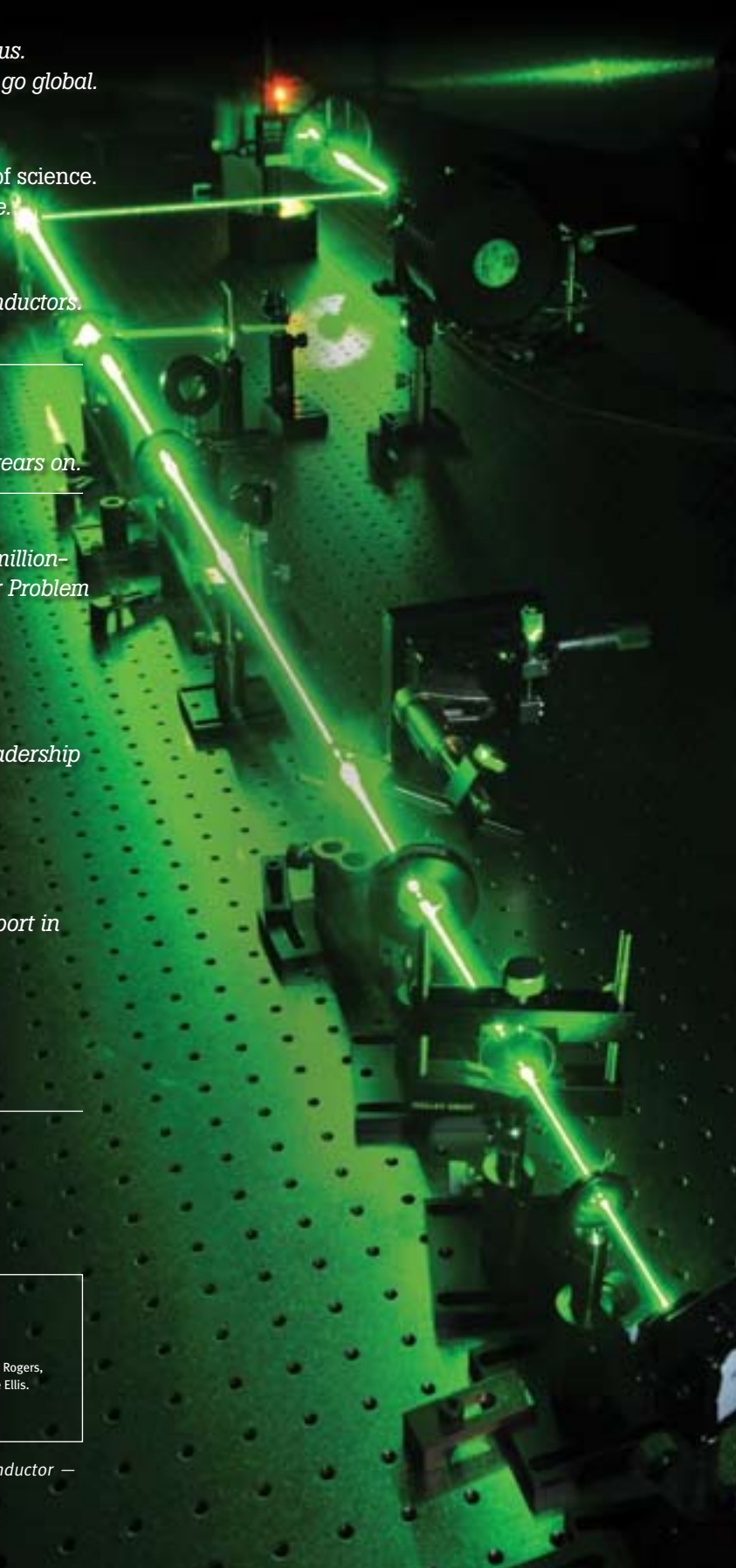
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**COVER IMAGE:** *Magnetic levitation over a high temperature superconductor — a demonstration of the Meissner effect.*



# Productive thinking

**W**hile opinions on the best way forward for the world economy vary, there is one point that the overwhelming majority of economists and politicians agree upon – the undeniable link between investment in science and technology and sustained economic development.

In the New Zealand context there has been much discussion recently on levers to improve productivity. While regulatory reform, better infrastructure, and improved public services can all play a part, their combined potential pales into insignificance when compared with what can be achieved through advances in science and technology.

Where we collectively sit today is not dissimilar to where Finland found itself in the early 1990s. A small export-dependent country with a reliance on primary sector commodities, it went into free fall after its main customer, the Soviet Union, collapsed. Unemployment skyrocketed from 3 to 18 per cent as the country slipped into a severe recession.

While I am not suggesting that New Zealand workers will suffer the same fate, the parallels with Finland in the early 90s remain: when commodity prices collapsed, Finns realised they needed to rethink the way they did business and in the process they revolutionised their economy.

What followed was a painful period of 'creative destruction' where some companies went under and others were acquired by competitors.

Some, like then wood-pulp producer Nokia, realised they would need to re-invent themselves if they were to survive. Through significant investment in science and technology, the country's ICT sector witnessed phenomenal growth.

How did Nokia become a world leader so quickly? Through R&D based on innovative science and technology solutions – Nokia's phones were smaller, lighter and performed better than competitors'.

The key to Nokia's success was that its heavy R&D investment was firmly focused on market-led solutions; there was very little investigation into technologies that didn't directly meet a consumer need. Today, Nokia's annual revenues are greater than the tax take of the Finnish Government.

Like many in R&D provider organisations and in the private sector, I was disappointed to see our Government scrap the R&D tax credit scheme set up by its predecessor. However, recent developments, including the appointment

of internationally renowned scientist Sir Peter Gluckman as Chief Science Advisor to the Prime Minister and a renewed emphasis on improving productivity, are encouraging.

Recently the Prime Minister spoke of "promoting a stronger, interactive relationship between the business sector and our publicly-funded research institutions". He said that universities and Crown Research Institutes need to be more responsive to the needs of firms and that our innovation system also needs to encourage firms to increase their uptake of research.

A stronger relationship with industry is something that IRL has been firmly focused on for the past 18 months. We are acutely aware that New Zealand's private sector investment in R&D is well below the OECD average and this must improve if we are to enjoy the living standards to which we aspire.

In an effort to do our bit to raise the profile of investment in R&D by the private sector, we recently concluded 'What's Your Problem New Zealand?', a competition open to New Zealand businesses. With a top prize of up to \$1 million in R&D services for the winner, competition was tough. We received more than 100 entries, but one stood out from the rest.

I look forward to seeing how IRL's chemistry expertise can assist competition winner Resene to develop a new range of paints with up to 80 per cent sustainable ingredients.

It may appear that choosing the winner of 'What's Your Problem New Zealand?' is the conclusion of IRL's campaign to re-engage with industry. In fact, it is just the beginning. Over the next few months we intend to further increase our engagement with a range of businesses from across the many sectors with which we work.

Our efforts will be underpinned by a market-pull philosophy, rather than one of technology push, and we hope this will enable a wide range of businesses to develop exciting new products, open new markets and improve productivity.

This new publication is just one of several vehicles we will be producing to enable IRL to communicate better with our many and varied stakeholders. Personally I am excited about helping New Zealand businesses realise their potential through the uptake of R&D and I look forward to bringing you some of these stories in future editions of *IRL Solutions*.

**Shaun Coffey**  
**Chief Executive**  
**Industrial Research Ltd**



*We are acutely aware that New Zealand's private sector investment in R&D is well below the OECD average and this must improve if we are to enjoy the living standards to which we aspire.*

*Watt's nano-sized palladium has been lauded internationally for both superior performance and cheaper cost than conventional palladium and samples are now being assessed in the UK to determine their suitability for pollution control systems.*

## Small wonders

IRL research collaborator John Watt may have been named 2009 MacDiarmid Young Scientist of the Year for his groundbreaking work at the nano-scale, but his world-leading studies could have a very big impact both locally and on the global stage.

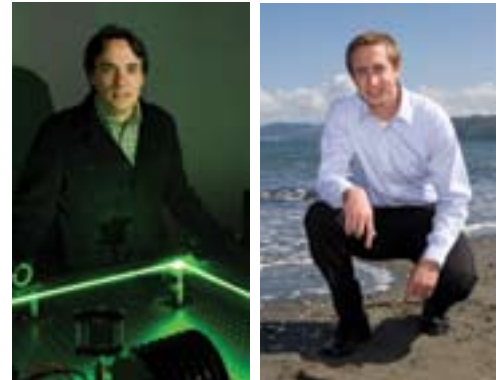
Watt, 27, earned the top prize at this year's prestigious MacDiarmid Awards – as well as the Industrial Research-sponsored Future Science and Technology category – for research that could both vastly improve our air quality and even lead to the establishment of a nanomaterial manufacturing industry in New Zealand. The Victoria University PhD student's work involved the growth of infinitesimally tiny particles of the rare metal palladium which works to cleanse a car's exhaust of toxic gases. Watt's nano-sized palladium has been lauded internationally for both superior performance and cheaper cost than conventional palladium. Samples are now being assessed in the UK to determine their suitability for pollution control systems.

"We grow the nanoparticles in solution which makes them easier to extract and results in less waste," says Watt. "Normally, to create nanoparticles, you need very high temperatures but we have found a way to work with the palladium at room temperature, delivering significant energy savings."

In addition to improving our air quality, Watt hopes his research will "make a contribution to strengthening New Zealand innovation and our high technology economy".

IRL research scientist Bridget Ingham has been working with Watt on his palladium nanoparticle project since January 2008, and the two recently co-published a paper on the growth of platinum nanocrystals followed using synchrotron x-ray techniques.

NO PIPE DREAM: John Watt, 2009 MacDiarmid Young Scientist of the Year.



## Stanford MBAs help IRL's emerging tech go global

IRL's efforts to take its cutting-edge photonics and wave power research to the global marketplace achieved a boost recently thanks to the contributions of two Stanford MBA students, Alberto Nanes (pictured left) and Tyler Warnock.

Sponsored by IRL under the Global Management Immersion Experience (GMIX) programme, Alberto and Tyler spent a month based at IRL in Lower Hutt channelling their energy into bringing some of the Crown Research Institute's most promising research closer to commercial reality. Their visit was funded by the Foundation for Research, Science & Technology, as part of an initiative aimed at strengthening international relationships.

Alberto, from Mexico City, devised a commercialisation strategy around IRL's research into photonics, an emerging technology that hinges on the use of photons rather than electrons in signal processing and has potential applications ranging from high bandwidth telecommunications, to defence, security and sensing.

"I was able to determine the market size for the most profitable industries that could be interested in IRL's technology," says Alberto, who has one more year to go to complete his MBA.

He also sought out potential partners to develop prototypes, and produce and sell the technology worldwide, as well as potential end-users.

Tyler, from Atlanta, Georgia, worked on a commercialisation plan for a wave energy device under development by Wave Energy Technology-New Zealand (WET-NZ), of which IRL is a partner. The aim is to have pre-commercial devices generating electricity within three years.

He also identified potential strategic partners to augment funds already raised by WET-NZ. "The dialogue is ongoing and looks promising so far," he says.

Tyler, who aims to found and operate clean technology start-ups, predicts "the technology could have a profound impact on the energy portfolio in New Zealand".

Despite so much progress in just four weeks, it wasn't all hard yakka – at the weekends the students took in some of New Zealand's top tourist attractions – more than making up for missing their own summer break back home.

# Good company

Royal ranking recognises IRL chief as steward of science.

Colleagues, peers and friends gathered recently at IRL's Alan MacDiarmid Centre to congratulate Chief Executive Shaun Coffey on being made a Companion of the Royal Society of New Zealand.

The title of Companion is an honour recognising outstanding leadership in science, and contributions to the promotion and advancement of science and technology in New Zealand.

Royal Society President Dr Garth Carnaby presented the award and spoke of Shaun's contribution to the New Zealand science community since his arrival in 2006 from Australia, where he was foundation head of the Livestock Industries Division of Australia's Commonwealth Scientific and Industrial Research Organisation.

"Shaun has demonstrated exceptional leadership by promoting throughout New Zealand the benefits of a strong and innovative science community which is focused on the needs of industry."

Dr Carnaby said the election of Shaun Coffey as a Companion was formal acknowledgement of the significant contribution he had made over the past three years.

Shaun Coffey thanked a number of people both within IRL and externally, including former Board Chair Dr Brian Rhoades, Dr Carnaby, Business New Zealand Chief Executive Phil O'Reilly and Foundation for Research, Science and



Shaun Coffey (left) receives his award from Royal Society President Dr Garth Carnaby

Technology head Murray Bain.

"Much of what I have been able to achieve is due to the great people we have here at IRL. Things like high temperature superconductivity technology, which is now moving into a high-value, global market, are good examples of the tremendous technology being developed here that is based on good science. Technologies like HTS are going to drive this organisation forward," he said.

*The award of the Companion of the Royal Society of New Zealand was introduced in 1999; there are currently 27 Companions.*

*Shaun has demonstrated exceptional leadership by promoting throughout New Zealand the benefits of a strong and innovative science community.*

*Dr Garth Carnaby, Royal Society of New Zealand President.*



## New Board Chair

Recently appointed Board Chair Keith McConnell brings a wealth of commercial, industry and governance experience to IRL.

An Auckland-based professional company director, his diverse commercial experience includes stints as Chief Executive of a number of medium-sized companies in the engineering and construction sectors.

More recently Keith has specialised as a director and consultant with particularly strong connections to the wind power industry in New Zealand – he is a founding director of NZ Windfarms and a long-standing director of Windflow Technology.

Keith, who lives in Auckland, says he is looking forward to working with the IRL management, staff and stakeholders as the company steps into its next stage of development.

Minister for Research, Science and Technology the Hon Dr Wayne Mapp said Keith McConnell's experience "covers a range of sectors relevant to IRL".

Keith replaces Dr Brian Rhoades, who, upon completing his term as IRL Board Chair, was appointed to the Board of Rotorua-based Crown Research Institute Scion. Ray Thomson, who has over 30 years' experience as a director of listed companies and a particular interest in investment in natural products, also recently joined the Board as a director. He replaces Craig Stobo, who completed two terms as a director.



## Testing IRL's metal

Kiwis tasked with discovering the role of iron in superconductivity.

GRANT WILLIAMS: assessing the potential of iron-based superconductivity.

**I**RL's world-leading copper oxide-based high temperature superconductor (HTS) researchers are now turning their attention to one of the world's oldest known metals – iron.

Superconductivity is a phenomenon where some materials conduct electricity with no resistance or energy loss during the transmission process. High temperature superconductors are very cold but termed high because they operate at much higher temperatures than low temperature superconductors. HTS technology yields products which are lighter, smaller and more efficient than existing copper wire technology.

Interest in HTS compounds containing iron dramatically increased in 2008 when Yoichi Kamihara and colleagues at the Tokyo Institute of Technology reported that an iron-based compound can be made to superconduct below -247 degrees Celsius. However, there is no clear consensus concerning the fundamental physics and this is crucial for future commercialisation of the technology. A team of IRL researchers, Dr Grant Williams, Professor Jeff Tallon, and Dr Andrew Kay, have now been granted \$750,000 over three years by the Marsden Fund to research the complex and competing magnetic and electronic interactions in iron-based compounds.

This research has the potential to revolutionise our understanding of how high-temperature superconductivity actually works and create a new global market, according to programme leader Grant Williams.

"Until the advent of high-temperature copper oxide-based superconductors, magnetism and superconductivity were considered antagonistic. Ironically they now seem to be intimately linked and magnetism plays a very important role in allowing superconductivity to occur at relatively high temperatures.

"There is potential for superconducting compounds containing iron to supersede copper oxide compounds for a number of important commercial applications. It's very difficult at this stage to predict, but it's possible that a new market for iron-based superconductors could grow to one billion dollars by the end of the next decade."

**IRL staff profile:** Patrick Lim

## Automan's passion of primary importance

Robots have long piqued the curiosity of boys of all ages, and IRL's Engineering Innovations leader, Patrick Lim, is no exception.

His enduring interest in robotics control spans years of university study in electrical and electronics engineering and has earned him several contemporary awards, including a Royal Society medal.

The remote-controlled robots of the past have now given way to sophisticated automatic systems for handling and processing items of varying sizes and shapes – a skill very much in demand due to New Zealand's reliance on primary products.

The Engineering Innovations team is providing a vital springboard for developing a range of robotic systems for processing sheep carcasses through the Ovine Automation Limited (OAL) consortium – the joint FRST/industry-funded programme to rejuvenate the meat processing industry.

Currently, the two active OAL projects spearheaded by the team are making good progress along with the commercialisation of IRL technologies; the gas de-pelter and the intelligent Y-cutter.

As co-science leader for the OAL consortium, Patrick and his R&D team deliver state-of-the-art technologies that would provide the best possible outcome for the industry in terms of improved productivity and competitiveness.

"A lot of what I do involves getting out there and talking to people," says Patrick. "That's what it's all about – getting a good understanding of industry needs and what technologies they would like to see operating in their plant."

While Patrick admits the work can be frustrating, he is passionate about providing solutions to industry problems.

"It's challenging because often the things that we do have never been attempted before, so you start from scratch. Sometimes you have to go through several iterations before you come up with a viable solution.

"We currently have a strong R&D group in IRL in robotics and automation.

I want to build on that capability and within the next five years I envision the establishment of a centre of excellence in IRL in this field."



# Breathing life into business

Heated humidifier technology developed in the 1970s pioneered a new medical device manufacturing capability for New Zealand. The invention was commercialised by Fisher & Paykel Healthcare and provided the world with significantly improved systems for ventilating critically-ill patients.

## Industry need

A team of engineers at IRL's predecessor, the DSIR, developed a strong working relationship with doctors in Auckland hospitals, supporting world-leading medical research.

Physician Dr Matthew Spence, head of Auckland Hospital's Acute Respiratory Unit, was concerned that ventilators providing medical oxygen and air caused the lungs of seriously ill patients to dry out and cause infection or critical blockages in endotracheal tubes. He asked DSIR if it could develop a more efficient device to deliver humidified gas to patients being artificially ventilated. The gas needed to be saturated with water vapour and remain at body temperature.

## IRL innovation

The solution, developed by DSIR's Alf Melville, George Palmer and Dave Patterson, was to add heat and moisture to air and oxygen in a novel way to prevent airways from drying out. The original prototype was built using an Agee preserving jar, a heating element and blotting paper to provide gas at body temperature and fully saturated with water vapour. The concept involved a heated coil to warm the air in the delivery tube and prevent condensation of the moisture.

The prototype was tested in a range of conditions to prove it could generate a source of warm, humidified air and the technology was patented. Peter Connor, who joined the DSIR team as a university graduate, says the innovation is an example of scientists successfully applying physics and engineering to resolve an industry problem. Fisher & Paykel (F&P), then a whiteware manufacturer looking to diversify, picked up the prototype in 1969.

Commercial success was not assured. F&P had no experience in manufacturing and selling medical equipment, and clinicians are extremely cautious about adopting new technologies.

It was the personal commitment of Maurice Paykel and F&P's Dave O'Hare to developing the medical technology that eventually resulted in successful commercialisation of the world-first heated tube respiratory humidifier, almost 15 years after the innovation was developed.

## Economic benefits

Forty years on, the fundamental technology is the cornerstone of F&P Healthcare, established as a separate entity in 2001, and now a leading designer, manufacturer and marketer of products and systems for use in respiratory care, acute care and the treatment of obstructive sleep apnea. The company listed on the New Zealand and Australian sharemarkets in 2001.

F&P Healthcare Managing Director and CEO, Michael Daniell, says the technology underpins the revenue earned from its respiratory and acute care products – about half of the \$550 million total expected this financial year. The other half is generated from its sleep apnea equipment.

He says the development of F&P's obstructive sleep apnea technology was also based on the earlier technological breakthrough by IRL. The technology has facilitated the company's entry into a range of world medical markets.

"It continues to provide a thread through the whole business, also feeding into the development of two new applications: one that conditions carbon dioxide gas used to inflate the abdomen during laparoscopic surgery and another to assist patients with chronic obstructive pulmonary disease.

"The IRL technology relates to about 90 per cent of everything we do," says Mr Daniell.

The pathway to market was long and slow, with the technology earning less than \$200,000 a year during its first decade of sales, or around \$1 million in today's dollars.

"F&P probably would not have supported the humidifier technology for more than a decade if it wasn't able to take advantage of some government incentives available at the time for export development."

Today F&P Healthcare exports to 120 countries and continues to develop opportunities beyond its traditional intensive care markets.

## Future work

F&P continues to work with IRL on some specific projects and has its own research and development team of 250 scientists, engineers and physiologists involved in clinical research and product and process development.



*F&P continues to work with IRL on some specific projects and has its own research and development team of 250 scientists, engineers and physiologists involved in clinical research and product and process development.*

# Million-dollar winner

Overwhelming response from industry to IRL's million-dollar question.

*With the assistance of IRL, Resene hopes to have developed its world-first, waterborne paint using 80 per cent renewable ingredients in 18 months' time.*

**W**hile pundits theorise about the best way to promote the benefits of R&D to the private sector, IRL has been conducting one of the most revolutionary marketing campaigns New Zealand science has ever seen.

A competition offering up to \$1 million in R&D services from IRL to the winner, 'What's Your Problem New Zealand?' was aimed at engaging with industry to raise awareness of how R&D can help raise productivity and profitability.

By asking New Zealand businesses what their biggest science and technology hurdle was and getting them to articulate how solving the issue would enhance their business, IRL prompted a huge response.

"We wanted to do something big. Rather than offer several small prizes, we wanted to choose an idea that sought to make a step-change for the winning business that ideally would translate into success on the international stage," says IRL Chief Executive Shaun Coffey.

After engaging with around 700 companies, IRL received more than 100 formal entries from New Zealand firms. The competition

culminated with Resene Paints being announced winner in August after a gruelling multi-stage judging process.

Resene will work in concert with IRL's world-leading chemistry experts to develop new waterborne paints based on resins made from up to 80 per cent sustainable ingredients and in doing so break the long-term reliance on gas and oil for high performance paints.

Resene Managing Director Nick Nightingale said the competition presented an amazing opportunity for Resene to team its commercial experience with world-leading science and revolutionise an industry.

"We're committed to sustainable developments and we took a bold idea to the judges and showed them how it can be realised with IRL to ensure the financial benefits continue to flow to New Zealand."

While there could only be one winner of the competition, the IRL business development team has been working with the nine finalists and many of the other entrants to utilise IRL's world-class R&D expertise to enable them to overcome science and technology hurdles.

The 105 entries represented a diverse range of sectors including agriculture, biotechnology and bio-manufacturing, building and construction, ICT, energy, food and beverage, and manufacturing.

The finalists represent a wide range of sectors and company sizes which mirrors the diversity of the wider field says Shaun Coffey.

"To have this number of entries in a country with a small population like New Zealand shows there are many companies out there who realise the true value of R&D," he says.

Just weeks after the conclusion of the competition, IRL was in negotiation with more than 50 of the companies that entered. "While the Resene project will bring significant benefits to this iconic New Zealand company, it is equally important that we maximise our exposure to the others who entered the competition."

With the assistance of IRL, Resene hopes to have developed its world-first, waterborne paint using 80 per cent renewable ingredients in 18 months' time.

"We may repeat the competition in the future but we need to first work with Resene to ensure the success of their project. Once we have achieved this it will be in itself a great advertisement for the power of research and development based on world-class science and technology," says Shaun Coffey.

Finalists mix and mingle with IRL staff and stakeholders at the awards reception.





CLOCKWISE FROM LEFT: Chief Judge Dr Garth Carnaby addresses the finalists; Professor Peter Gluckman, Chief Science Advisor to the Prime Minister, announces Resene as competition winner; IRL Chief Executive Shaun Coffey with Resene Managing Director Nick Nightingale holding the winner's trophy; competition finalists.



## Win-win for What's Your Problem NZ? finalists

While Resene got the lion's share of the publicity for winning What's Your Problem New Zealand? it would be an understatement to say the other nine finalists presented outstanding proposals.

The independent judging panel, made up of a team of business and science leaders, were unanimous in their opinion that any one of the firms that made the final cut would have been worthy winners.

"From my point of view it was particularly encouraging that we got quality entries from across the variety of sectors we serve," says IRL Chief Executive Shaun Coffey.

The ten finalists were Dynamic Controls, Fisher & Paykel Appliances, Glidepath, Gallagher Group, Group3 Technology, Mars Petcare NZ, Pacific Edge Biotechnology, PowerShield, Pultron Composites and Resene.

The ideas put forward by the finalists were as diverse as the organisations they represented.

Dynamic Controls' proposal focused on developing integrated data analysis tools to inform healthy wheelchair living while Fisher & Paykel proposed developing new technologies to redefine the washing process in appliances to make water usage environmentally sustainable.

Gallagher Group's project tackled the development of an asset-tracking system that represented an opportunity to expand upon a core strategic product. Glidepath suggested the development of a low-impact diversion device for baggage handling and Group3 Technology put forward a proposal to develop a next-generation teslameter to enhance measurement accuracy and application options.

Mars Petcare NZ planned to develop an imaging system to detect seal imperfections that cause product spoilage. Pacific Edge Biotechnology wanted funding for the development of a second-generation cancer detection device that would be cost-effective, quick and significantly more accurate.

PowerShield proposed the development of an integrated system that would ensure accurate monitoring of batteries that provide back-up power for large data centres. Pultron wanted funding to conduct independent testing of their novel composite reinforcing bar and to develop tools to inform design engineering parameters.

Chosen from a field of more than 100 entries, the finalists all stood out because they could articulate how they would go about utilising the investment to advance their business in a meaningful way.

Shaun Coffey says the level of interest in the competition showed that despite challenging market conditions, many of New Zealand's most progressive firms had their sights set firmly on a brighter future.



# Leadership hothouse sparks *eureka* moment

*"Innovative R&D will always underpin world-leading products and services. New Zealand businesses need to take advantage of the science and technology expertise available at IRL and other R&D providers to enable them to meet the challenges of competing successfully in global markets."*

Shaun Coffey, IRL Chief Executive

**W**hen IRL's Nick Long, Madhu Vasudevamurthy and Robert Holt were asked to join IRL's Leadership Development Programme (LDP), they had no idea they would conceive one of the most revolutionary marketing strategies that New Zealand science has ever seen.

Part of a group of 32 IRL staff chosen for the first intake of this intensive course, the group was challenged to devise a business case and present their plan to a panel of business leaders who asked searching questions about the viability of the proposal, in a manner similar to the popular TV series, *Dragons' Den*.

One of the 'dragons' was IRL Chief Executive Shaun Coffey, who was so impressed with their idea of awarding up to \$1 million in R&D services as part of a competition for New Zealand businesses that he agreed to run the campaign as IRL's key marketing initiative for 2009.

Delivered by Victoria University's Centre for Executive Development, the LDP seeks to develop leadership skills at all levels of the organisation, giving staff the opportunity to actively take part in mapping the strategic direction of the Crown Research Institute.

Victoria University's Professor Stephen Cummings said that when What's Your Problem NZ? was proposed it was clear the idea was something special.

"While a huge amount of work went into refining the idea, it was a 'eureka' moment each time it was presented. You could feel the rooms expand with people thinking 'this is so simple and so clever that it's brilliant'.

"Part of IRL's strategy is to better engage with industry over the coming years and when the team came up with What's Your Problem New Zealand?, the idea really resonated with me,"

says Shaun Coffey.

He says the current challenging economic environment was an opportunity for New Zealand businesses to re-examine the way they went about developing products and services.

"Innovative R&D will always underpin world-leading products and services. New Zealand businesses need to take advantage of the science and technology expertise available at IRL and other R&D providers to enable them to meet the challenges of competing successfully in global markets."

Leadership programme participant and competition project team member Dr Paul Benjes says he found the experience immensely educational and enjoyable.

"It was great to meet people from other parts of the organisation and learn more about the workings and interests of other science and technology teams."

He says there was a strong link between IRL and the programme with a real expectation that ideas and solutions found on the course would be brought back to IRL and proactively pursued with the full support of senior management.

"IRL historically has had a low public profile and we are always striving to better engage with industry. We saw the idea of an internally funded competition open to all New Zealand businesses as a way to address both problems. By getting industry to talk to us we will be far better placed to understand, and respond to, their changing R&D needs. As an added bonus we hope to stimulate levels of R&D investment from the private sector and help New Zealand emulate other small export-dependent countries like Finland and Singapore that have reaped the benefits of significant R&D investment from the private and public sectors."

The competition project team (from left) Madhu Vasudevamurthy, Nick Long, Paul Benjes, Robert Holt and Melissa Yiannoutsos.



## What's Your Problem NZ? highlights industry need

IRL competition reveals industry's need for support in science and technology research and development.

**I**RL's \$1 million What's Your Problem New Zealand? competition has heralded a major sea-change within the Crown Research Institute, according to Royal Society of New Zealand President and WYPNZ Chief Judge Garth Carnaby.

This change in strategic direction signals IRL's decision to engage far more proactively with the secondary sector, he says.

Dr Carnaby believes the competition revealed a significant industry need for support in science and technology R&D. The competition showed that industry people, who have a very good capacity to define their business needs, must talk to scientists who can envisage technical solutions.

Dr Carnaby was impressed with the calibre of the applications, saying they were all extraordinary propositions, with differing degrees of technical stretch. Resene Paints, he says, was chosen from the 10 finalists as having a standout problem with a standout potential solution which

could have global economic implications.

One of the most important points about the competition, in his view, was that it focused on individual companies. If the participating companies are able to develop technology-based solutions to their problems with IRL's help, he believes they will gain a huge competitive advantage over companies who were not involved.

Dr Carnaby's main concern now is whether the science funding agencies in this country will pick up on the need for further R&D development in SMEs.

"This competition was the pilot for a completely different way of approaching the model for funding small companies who make up the secondary sector and there are lessons here for the effective application of public funds to support industry.

"A whole new opportunity has been opened up by this competition – I just hope it's not lost."

LEFT: Though the paint was yellow, black and white, Resene's help bringing new life to the concrete gannets of Mana Island proves it has a green streak.

TOP RIGHT: Managing Director Nick Nightingale.



# Resistance is useless

Siemens cable deal proves tipping point for superconductor industry.

**T**wo years of painstaking work by IRL's high temperature superconductivity (HTS) team has culminated in the manufacture and sale of the world's longest second-generation HTS cables.

IRL and partner General Cable Superconductors are the leading developers of HTS technology, an emerging field that enables the transmission of electricity without resistance or the loss of energy. This in turn will enable the manufacture of lighter, smaller and more efficient machines than can be achieved with existing copper wire technology.

It has been estimated that the international market for HTS applications will be worth more than US\$20 billion by 2020.

Two long length HTS Roebel cables were recently shipped to multinational Siemens AG in Germany, where they will be tested for industrial use. This is part of a long-term project for Siemens which may require up to 2.5 kilometres of cable in four years' time.

This will enable Siemens to wind, with a single length of cable, the rotors for a power station generator with increased power output, reduced mass, smaller volume and higher efficiency.

"Supplying this first order is an important milestone because it demonstrates that HTS technology is not just something of interest in the lab, there are customers who are willing to invest significant sums in it because they understand the potential HTS represents," says Dr Bob Buckley, IRL group manager, HTS Conductors and Devices.

IRL research engineer Dr Rod Badcock led the team that manufactured the cable. "We've been developing a pilot production line here for General Cable Superconductors. For the last two years the team has been developing the automated processes and validating them for producing and

then winding strands of cable together."

This activity was the groundwork that enabled the team to manufacture the cables for Siemens AG.

"For the second cable there was a delay with the delivery of the material from our third-party supplier. It was a bit of a shock to look back and see that we had processed, manufactured and tested the cable before sending it to Siemens all within two weeks. This quick turnaround is a testament to the dedication of the team and the robustness of our process," he says.

The team has been asked to provide samples of cables for a number of companies across a number of industries around the world.

Dr Badcock says, "We're starting to build a critical mass in New Zealand in terms of expertise, in terms of generating income and in terms of developing the market."

General Cable Superconductors Chief Executive Andrew Priest says the sale of the cables to Siemens represents a tipping point for the emerging HTS industry.

"Delivering on a significant order for one of the world's fifty biggest companies in the first stage of its high profile generator project is a considerable milestone for HTS.

"The quick turnaround of the cable manufacture under such a tight time-frame is a real endorsement of all the work put in on the systems, processes and procedures."

The next phase of development for HTS will be the continuation of intensive marketing around the globe to demonstrate the capabilities of the technology and to establish exactly what potential customers want in terms of performance and specifications.

"We need to teach leading-edge companies about Roebel cable – that's how new it is," says Andrew Priest.

IRL Engineer Kent Hamilton makes adjustments to the Tapescope magnetic imaging system which is used for qualifying the raw HTS tape prior to Roebel punching.



HTS Roebel cable is lighter and can carry significantly more current than traditional copper cable.

HTS Roebel cable is woven together using a customised winding machine from 5 strands of 2mm wide superconductor.

### What is high temperature superconductivity?

Superconductivity is a phenomenon where some materials conduct electricity with no resistance or energy loss during the transmission process. While it would appear that high temperature superconducting cables are very hot, they are in fact extremely cold and are termed high temperature because they are comparatively much warmer than previously developed low temperature superconducting materials, which operated at close to absolute zero — the temperature of liquid helium (-273 Celsius). HTS technology operates at the relatively warmer temperatures of liquid nitrogen (-196 Celsius). The colder the materials are, the greater the financial cost, and the development of HTS makes superconducting technology a viable commercial proposition.

*Innovation through R&D can result in new industries and technologies that will help improve New Zealand's economic performance. Groundbreaking IRL research into rehabilitation is an example. Scientists and collaborators are investigating the use of therapeutic digital gaming to improve the outcomes and productivity of rehabilitation therapy.*



**Murray Bain**

## **Productivity gains from Research & Development**

Lifting our economy is one of the main reasons we invest in research, science and technology.

New Zealand's productivity rates are low by international standards, with growth of less than 1 per cent in recent years. While it is notoriously difficult to quantify, investing in research and development (R&D) and technology transfer are widely regarded as proven tools for productivity improvements.

R&D can do a number of things. It can result in new products or processes that help existing industries produce the same or more from fewer inputs. In the manufacturing sector, for example, automation, advanced sensing technologies, new materials, innovative design and using sustainable materials are all ways of improving productivity.

Take our partnership with research consortium Ovine Automation Limited to develop state-of-the-art sensing and robotic technology that will automate the early stages of sheep processing.

This initiative, in which IRL is a key research partner, is predicted to deliver productivity improvements of up to \$43 million a year within five years. The gains come from efficiencies on the processing chain, improving pelt and meat quality and cutting the costs of accidents and related injuries.

Just as importantly, innovation through R&D can result in new industries and technologies that will help improve New Zealand's economic performance.

Groundbreaking IRL research into rehabilitation is an example. Scientists and collaborators are investigating the use of therapeutic digital gaming to improve the outcomes and productivity of

rehabilitation therapy.

Other IRL research is helping companies such as Phitek Systems, with its noise cancelling products and other advanced audio technologies, become world leaders in their fields.

As a key investor in innovation through R&D, the Foundation for Research Science and Technology has a sharp focus on the economic growth achieved as a result of the research we fund.

This is important both at a strategic level, when setting our investment priorities, and at an individual contract level. Recent changes to the way the Foundation is organised will help us target economic growth in our investment decisions. We will be looking right across the value chain at our investments in key sectors, from agreeing strategy right through to commercialisation. Past progress and results will be an important factor to consider.

We've always asked research organisations and businesses about potential benefits from their projects but now we are shifting our emphasis. Our key concern is how they plan to realise benefits from their work. We want more specific information about the likely outcomes, such as market demand for the research, the potential for job creation, new products for export and productivity gains from working smarter. There is still room for researcher-led ideas but even in this area we will want to know about the benefits ultimately likely to result from the research.

We are also looking at how to follow up on whether those projected outcomes were achieved.

This includes evaluating the impact of research we have funded in the past. Numerous international studies have shown a strong connection between R&D and productivity growth but it remains an imprecise science for a number of reasons – it can take a decade or more for the benefits of R&D to show up and it is a challenge to determine exactly how much growth can be directly attributed to R&D.

We hope to provide some better estimates through an evaluation underway of investments we have made through our Research for Industry portfolio. We will be finding out how many new products, processes and services have been created, how widely the research is being used and the benefits it is delivering in terms of improved productivity, reduced costs and increased revenues from exports.

As well as informing the debate about the link between R&D and productivity, the evaluation will give us important information to guide future investments to ensure they deliver maximum economic benefit for New Zealand.

*Murray Bain is the Chief Executive of the Foundation for Research, Science and Technology*



**Helen Anderson**

## Bridging the cultural divide

The global recession has brought increased urgency to the ongoing discussion about the structure of New Zealand's economy and its ability to deliver growth.

A continuous theme has been the need to diversify our economy and make it more resilient. This requires greater attention to building the high-tech sector.

So what can science contribute to the diversity and resilience of New Zealand's economy, and how can RS&T help boost productivity?

One standout area is business R&D performance. New Zealand's track record here is poor. Our

business R&D expenditure is growing but off a very low base. Added to that, New Zealand has a disproportionate number of very small firms.

So helping SMEs to innovate assumes particular importance. This requires researchers and businesspeople who understand each other's strengths. Firms often have a great insight into the challenges of the market but smart firms know they can't do it all on their own. They know they can benefit from talking to talented researchers who can help them identify opportunities that lie beyond the horizon.

IRL has shown that research organisations can add value to firms of all sizes. When Mesynthes, a Wellington-based SME specialising in medical devices, was being set up, IRL scientists worked within the firm for six months. Their expertise gave Mesynthes a head-start on product development.

And the benefits of partnerships extend to larger firms. The relationship between IRL and Resene through What's Your Problem New Zealand? provides an excellent example of what can be achieved when researchers bring their specialised knowledge to commercial problems.

The 'cultural' divide between researchers and business can be addressed by networks, facilitation and co-operation. We need to draw on the best local and international models to ensure smart firms can access the ideas coming out of our research organisations. Building rich relationships between firms and researchers has paid off for other countries. With the right attitudes this approach can work for us too.

*Dr Helen Anderson is the Chief Executive of the Ministry of Research, Science and Technology*

*IRL has shown that research organisations can add value to firms of all sizes. When Mesynthes, a Wellington-based SME specialising in medical devices, was being set up, IRL scientists worked within the firm for six months. Their expertise gave Mesynthes a head-start on product development.*

## Sharing gains from meat mechanisation

Ovine Automation Limited (OAL) Manager Richard McColl believes the R&D consortium which was recently awarded funding of more than \$7 million is only scratching the surface of potential automation projects in the meat industry, and the future benefits for New Zealand industry could be enormous.

The most obvious benefits, he says, are the reduced reliance on labour and improved productivity, which will in turn improve returns for farmers.

"This consortium potentially improves the value chain returns both to the farmers in New Zealand and the processors. Ultimately, what we want to do is then invest back in their businesses as well. So if we can improve profitability, particularly domestically, significant investment opportunities will be opened up."

It is important to understand that reduced reliance on labour does not mean redundancies, Richard says.

While 25 years ago people were leaving school to join the meat industry, this has now changed and the industry struggles to get the labour it needs — particularly as real wages in the industry have fallen during this time. As OAL Manager, Richard co-ordinates the contracts with Government and with the providers of the technology, specifically IRL and Millers Mechanical. OAL was set up as a consortium by the industry partners to manage the ovine automation programme, with Richard becoming involved through his role as Innovation Programme Manager with the Meat Industry Association and previous roles within industry.

Industry at the time was looking at projects that met certain criteria, he says. They had to be of a size that no individual company would be able to commit to on their own, and have the capability to attract Crown funding.

"That was really what attracted us to it," says Richard. "And also that it was the first cab off the rank, if you like — every carcass in New Zealand has to go through the slaughter board and, by and large, the processes are fairly similar from company to company. It's when you get to the boning rooms they get a bit different, and the commercial drivers subsequently change."

Whilst there have been many challenges along the way, Richard McColl believes that ultimately the OAL consortium will significantly reinforce New Zealand's position as a pre-eminent research provider and innovator in sheep meat processing around the world.



# Scientists in Suits

In the boardroom and on the factory floor, Industrial Research Ltd's world class scientific and engineering expertise lifts productivity and profitability.

We know that R&D can help New Zealand business lift its game so we asked the million dollar question:

*"What's Your Problem New Zealand?"*



Resene Paints replied "Our industry needs to step forward into a sustainable future, NOW!"

**The multi-million dollar solution:**

Work with IRL's world leading chemistry expertise to develop a range of resins with 80% sustainable ingredients that can be used in premium waterborne paints.

**So congratulations Resene**, the winner of IRL's \$1 million Research and Development competition What's Your Problem New Zealand?

*Industrial Research Ltd – science is our business. To find out more visit [www.irl.cri.nz](http://www.irl.cri.nz) or phone 0508 CALL IRL*

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