Making science useful

The key to Australia's future

Recent highlights of the
Cooperative Research Centres Programme | 2006

CRC ASSOCIATION

Foreword

I am pleased to share with you the many Cooperative Research Centres (CRCs) success stories featured in this booklet.

Investing in science and innovation is critical for Australia to stay competitive in an increasingly knowledge-based global economy. The CRCs help to ensure that Australia remains internationally competitive, with Australian industry benefiting from smarter, faster and more reliable products, technologies and processes.

The case studies highlighted in this booklet are based on applications for the Awards for Excellence in Innovation, which were presented by the Hon. Teresa Gambaro MP, Parliamentary Secretary to the Minister for Foreign Affairs, at the CRC Association's annual conference in May this year.

Also featured are the presentations made by CRC students at the conference, demonstrating that CRCs continue to provide substantial opportunities for students to contribute to, and engage in, vital research. It also showcases the educational, environmental and social implications of the CRCs' work.

There are currently 57 CRCs established under the CRC Programme. Over the 10-year period of the $8.3 billion *Backing Australia's Ability* initiative, some $1.8 billion has been allocated to support the CRC Programme. This signifies the confidence that the Australian Government has in the CRC community to deliver both innovative research and the commercial application of that research.

The CRCs featured here have made a significant contribution to achieving national benefits by providing innovative solutions to many environmental, economic and social problems. I sincerely congratulate them on their efforts and look forward to hearing many more success stories in the future.

The Hon. Julie Bishop, MP

Minister for Education, Science and Training
2006

Winners

Capital Markets CRC
Award winner for uptake and use of research
The Hon. Tony Staley, Chair, Cooperative Research Centres Association
Dr Andreas Furche, Chief Technology Officer, Capital Markets CRC Ltd
Professor Donald Stokes, Deputy Chief Executive Officer, Capital Markets CRC Ltd
The Hon. Teresa Gambaro MP, Parliamentary Secretary to the Minister for Foreign Affairs
Professor Mike Aitken, CEO, Capital Markets CRC Ltd

CRC for Tropical Plant Protection
Award winner for uptake and use of research
The Hon. Tony Staley, Chair, Cooperative Research Centres Association
Mr Tim Cadzow, Managing Director, Keith Seeds Pty Ltd,
Mr John Hay, Manager—International Business, Heritage Seeds
Mr Chris Bazley, Managing Director, Pacific Seeds
Professor John Irwin, CEO, CRC for Tropical Plant Protection
The Hon. Teresa Gambaro MP, Parliamentary Secretary to the Minister for Foreign Affairs

Molecular Plant Breeding CRC
Award winner for education, training and public outreach
The Hon. Tony Staley, Chair, Cooperative Research Centres Association
Miss Belinda Barr, Australian Centre for Plant Functional Genomics
Mr Bruce Stevens, Spotlight on Science, Education Queensland, on behalf of secondary schools
The Hon. Teresa Gambaro MP, Parliamentary Secretary to the Minister for Foreign Affairs
Dr Amanda Able, Education Program Leader, Molecular Plant Breeding CRC

CRC for Australian Weed Management
Award winner for education, training and public outreach
The Hon. Tony Staley, Chair, Cooperative Research Centres Association
Dr Rachel McFadyen, CEO, CRC for Australian Weed Management
The Hon. Teresa Gambaro MP, Parliamentary Secretary to the Minister for Foreign Affairs
Dr Annabel Bowcher, Education Officer, NSW Department of Primary Industries

CRC for Innovative Grain Food Products
Award winner for best ten-minute student presentation
The Hon. Tony Staley, Chair, Cooperative Research Centres Association
Mr Louis Bradbury, CRC for Innovative Grain Food Products
The Hon. Teresa Gambaro MP, Parliamentary Secretary to the Minister for Foreign Affairs

CRC for Coastal Zone, Estuary and Waterway Management
Award winner for best three-minute student presentation
The Hon. Tony Staley, Chair, Cooperative Research Centres Association
Ms Melanie Cox, CRC for Coastal Zone, Estuary and Waterway Management
The Hon. Teresa Gambaro MP, Parliamentary Secretary to the Minister for Foreign Affairs

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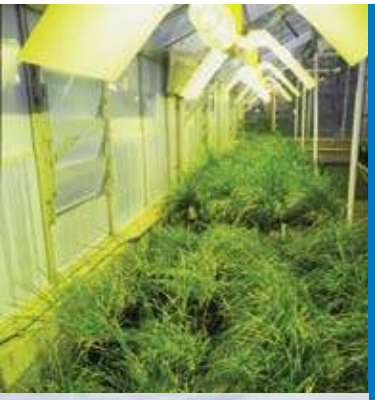


Introduction

Here are the stories behind the entries in the 2006 Awards for Excellence in Innovation. They tell how 22 CRCs are transferring their research results into businesses, educational institutions and communities in Australia and overseas.

This is the eighth year of the Awards for Excellence in Innovation, and this year's entries once again show the depth and spread of CRC research. The work spans our continent, and the products are in use from the remote Aboriginal communities of the Top End to deep underground, in the world's biggest uranium mine.

The work has been judged in two categories: 13 entries for uptake and use of research; and eight for education, training and public outreach. A third category, sponsored by CSIRO, showcases the work of eight CRC PhD students. Between them, the entries cover research by 22 CRCs from all six industry sectors in which CRCs operate.

The winners of the 2006 Excellence in Innovation Awards for Uptake and Use of Research are:

- **The Capital Markets CRC**—for developing Compliance Explorer, real-time fraud detection software to protect security brokers here and overseas against rogue and illegal trading. The world market is estimated at more than $500 million per year.
- **The CRC for Tropical Plant Protection**—for developing new strains of high-yielding, disease-resistant forage crops. These 'superfodders' have already penetrated markets in North Africa, the Middle East and South America, while in Australia they are likely to lift pasture production by up to 30%.

The winners of the 2006 Excellence in Innovation Awards for Education, Training and Public Outreach are:

- **The CRC for Australian Weed Management**—for developing WeedED, a package of training resources on weed identification and control for the vocational education and training sector. Weeds cost us $4 billion a year, so this investment in training those who have to manage them will pay off handsomely.
- **The Molecular Plant Breeding CRC**—for 'Get into Genes', a hands-on workshop and teaching resource program pitched at secondary school students. A few years hence, some of Australia's most talented young biologists and biotechnologists will recall Get into Genes as the initial spark for their careers.

The four winners were the best of an excellent field. Other research and work highlighted in this booklet delivers:

- *benefits to education*—effective training for scientists and administrators in research management and commercialisation, top-class educational resources for courses on fire ecology and fire management, and a postgraduate course in greenhouse science for teaching, management and policy professionals
- *commercial benefits*—greater market penetration for contact lens practitioners here and in Europe, software that allows architects to check that their designs meet crucial Australian standards, an ingenious radar-based underground monitoring system that will save millions of dollars for miners, and an online tool for quality control and accreditation in Australia's vast tourist industry

- *better natural resource management*—more effective communication between grassroots community bodies, a remarkable collaboration between scientists and Indigenous Australians to manage dry season fires in the Top End, a new role for rural commercial suppliers in fighting salinity, and the Aboriginal Plan, Australia's first dedicated Indigenous natural resource management plan for a region with multiple traditional owner groups
- *value adding for agriculture*—varieties of ryegrass and fescue to make our pastures more nutritious and digestible for livestock and less likely to give us hay fever, and new varieties of wheat for better bread, crunchier breakfast foods and bakery products with less fat
- *advances in health care*—two delightful 'augmented reality' devices to make the treatment of young burns patients less stressful, an efficient way to tailor antibodies to deliver anti-cancer toxins directly into tumour cells, research to quantify the cost to Australia of vision impairment, and a program to manage chronic health problems in Indigenous communities.

This year, our eight PhD student finalists entered research reports on topics ranging from prospecting pond scum for new drugs to breeding barley to delight beer lovers. They made presentations in one of two formats: three minutes without visual aids, or ten minutes with visual aids. The two winners, respectively, were Melanie Cox, for research measuring the correlation between the health of Australians and the condition of our coastlines, and Louis Bradbury, for work that could enable our ricegrowers to produce premium scented rice.

Finally, I want to thank the judging panel members, who put in many hours to assess this year's entries:

- Awards for Excellence in Innovation
  - Mr Dick Davies, Managing Director, CEO Partnerships
  - Dr Annabelle Duncan, Chief Operating Officer, Bio21 Molecular Science & Biotechnology Institute
  - Professor Leon Mann, Director, Centre for R&D Leadership, University of Melbourne
  - Mr Peter McIntosh, Director, Alumina Technology, Hatch Associates Ltd
  - Dr Michael Panaccio, Investment Principal, Starfish Ventures
  - Dr Geoffrey Vaughan, IR&D Board Member, Deputy Chairman of Questacon
- Showcasing PhD Students Awards
  - Dr John Boyd, Consultant, previous General Manager of the CRC Programme in the former Australian Government Department of Industry, Science & Tourism
  - Ms Bobby Cerini, Science Communications Adviser, Questacon
  - Dr Sue Stocklmayer, Director, Centre for Public Awareness of Science, Australian National University
  - Dr Geoffrey Vaughan, IR&D Board Member, Deputy Chairman of Questacon
  - Mr Graham Walker, Marketing Coordinator, Education Group, CSIRO.

Hon Tony Staley
Chairman, CRC Association

Gramina to boost production and stop sniffles

UPTAKE AND USE OF RESEARCH

Australia's pastoral industries are worth nearly $19 billion a year, making pasture grasses our most valuable crop. Gramina Pty Ltd, a 50:50 joint venture between the Molecular Plant Breeding CRC and PGG Wrightson Genomics (a subsidiary of New Zealand's largest agribusiness, PGG Wrightson Ltd), is poised to boost pasture production and value. Gramina could also save us around $86 million a year in costs from hay fever.

The partners have licensed Gramina to use transgenic technologies developed by the CRC and its predecessor and the subject of ongoing collaborative R&D with PGG Wrightson. These include gene sequences and methods to alter the production of lignin, a structural component of grass that affects digestibility; to increase production of fructans, a storage carbohydrate, thereby improving nutritional value; and to decrease production of pollen allergens that cause hay fever.

Gramina will use either the soil bacterium *Agrobacterium tumefaciens* or biolistics (gold particles fired into plant material) to transfer gene sequences from ryegrass and tall fescue back into the plants' genomes to up- or down-regulate the production of natural grass gene products—the enzymes involved in making lignin, fructans and pollen allergens. This will produce grasses that are more digestible and nutritious for livestock but less allergenic to humans.

The technologies have already been applied in perennial ryegrass, and will soon be used to improve hybrid ryegrass and tall fescue.

The partners have backed up $9.3 million (mainly grant) funding with another $26.6 million in in-kind support. An independent evaluation of the work on perennial ryegrass shows likely net benefits to Australia over 20 years of $131 million, most of it from reduced supplement feeding, higher dairy output and increased wool production.

Just as importantly, more efficient pasture production will reduce the ecological footprint of the pastoral industries, making them much more sustainable and competitive.

Gramina's perennial and hybrid ryegrass and tall fescue varieties should benefit Australia by over $130 million in the next two decades. For livestock, they offer greater digestibility and higher nutritional value; for humans, they could even take the hay fever out of spring.

Molecular Plant Breeding CRC

CRC category Agriculture and Rural Based Manufacturing

Core participants

University: Murdoch University, University of Adelaide

State and territory governments: South Australian Research and Development Institute, Victorian Department of Primary Industries, Department of Agriculture and Food Western Australia

Other: International Maize and Wheat Improvement Centre (CIMMYT)

WINNER

Safeguarding the world's securities markets

UPTAKE AND USE OF RESEARCH

Real-time fraud detection software developed by the Capital Markets CRC fortifies brokers against rogue and illegal trading, reducing their regulatory compliance costs and helping to guarantee the integrity of securities markets here and overseas.[1]

The software, Compliance Explorer, gives broking firms surveillance capabilities once the preserve of large exchanges, regulators, central banks and big market players.

Based on high-profile SMARTS technology (an earlier product of the research team, now in use in over 20 national stock exchanges), Compliance Explorer is helping, for example, to safeguard Australia's superannuation savings, 80% of which ($800 billion dollars) is invested in the securities markets.

Compliance Explorer analyses data from exchanges and other sources for patterns of aberrant or illegal trading, including insider trading and market manipulation across different markets. It also allows brokers to sniff out breaches of their own trading rules, such as trading with particular players (on 'watch' and 'restricted' lists). The software can handle tens of thousands of transactions per second and gives immediate alerts, direct to the broker, over a secure internet connection. Users can be up and running within 24 hours of signing a contract and after 90 minutes of training.

In just over two years, Compliance Explorer has captured 95% of the Australian market and has penetrated New Zealand, Singapore, Hong Kong, the United Kingdom and Canada.

The CRC, its partner, SMARTS Pty Ltd, and research staff and students have spun off Capital Markets Surveillance Services to market the product and service. Revenues are approaching $3 million a year—projected to rise to $5–10 million by the end of 2007 and to $50 million within five years. A recent $3 million AusIndustry R&D grant will help extend the product's reach beyond equities markets. The CRC estimates the world market for the technology at about half a billion dollars a year.

1. For an explanation of the strategy behind this development, see http://www.exchange-handbook.co.uk/index.cfm?section=articles&action=detail&id=54120

Capital Markets CRC's Compliance Explorer detects insider trading and market manipulation, and alerts the user over a secure internet connection. The world market for the technology is estimated to be around half a billion dollars a year.

Capital Markets CRC

CRC category Information and Communication Technology

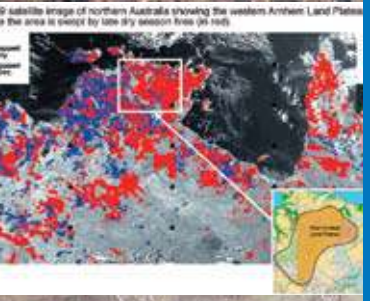
Core participants

Industry: ABN Amro, ac3, Computershare Limited, Credit Suisse, SMARTS Pty Ltd

University: Macquarie University, The University of New South Wales, The University of Sydney, University of Technology Sydney

Other: Securities Industry Research Centre of Asia Pacific

Taming wildfires in the Top End



UPTAKE AND USE OF RESEARCH

Western science and traditional Aboriginal knowledge have made a formidable alliance to defend one of Australia's most precious resources.

The Tropical Savannas CRC has united Aborigines, scientists, firefighters and government land managers in the research, which is aimed at subduing wildfires in Western Arnhem Land, a vast sandstone plateau almost as big as Tasmania. Each year, in the hot, windy, dry season, wildfires used to rip across some 370,000 square kilometres of the savannas. The fires threatened industries, communities and ecosystems.

Australia's savannas cover a quarter of the continent's landmass, so the economic impact of the fires on agriculture and tourism has been huge. They've also affected biodiversity and regional communities, while pumping greenhouse gases into the atmosphere.

The fires were once managed by Aborigines through controlled burns, a strategy now being readopted and developed by scientists in a 'two toolkits' approach.

The Arnhem Land Fire Abatement Project has already created some of the world's largest firebreaks. Working with Aboriginal ranger groups to patch burn and form the breaks, the project has reduced the impact of wildfires in the region over the past six years.

Indigenous people contribute their ancient know-how, while science provides aerial burning techniques with pinpoint accuracy, and web-based maps—sourced from satellite images—of fire scars and burning fires. Satellite imagery shows that linked breaks and patches extending 100 kilometres in 2005 effectively protected the plateau from late season wildfires.

Companies, especially those in the energy sector, are now interested in funding Indigenous fire management to offset their own greenhouse gas emissions, and carbon accounting forms a major part of the research program. Studies on fire ecology, emissions analysis and modelling allow the emissions prevented by the CRC's fire management techniques to be quantified.

At the same time, research into biodiversity surveying and analysis helps wildlife managers measure the environmental impact of the program.

1. Members of an Indigenous ranger group in western Arnhem Land using maps with satellite information on fires. (Photo: P. Cooke) 2. Wildfires can even spread across rocky country, leaving the gullies blackened with ash. (Photo: Andrew Edwards) 3. 1999 satellite image of western Arnhem Land (late dry season fires in red). (Image: Western Australian Government) 4. Wildfires were slowly destroying the internationally significant cultural and biological values of the region. (Photos: Andrew Edwards)

CRC for Tropical Savannas Management

CRC category Environment

Core participants

Industry: Meat and Livestock Australia

University: Charles Darwin University, James Cook University, The University of Queensland

Australian Government: CSIRO, Director of National Parks

State and territory governments: Northern Territory Government (through Department of Business, Economic and Regional Development, Department of Natural Resources, Environment and the Arts, Department of Primary Industry, Fisheries and Mines), Queensland Department of Primary Industries and Fisheries, Western Australian Department of Agriculture, Western Australian Department of Conservation and Land Management

Other: North Australian Indigenous Land and Sea Management Alliance

Diversionary therapy chases pain away for burns kids

UPTAKE AND USE OF RESEARCH

Burns are among the most painful injuries. Treatment often requires many changes of dressings, which can be very distressing, especially for younger patients. Treatment can also require youngsters to stay very still, so pain and anxiety management rely heavily on drug intervention.

The Australasian CRC for Interaction Design (ACID), working with the Brisbane Royal Children's Hospital, has come up with diversionary therapy technology devices shown in a randomised clinical trial to significantly reduce pain scores in young burns patients.

Building on research into the use of 'virtual reality' devices with adult patients, ACID has developed 'augmented reality' (AR) devices for children. AR distracts, but still allows clinicians and carers to communicate with the child.

For 2–8-year-olds, a digital storyboard (a 3D book) takes them into an interactive world of adventures and quests featuring colourful characters, animated segments and automated narration.

Older children can use 3D goggles, which are worn like glasses, to move through the narrative by turning their heads.

Both devices combine AR with computer vision tracking in robust, portable platforms. They are easy to use, and require little intervention from support staff. Although they are designed to be used under medical supervision, they are not classed as medical devices and are used in conjunction with other methods, such as painkillers.

Backed by the results from the clinical trial, ACID is now assessing the potential market for the technology in Australia, the United States, the United Kingdom and Europe. The CRC is also negotiating with commercial investors to establish a new company to develop and exploit the technology.

A young patient at the Brisbane Royal Children's Hospital explores the Australasian CRC for Interaction Design's digital storyboard and 3D goggles. Exploring a virtual world takes his mind off pain, reducing stress and allowing better interactions with health workers.

Australasian CRC for Interaction Design

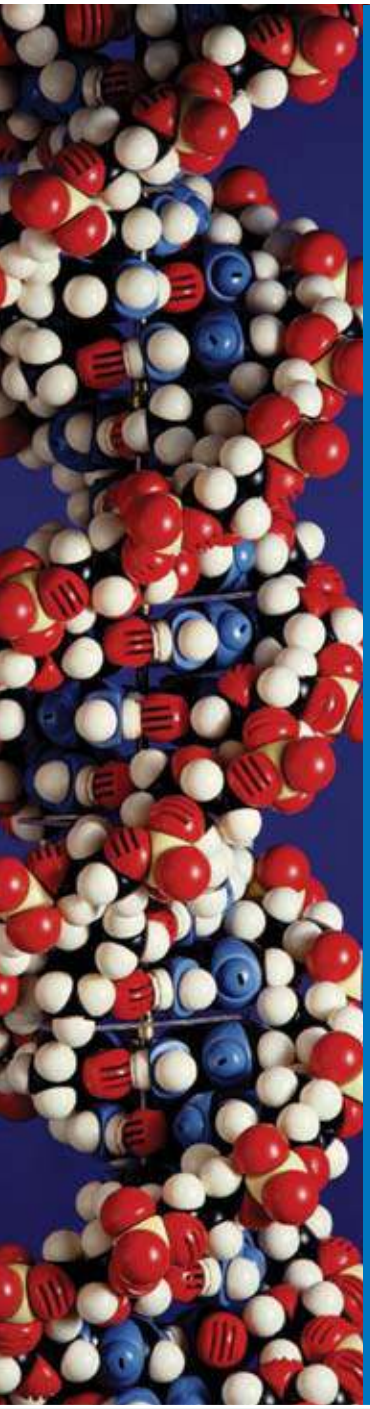
CRC category Information and Communication Technology

Core participants

Industry: Auran Technologies, Heritage Properties Pty Ltd, iMap Systems Pty Ltd, Silicon Graphics Pty Ltd

University: Murdoch University, Queensland University of Technology, Royal Melbourne Institute of Technology, The University of Queensland, University of Technology Sydney

EvoGenix, a super spin-out



UPTAKE AND USE OF RESEARCH

The CRC for Diagnostics span out its first company in 2001 to commercialise significant discoveries in protein engineering. The company, now EvoGenix Ltd, was successfully floated on the Australian Stock Exchange in August 2005. The CRC holds approximately 9% of EvoGenix shares.

The initial intellectual property was in two areas: Evibodies™, a scaffold technology for antibody-like molecules, and EvoGene™, a key technology deployed by EvoGenix to produce tailored antibodies. Antibodies are proteins, made up of many amino acids, that bind to and disable antigens (foreign substances); tailored antibodies are designed to bind to particular cells, and can be used to deliver anti-cancer toxins directly into tumour cells.

EvoGenix takes mouse antibodies with desirable therapeutic characteristics and attaches their antigen-binding parts to human antibodies that will not be rejected by the body. Such 'humanisation' often leads to a reduction in the ability of the antibody to bind tightly to its target, but this can be restored utilising the EvoGene technology.

The EvoGene process makes a huge number of single amino acid variations on the antibody. The variants are compared for their binding ability, and the best can be recycled through the system to get the optimal profile of properties. The system is superior to others because it requires no assumptions about protein structures (it produces mutations randomly) and it preserves desired properties more effectively. It's also faster and more cost-effective.

Along with the initial intellectual property, the CRC partners also helped to organise start-up grants for the company. EvoGenix has since established operations in Melbourne and California to position itself in the international market for therapeutic and diagnostic antibodies, which is expected to grow from around $15 billion a year now to nearly $26 billion in 2010.

EvoGenix uses its technology capabilities in collaborations with GlaxoSmithKline and CSL, assisting them to develop optimised products for their pipelines. In parallel, the company's antibody engineering technology is being used internally, to develop a number of antibody products. Successful development and testing of the first such product, a modified protein for osteoporosis treatment, was announced recently.

CRC for Diagnostics

CRC category Medical Science and Technology

Core participants

Industry: Queensland Medical Laboratory

University: La Trobe University, Queensland University of Technology

Australian Government: CSIRO

Other: Child Health Research Institute Inc

WINNER

Superfodders lift production, beat disease

UPTAKE AND USE OF RESEARCH

High-yielding, disease-resistant forage varieties are generating millions of dollars in export earnings for Australian seed producers and boosting the productivity of livestock and forage growers.

Nine new 'superfodders' developed by the CRC for Tropical Plant Protection, including varieties of lucerne, *Stylosanthes* ('stylo', a tropical pasture legume), cowpea and oats, have opened up export markets for Australia's seed industry and are spearheading a push into the multi-billion-dollar fodder market. The forage varieties, some of which are also fortified against common pests, are protected by plant breeder rights and licensed to four Australian seed producers.

The CRC's disease-resistant forages now make up around 40% of Australia's proprietary seed market and have penetrated markets in Argentina, Saudi Arabia and Tunisia.

The CRC used a combination of molecular genetics and selective breeding to develop the new varieties. Two lucerne strains, resistant to *Phytophthora* root rot and to aphids, are also the only varieties resistant to all races of the anthracnose fungus *Colletotrichum trifolii*.

Australia's fodder industry trades about $1.1 billion in farmgate value each year, a figure that has doubled over the past decade. Lucerne is our most important forage crop, with 3.5 million hectares grown as pasture and 200,000 hectares grown under irrigation. We produce up to 5000 tonnes of lucerne seed each year and export much of it. The rapidly growing lucerne hay export market is worth $13.5 million a year.

The new lucerne varieties are expected to lift production in dryland pastures by 10% and in irrigated crops by 30%, and reduce the need for chemical fertilisers and pesticides. Productivity gains are projected to be worth $45 million over the next five to 10 years.

The CRC has already seen results from its research into stylo. Beef growers have widely adopted mixtures using varieties resistant to anthracnose, a disease that wiped out vast areas of the tropical legume between the 1970s and 1990s.

The CRC for Tropical Plant Protection's disease-resistant forages are likely to lift dryland pasture production by 10% and boost irrigated pasture by 30%. Productivity gains over the next 5–10 years are estimated to be worth $45 million.

CRC for Tropical Plant Protection

CRC category Agriculture and Rural Based Manufacturing

Core participants

Industry: Biogemma, BSES Ltd

University: Charles Darwin University, The Australian National University, The University of Queensland

Australian Government: Australian Quarantine and Inspection Service, CSIRO, Office of the Chief Plant Protection Officer

State and territory governments: Northern Territory Department of Primary Industry, Fisheries and Mines, Queensland Department of Primary Industries and Fisheries

DesignCheck gets it right first time

UPTAKE AND USE OF RESEARCH

Failure to meet building code requirements can be ruinously expensive—poor wheelchair ramps in one British project cost the developer £800,000 (nearly $2 billion) in design changes. Conventionally, drawings produced from 3D computer-aided design (CAD) applications had to be checked against clauses in building codes in tedious, error-prone manual work.

By working with IT experts, building designers and the Building Commission (Victoria), the CRC for Construction Innovation has automated this process with its DesignCheck software. DesignCheck quickly assesses whether a building design meets Australian Standard AS 1428.1, which covers access to buildings and mobility within them.

Underlying the operation of DesignCheck are 'virtual objects', the equivalent in computer software to the real objects outside. For example, there are virtual doors, walls and rooms inside the DesignCheck software that correspond to those in the building to be checked. The research team developed rules that check that these virtual objects comply with the Australian Standard for disabled access.

DesignCheck is flexible, allowing checks at the early, detailed and specification stages of design. For example, at the early stage, the architect or designer is concerned that paths to and within the building are accessible and that there is room to manoeuvre wheelchairs. At the detailed stage, the width of doors and the height of handrails have to be factored in. During specification, requirements for floor surfaces, handrail materials and signage become important. DesignCheck accommodates all these stages, and catches errors before time and money are wasted.

Not only architects, but building certifiers, building code authorities and specification writers will save money with this capability, and those who maintain the buildings will be able to check the compliance of modifications before they are made. By getting it right first time with DesignCheck, the industry will be saved time, money and a lot of frustration.

1. A building plan produced by an object-oriented CAD system. 2. Using DesignCheck to check a plan against building codes. 3. An object-by-object display of checking results. 4. DesignCheck provides a printer-friendly report page.

CRC for Construction Innovation

CRC category Manufacturing Technology

Core participants

Industry: Arup, Bovis Lend Lease, Brookwater, DEM, John Holland, Rider Hunt, Woods Bagot

University: Curtin University of Technology, Queensland University of Technology, Royal Melbourne Institute of Technology, The University of Newcastle, The University of Sydney

Australian Government: Australian Building Codes Board, CSIRO

State and territory governments: Building Commission (Victoria), Queensland Department of State Development, Trade and Innovation, Queensland Building Services Authority, Queensland Department of Main Roads, Queensland Department of Public Works, Western Australian Department of Housing and Works

Other: Brisbane City Council

New vision for Australia

UPTAKE AND USE OF RESEARCH

In 2004, vision disorders cost Australia $9.85 billion in care, welfare, medical expenses and lost production. One in four Australians over 60 has a chronic vision problem, making vision loss our seventh leading cause of disability.

The Australian national, state and territory governments responded in 2005, developing a national framework to promote eye health and prevent vision impairment. The framework drew heavily on two reports commissioned by the Centre for Eye Research Australia, prepared by Access Economics, and supported by the Vision CRC.

The first report, *Clear Insight: The Economic Impact and Cost of Vision Loss in Australia*, quantified the price we pay for vision impairment. Along with the direct costs of serious eye problems, vision loss doubles the risk of falls, triples the risk of depression, multiplies the risk of hip fractures four to eight times, and sees people admitted to nursing homes three years earlier. Add the expenses of welfare dependency and lost production, and the bill nudges $10 billion each year.

The second report, *Investing in Sight: Costing a Visual Impairment Package*, developed and costed a platform of strategic policy interventions to eradicate preventable blindness and vision impairment through early detection, intervention, rehabilitation, education and research. The costed model included regular testing for at-risk groups, encouraging people to quit smoking, reduced waiting times for surgery, improved access to subsidised spectacles, funding for retinal photography, and solving workforce and training problems. The bill would be $189 million, but we would save more than $650 million over the lifetimes of the people helped by these measures.

Research shows that the two health conditions we fear most are cancer and blindness. The Vision CRC's work in this area will allay the second of these, improve our quality of life, and save Australian health and social services millions of dollars.

Australia's national framework to promote eye health and prevent vision loss draws heavily on work supported by the Vision CRC. The framework aims to save the nation nearly half a billion dollars a year in care and welfare costs, medical expenses and lost production.

Vision CRC

CRC category Medical Science and Technology

Core participants

Industry: Institute for Eye Research

University: Centre for Eye Research Australia (The University of Melbourne)

Other: International Centre for Eyecare Education, LV Prasad Eye Institute (India)

Caring for country in the wet tropics

UPTAKE AND USE OF RESEARCH

The 18 Traditional Owner groups of Far North Queensland's wet tropics, working through the Aboriginal Rainforest Council, have produced Australia's first dedicated Indigenous natural resource management plan for a multi-tenured region. The council worked closely with the CRC for Tropical Rainforest Ecology and Management and the region's natural resource management body, FNQ NRM Ltd, to launch *Caring for Country: The Wet Tropics Aboriginal Cultural and Natural Resource Management Plan* in April 2005.

Based on published material, new research and deep Indigenous knowledge of country, the plan identifies factors affecting Traditional Owners' ability to look after their land and resources, and provides strategies for improvements. It also sets out how non-Indigenous stakeholders can work with Traditional Owners towards a culturally reconciled and environmentally sustainable future.

The Aboriginal Plan, as it is known, resulted from three years of work involving Traditional Owners, Indigenous organisations, academics, government agencies, non-Indigenous landholders, industry and the public, along with the CRC and FNQ NRM Ltd. With the plan document are a plain English poster and an interactive CD-ROM.

The Aboriginal Plan now forms an essential part of the Regional Agreement for the Wet Tropics World Heritage Area and the overall Wet Tropics Natural Resource Management Plan. It is simultaneously a condition report, a framework for Indigenous engagement with government and others, a tool for attracting funding for Indigenous projects, and an environmental and cultural prospectus for future investments of national and state funds. The development of the plan also initiated the skills-based selection of Aboriginal elders as scientific advisers to the regional plan, the appointment of an Indigenous director on the FNQ NRM board, and the formation of an Indigenous committee to oversee implementation.

The Australian Government, the National Native Title Tribunal and AIATSIS (Australia's peak institute for Indigenous research) have hailed the Aboriginal Plan as an exemplar of how things should be done.

1. Passing on traditional knowledge to the new generation. 2. Caring for country doesn't stop at the watermark: getting involved in seagrass research. 3. Claude Beeron and children with bushtucker. 4. Ma:Mu people from the Innisfail region working on riparian restoration. (Photos: Leigh Harris). 5. Ngadjon-Jii Traditional Owners. (Photo: Libby Larsen)

CRC for Tropical Rainforest Ecology and Management

CRC category Environment

Core participants

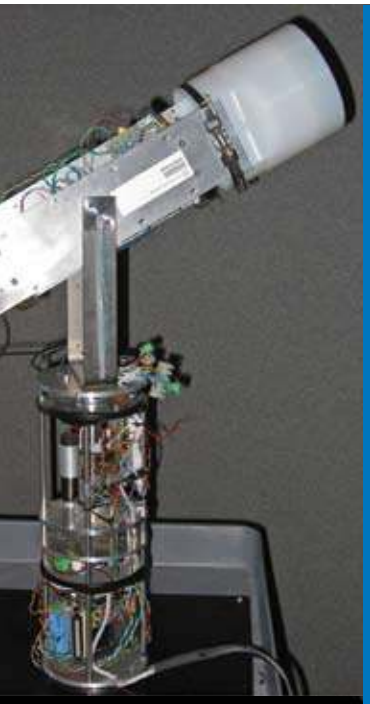
Industry: Tourism Council Australia Limited

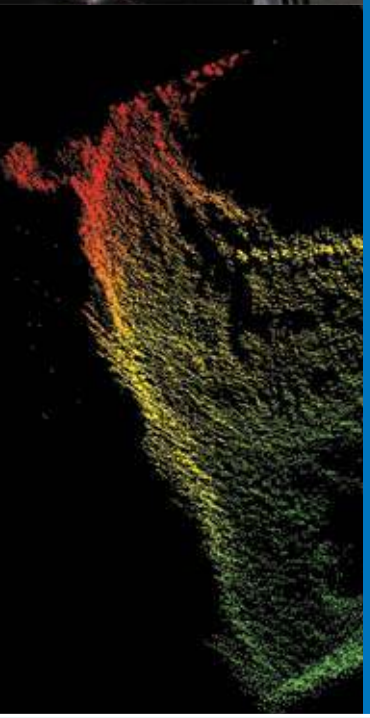
University: Griffith University, James Cook University, The University of Queensland

Australian Government: CSIRO, Office of Indigenous Policy Coordination, Wet Tropics Management Authority

State and territory governments: Environment Protection Authority (Queensland), Queensland Department of Natural Resources, Mines and Water, Queensland Department of Primary Industries and Fisheries, Tropical Tourism North Queensland

Radar unit cuts downtime, boosts safety





UPTAKE AND USE OF RESEARCH

A remotely controlled device that sees through dust and water vapour in huge underground voids will make mines safer, while reducing environmental impact and running costs.

The millimetre wave radar stope monitor, invented by CRCMining, enables engineers to monitor the backfilling of stopes—skyscraper-sized cavities up to 300 metres deep, with diameters of up to 45 metres. The stope monitor finetunes the operation from a safe distance.

In a typical mine that uses the 'longhole open stope mining' principle, up to 1.3 million tonnes of ore are extracted, and the resulting stope is backfilled before miners move into neighbouring rock. The strongest backfilling material is cemented aggregate fill (CAF), but it costs $20 per cubic metre. Excavated waste rock fill is only $4 per cubic metre, but it lacks strength and is often used as core material surrounded by CAF.

Before the stope monitor, engineers had to stop the backfilling process periodically and wait for the dust and vapour to clear before they could use laser monitoring. And personnel had to venture into the dangerous area around the stope during the downtime.

CRCMining's radar stope monitor has changed all that. Comprising a hermetically sealed radar and a mirror scanner, it uses the characteristics of signals reflected from the floor and walls of the stope to generate a 3D snapshot of the void as it fills.

Engineers display the information on a remote computer, using the images to optimise the strength of the fill by altering the proportions of the material in it and adjusting the packing. They can use more waste rock, cutting costs and cleaning up the environment around the mine.

CRCMining's industry partner, WMC Resources (now part of BHP Billiton), estimates that the prototype monitor trialled at the Olympic Dam mine could save it millions of dollars a year.

1. Prototype miniaturised radar: part of the millimetre wave radar stope monitor, invented by CRCMining.
2. Image of a stope, generated remotely from radar monitoring data, allows safer, cheaper mining operations deep underground.

CRCMining

CRC category Mining and Energy

Core participants

Industry: Anglo Coal Australia Pty Ltd, AngloGold Ashanti Australia Ltd, BHP Billiton Innovation Pty Ltd, Caterpillar Elphinstone Pty Ltd, Hamersley Iron Pty Ltd, Harnischfeger of Australia Pty Ltd, Komatsu Australia Pty Ltd, Peabody Energy Australia Coal Pty Ltd, Phelps Dodge Corporation, Rio Tinto Technological Resources Pty Ltd

University: Curtin University of Technology, The University of Newcastle, The University of Queensland, The University of Sydney

Waxy wheat for better bread and crunchier cereals

UPTAKE AND USE OF RESEARCH

The CRC for Value Added Wheat has combined modern molecular genetics and traditional selective breeding to develop a new type of wheat with amazing characteristics. The innovation is expected to add value to the 20 million tonnes of Australian wheat produced each year.

Flour from 'waxy' wheat produces bread with improved quality. It may improve the quality of soups and sauces, and it raises the possibility of cutting fat in some bakery products. And it's the first wheat variety that doesn't always have to be milled. Wholegrain waxy wheat could be used in novel, non-soggy, breakfast cereals or in one-pot meals. It's edible—and easy on the teeth—after boiling water has been added.

Two starches account for the difference between normal and waxy wheat. Normal wheat has both amylose, which has straight-chain molecules, and amylopectin, which has molecules with branched chains, and also has three copies of a gene for an enzyme that reduces the amount of amylopectin. Waxy wheat has only amylopectin, and lacks the genes for its reduction.

CRC scientists based at the University of Sydney's Plant Breeding Institute used molecular genetics to identify strains without the gene, and then selectively bred them to produce types containing only the branched-chain amylopectin.

The CRC now has three promising lines based on the Australian prime hard wheat variety, Janz. Research is under way to produce other quality grades for use in noodles and biscuits.

CRC partner George Weston Technologies (GWT) holds an exclusive licence to the waxy wheat technology and has been driving the commercialisation of the new type. Thousands of tonnes of waxy wheat have been grown in Australia, and the grain has been undergoing commercial-scale milling and baking trials. Because GWT doesn't make biscuits or noodles, it will offer the flour to other local and overseas manufacturers.

New strains of 'waxy wheat', developed by the CRC for Value Added Wheat, will mean improved quality bread, less fat in bakery foods, and crunchier, non-soggy breakfast cereals. Waxy wheat strains will add value to the 20 million tonnes of wheat Australia produces each year.

CRC for Value Added Wheat

CRC category Agriculture and Rural Based Manufacturing

Core participants

Industry: Allied Mills Australia Pty Ltd, Arnott's Biscuits Ltd, C-Qentec Diagnostics Pty Ltd, Grains Research and Development Corporation

University: The University of Sydney

State and territory governments: NSW Department of Primary Industries, Department of Agriculture and Food Western Australia

The ABCDs of Aboriginal health

Audit and Best practice for Chronic Disease

ABCD

UPTAKE AND USE OF RESEARCH

Indigenous Australians—our most disadvantaged people—are hit hardest by chronic diseases, such as diabetes and cardiovascular disease. Managing chronic illness in remote communities, where many live, has proven very difficult.

The Audit and Best Practice for Chronic Diseases (ABCD) project, led by the CRC for Aboriginal Health, has already benefited thousands of Indigenous people in the Top End, and looks set to lead to improvements elsewhere.

CRC researchers, health workers, health departments and policy makers collaborating on the project came up with a set of guidelines, systems and information technology tools to lift the standard of health care in remote communities.

ABCD, trialled by 12 health services across the Top End, sets guidelines for standard tests, like blood pressure and body mass index tests, to be performed routinely on patients. It also includes medical record systems and paper- and computer-based systems to recall patients for monitoring and management of chronic disease. Vaccination and health worker training are part of the strategy, too.

The immediate pay-offs of the trial have been better diabetes and blood pressure management, an increase in influenza vaccinations, and higher rates of men's health screening.

The Northern Territory Department of Health and Community Services is now implementing ABCD in its remote health clinics. Indigenous health services in New South Wales, Western Australia and central Australia have joined ABCD in the Extension project, with Queensland soon to follow suit. And the Australian Government has incorporated ABCD in its four-year, $102 million Healthy for Life program targeting Aboriginal health.

Meanwhile, ABCD's rigorous systems for monitoring and reporting will for the first time deliver good national longitudinal data on health care quality. Data interpretation will be supported by innovative web-based analysis, reporting and networking software.

The ABCD project (led by the CRC for Aboriginal Health) has already produced results for Indigenous Australians: better diabetes and blood pressure management, increases in influenza vaccinations, and more men's health screening. The project was so effective that the Australian Government has incorporated it in the $102 million Healthy for Life program.

CRC for Aboriginal Health

Cooperative Research Centre for Aboriginal Health

CRC category Medical Science and Technology

Core participants

University: Charles Darwin University, Flinders University, La Trobe University, The University of Melbourne, The University of Queensland

Australian Government: Australian Institute of Aboriginal and Torres Strait Islander Studies, Department of Health and Ageing

State and territory governments: Northern Territory Department of Health and Community Services, Queensland Institute of Medical Research

Other: Central Australian Aboriginal Congress, Danila Dilba Medical Service, Menzies School of Health Research

Deciphering star systems

UPTAKE AND USE OF RESEARCH

By 2015, the real economic value of tourism to Australia is predicted to nudge $100 billion per year, with domestic tourism making up two-thirds of the figure and inbound tourism the remainder. Tourists and their travel agents need reliable measures of quality, such as certified accreditation ('star') systems. Australia's 72,000 tourism services suppliers, many of them small businesses, need access to accreditation systems, up-to-date research results, sound market analysis and business development resources.

Decipher Technologies Pty Ltd, a spin-off from the CRC for Sustainable Tourism, is already well known for developing the decipher.biz online resource for operators seeking valuable business intelligence. The CRC supports Decipher, acting as an independent platform for information and communications technology development and as an independent knowledge broker.

In 2005, Decipher took on the daunting task of creating an online accreditation and quality assurance facility that would bring together around 20 separate accreditation systems and make them available to tourism operators in one place. The Australian Government invested $1.3 million, and industry organisations, many of them competitors for market share, worked with Decipher through a steering committee to drive the project.

The result is the Quality Tourism Portal at www.qualitytourism.com.au. Instead of attempting to shoe-horn the disparate accreditation systems into one new model, the portal provides business-to-business accessibility to all of them, using web services and a data store with multiple access points.

Tourism businesses can now access these services instantly, regardless of the business's location, size or sector. And quality assurance organisations gain a low-cost online presence, productivity improvements in processing applications, access to relevant business improvement information, and increased national recognition.

The Quality Tourism Portal at www.qualitytourism.com.au online brings together around 20 separate accreditation systems and makes them available to tourism operators in one place. As the economic value of Australian tourism approaches $100 billion a year by 2015, local and overseas operators will use the portal to save time and money.

CRC for Sustainable Tourism

CRC category Environment

Core participants

Industry: Australian Federation of Travel Agents, Australian Tourism Export Council, Tourism and Transport Forum Australia, Qantas

University: Charles Darwin University, Curtin University of Technology, Edith Cowan University, Griffith University, James Cook University, La Trobe University, Monash University, Murdoch University, Southern Cross University, The University of New South Wales, The University of Queensland, University of Canberra, University of South Australia, University of Tasmania, University of Technology Sydney, Victorian University of Technology

Australian Government: Tourism Australia

State and territory governments: Australian Capital Tourism, NSW Department of Environment and Conservation, NSW TAFE, Northern Territory Tourist Commission, Parks Victoria, South Australian Tourism Commission, Tourism NSW, Tourism Queensland, Tourism Tasmania, Tourism Victoria, Tourism Western Australia; Western Australian Department of Conversation and Land Management

WINNER

WeedED for vocational students

EDUCATION, TRAINING AND PUBLIC OUTREACH

Invasive plants cost Australia more than $4 billion each year, so weed management competencies are a key part of the nationally accredited vocational training package, *Conservation and Land Management*. This new training package, introduced in 2002, required additional materials for coursework to be used by the vocational education and training (VET) sector.

The CRC for Australian Weed Management delivered the goods. As Australia's experts in weed identification and control, the Weeds CRC partners had the most up-to-date research results. Over four years, the CRC's WeedED program developed more than 60 original resources for the VET sector. The count so far includes 43 fact sheets, 5 training manuals, 3 PowerPoint presentations, 2 sets of technical guidelines, and a special weed education resource newsletter. All are in plain English and available free on the web.

The VET resources are in addition to the CRC's other publications, which cover the full range of technical levels from scientific papers to media releases. The new material reinterprets the CRC's research output and targets it precisely to vocational students. For example, the *Introductory Weed Management Manual*, originally developed with the Natural Heritage Trust for community groups, is now a key component of the SMARTtrain chemical training program run by NSW TAFE and the NSW Department of Primary Industries. Much of the WeedED material is also suitable for use outside the VET sector, by university students, school students, governments at all levels, business managers and community groups.

Each resource is aligned to the nationally accredited competencies and labelled as such, making the job of VET trainers easier. Most of the relevant registered training organisations in Australia have now received CDs containing all the WeedED products, and they are making full use of them. The package has already led to the identification of previously unnoticed infestations of invasive species.

1. Participants in the field, taking a closer look. 2. A workshop gets down to business. 3. Blackberry identification workshops using WeedED resources. (Photo: Annette Beer). 4. Weed Collector's Manual.

CRC for Australian Weed Management

CRC category Environment

Core participants

Industry: Grains Research and Development Corporation

University: The University of Adelaide

Australian Government: CSIRO

State and territory governments: NSW Department of Primary Industries, Queensland Department of Natural Resources, Mines and Water, Victorian Department of Primary Industries, Department of Agriculture Western Australia

New certificate stresses management and commercialisation

EDUCATION, TRAINING AND PUBLIC OUTREACH

Heeding the Australian Government's call for researchers to be trained in management and commercialisation, two CRCs have collaborated to develop a Graduate Certificate in Research Management.

The CRC for Innovative Grain Food Products and the CRC for Sugar Industry Innovation through Biotechnology produced the course, which has been up and running at Southern Cross University since January 2005. More than 50 people enrolled in the first month, and this year's class has 62 students. About a quarter of this cohort are PhD students from CRCs, with the rest split between non-CRC postgraduate students and CRC academic and industry personnel.

The course is tailored for researchers and research managers who work at the interface of applied research and industry. It is offered as distance learning, with flexible delivery and assessment based on real research (often the student's own). Two course units, in project management and intellectual property management and commercialisation, are compulsory; another two are chosen by the student. Course credits can be used towards a diploma or masters degree, such as an MBA.

The course actively encourages participants to use their own work; for example, as they investigate intellectual property and commercialisation, they examine the prospects for their own research outcomes. They also develop an understanding that research is only one step of the innovation process, and that they can maximise success in the later stages.

Because students can customise the course to their own work, there are immediate and long-term benefits for them and the organisations for which they work. This flexibility also allows the course content to evolve in response to need.

Short course workshops and seminars have also been developed as 'tasters' to the full certificate course and as useful stand-alone programs, particularly for the development and review of CRC products.

1&2. Students use their own research in the new graduate certificate program. 3. Commercialising research outcomes is a major focus of study. The new course takes students from experiment to intellectual property commercialisation. 4. Professor Mike Evans congratulates Grain Food CRC PhD student Kelly Winter as she picks up her graduation certificate.

CRC for Innovative Grain Food Products

CRC category Agriculture and Rural Based Manufacturing

Core participants

Industry: Danisco, George Weston Foods Ltd, Grains Research and Development Corporation

University: Southern Cross University

Other: BRI Australia Ltd, Council of Grain Grower Organisations Ltd, Export Grains Centre Ltd, Puragrain

CRC for Sugar Industry Innovation through Biotechnology

CRC category Agriculture and Rural Based Manufacturing

Core participants

Industry: BSES Limited, Sugar Research and Development Corporation

University: Southern Cross University, The University of Queensland

Australian Government: CSIRO

Taming salinity through agribusiness

EDUCATION, TRAINING AND PUBLIC OUTREACH

The CRC for Plant-based Management of Dryland Salinity has teamed with the agricultural services company, Landmark, to spread the word about solutions to the dryland salinity problem. As state agricultural departments cut back one-on-one extension services to farmers, the CRC has been able to tap into Landmark's 430 branches and the talents of the company's 250 agronomists and hundreds of other professionals.

The CRC's research covers profitable production on recharge areas, sustainable grazing on saline land, the search for salt-tolerant species and cultivars, and the use of lucerne and other perennials to manage rising water tables and salt. Whole-farm systems using perennials have benefits at farm, regional and catchment scales.

Since its inception in 2002, the *Promoting salinity solutions through agribusiness* project has seen around 700 Landmark staff and 900 landholders and government officials attend 67 workshops over 120 training days. It has evolved to include workshops on irrigated, as well as dryland, farming systems, and collaborative projects have been set up in five states to promote uptake of research results.

Broader scale demonstrations involving regional authorities are likely, such as the Condamine Alliance Landcare Pasture project involving 60 properties in southern Queensland. In many salt-affected areas, regional or catchment-scale solutions are needed to avoid simply moving the problem to the next property.

Recent studies have highlighted the real and potential contributions of agribusiness to agricultural extension. Business already employs about a third of Australia's agricultural professionals, and the proportion is rising. Landmark's network of agronomists and other specialists is a respected, ready-made conduit from researcher to farmer and back.

Landmark depends on farmers' long-term profitability and sustainability, the CRC needs to get its results into the paddocks, and farmers need to solve the salinity problem. For all three stakeholder groups, this project is a win–win–win solution.

Since 2002, about 900 landholders and officials have been to nearly 70 workshops as part of *Promoting salinity solutions through agribusiness*. Now it covers irrigated as well as dryland systems in five states. Agricultural services company, Landmark, is backing the CRC's work with its national network.

CRC for Plant-based Management of Dryland Salinity

CRC category Environment

Core participants

University: Charles Sturt University, The University of Adelaide, The University of Western Australia

Australian Government: CSIRO

State and territory governments: New South Wales Department of Agriculture, South Australian Department of Primary Industries and Resources, Victorian Department of Sustainability and Environment, Western Australian Department of Agriculture and Food, Western Australian Department of Environment and Conservation

Fiery course sparks students' interest

EDUCATION, TRAINING AND PUBLIC OUTREACH

A new course, Fire Ecology and Management in Northern Australia, fires up university students by taking them deep into controversies over the use of fire in regional land management.

The course's undergraduate learning materials were developed by the Tropical Savannas CRC and the Bushfire CRC. The work brought together existing CRC products (research, publications and websites), expertise (fire ecologists, agency staff, educators, technologists and designers) and resources (staff time and direct funding).
CRC partner agencies contributed content, video interviews and constructive criticism.

The learning materials cover the theory and science of fire ecology and the social context of fire management in the north's tropical savannas. Singled out for high praise in the 2005 Australasian Society for Computers in Learning in the Tertiary Education Awards, the course materials combine videos of industry and Indigenous perspectives with current case studies and the latest research results.

Case studies span northwest Western Australia, the Northern Territory and northern Queensland. The management section of the course features models of community engagement for better fire management. These draw on current projects of the CRCs, such as work in the Kimberley, Kakadu National Park and eastern Indonesia.

Students develop their critical skills by analysing debates over the use of controlled burns to prevent wildfires. The course exposes students to the varying attitudes to fire among pastoralists, Aboriginal people and conservation and biodiversity land managers, and requires them to take a cross-jurisdictional perspective.

The natural resource managers of the future then draw their own conclusions.

The course was designed to fill a gap in national undergraduate curricula. It will form the basis of a new unit at Charles Darwin University and is also being used as a teaching resource at James Cook University and the University of Queensland.

1. The project team (left to right): Leslie Instone and Helen Rysavy (Charles Darwin University), Penny Wurm (Tropical Savannas CRC), Kate Parr (Bushfire CRC). 2. The electronic course material gives students up-to-date information and strongly encourages individual critical thinking. 3&4. CD video clips show fire managers at work in the field. (Photos: Charles Darwin University)

CRC for Tropical Savannas Management | CRC category Environment

Core participants

Industry: Meat and Livestock Australia

University: Charles Darwin University, James Cook University, The University of Queensland

Australian Government: CSIRO, Director of National Parks

State and territory governments: Northern Territory Government (through Department of Business, Economic and Regional Development, Department of Natural Resources, Environment and the Arts, Department of Primary Industry, Fisheries and Mines), Queensland Department of Primary Industries and Fisheries, Western Australian Department of Agriculture, Western Australian Department of Conservation and Land Management

Other: North Australian Indigenous Land and Sea Management Alliance

Bushfire CRC | CRC category Environment

Core participants

University: University of Melbourne, University of Tasmania, University of Western Australia

Australian Government: Bureau of Meteorology, CSIRO, Emergency Management Australia

State and territory governments: Fire and Emergency Services Authority of Western Australia, Metropolitan Fire and Emergency Services Board, New South Wales Fire Brigades, New South Wales National Parks and Wildlife, New South Wales Rural Fire Service, Queensland Fire and Rescue Service, New South Wales Forests, Tasmanian Government, Victorian Country Fire Authority, Victorian Department of Sustainability and Environment, Western Australian Department of Conservation and Land Management

WINNER

For cutting-edge learning, get into genes

EDUCATION, TRAINING AND PUBLIC OUTREACH

Genes are way cool! That's the message of *Get into Genes*, an interactive biotechnology education program aiming to raise the awareness of high school students about the genetic technologies driving the development of new cereal crops and pastures.

Designed by the Molecular Plant Breeding CRC and the Australian Centre for Plant Functional Genomics, Get into Genes is a workshop and teaching resource program that covers topics from conventional plant breeding through to the genetic engineering of food crops.

It's designed to help students, teachers and the wider community make informed decisions about the role of new technology in food production. Its aim is to increase the uptake of the CRC's research at a time when Australia needs to add value to its agricultural produce, but when community confidence in the usefulness of gene technology in food production is flagging. Every extra season a new, higher yielding variety takes to reach the market costs Australia money.

Get into Genes is pitched at middle and senior secondary school students. Enthusiastic young scientists and science communicators run workshops on such topics as plant breeding, DNA extraction, gel electrophoresis, and the restriction enzymes used to manipulate DNA.

The program makes full use of hands-on experience and pop culture to engage students, who get to extract DNA and use electrophoresis equipment. The young postgraduate students who act as workshop facilitators have a chance to sharpen their science communication skills.

Get into Genes has been delivered to over 3000 students. It began in South Australia in 2004, expanded into Victoria in 2006 and is due to move into other states soon. It's designed for delivery in both metropolitan and regional areas. Science teachers praise the program for its relevance to the curriculum and its effectiveness.

1&2. Students from St Helena Secondary College get into genes at the Victorian AgriBiosciences Centre in February 2006. 3. *Get into Genes* website. 4. Belinda Barr, Communications and Education Manager for the Australian Centre for Plant Functional Genomics, coaches a future biotech specialist. 5. Wheat crop.

Molecular Plant Breeding CRC

CRC category Agriculture and Rural Based Manufacturing

Core participants

University: University of Adelaide, Murdoch University

State and territory governments: Victorian Department of Primary Industries, South Australian Department of Primary Industries and Resources, Western Australian Department of Agriculture and Food.

Other: International Maize and Wheat Improvement Centre (CIMMYT)

Contacting the contact market

EDUCATION, TRAINING AND PUBLIC OUTREACH

The Global Contact Lens Education Program was developed by the Vision CRC, working with CIBA Vision, to enhance the silicone hydrogel contact lens business. The CRC and CIBA Vision developed the new, highly oxygen-permeable lenses, including Focus Night and Day lenses, which can be worn continuously for 30 days and nights, and O2OPTIX lenses offering high oxygen permeability to daily lens wearers.

While about 22% of potential customers in the United States use contact lenses, only 5% of Australians and 7% of Britons do so. American practitioners fit more than seven times as many wearers per practice as their Australian colleagues.

A pilot program funded by the Australian Contact Lens Industry Council involved 20 optometric practices around Sydney. The program showed contact lens business growth of up to 68%. This success, plus the Vision CRC's silicone hydrogel knowledge, resulted in CIBA Vision asking the CRC to run workshops in Australia, the United Kingdom and Europe.

The European program reached 900 practitioners in 2005, and has been extended into 2006 and 2007. The seminars describe the business benefits for practitioners, and give them the latest research and clinical information about client care. Of those attending, 24% were more confident about prescribing and fitting, and 96% intended to promote the product to suitable candidates.

An innovation of the seminars was the use of EziComms (handheld interactive wireless technology) to provide real-time feedback from audience to presenters. This allowed speakers to tailor their message to audience attitudes.

The Global Contact Lens Education Program successfully packages the industry's knowledge of market needs and business practice with the Vision CRC's detailed understanding of optometric practice, products and services, and expertise in developing educational courses. The result was an impressive 37% uplift in contact lens sales above market rate for program attendees.

1. Participants in the Global Contact Lens Education Program developed by the Vision CRC and CIBA Vision.
2–4. Only 5% of Australians who could wear contact lenses do so, compared with 22% of Americans.

Vision CRC

CRC category Medical Science and Technology

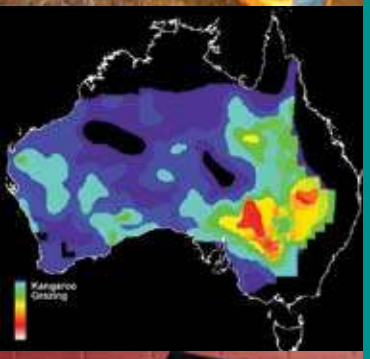
Core participants

Industry: Institute for Eye Research

University: Centre for Eye Research Australia (The University of Melbourne)

Other: International Centre for Eyecare Education, LV Prasad Eye Institute (India)

Studying the science of greenhouse



EDUCATION, TRAINING AND PUBLIC OUTREACH

Climate change is here, but most practising professionals graduated before greenhouse science was established. Teachers, policy advisers, land managers and agricultural consultants are in a position to change people's views and practices, but they need the data and theory to promote understanding and change. And there's no multidisciplinary textbook available.

The CRC for Greenhouse Accounting and the Australian National University have filled the gap, putting $100,000 into Greenhouse Science, a new online, single-semester postgraduate course for current students and busy professionals. The course is usually a component of the ANU's Master of Contemporary Science degree, but can also be a stand-alone professional development course or part of some other postgraduate degrees.

Students complete six online modules, and are expected to work on a cutting-edge research project within the Faculty of Science. The course covers greenhouse science, land management, risk management, greenhouse accounting and national and international policy. Practical exercises focus on carbon budgeting and accounting.

Eighteen leading CRC scientists from eight organisations contributed lecture material, reading lists, videos, practical exercises and other content. The lectures are personalised with video clips of researchers discussing their work, and students interact online for discussions. Web delivery means that busy students can manage their work flows and participate from anywhere.

So far, students have included teaching, management and policy professionals. Secondary school teachers comment that the course has given them the knowledge and confidence they need to incorporate climate change studies into their practice.

The CRC's arrangement with the university ensures that the course and its content will be maintained and available well after the CRC's term expires. This will further increase the benefits from the CRC's work, which is worth up to $6.2 billion in reduced abatement costs and better performance in international policy arenas.

1. The Greenhouse and Agriculture topic: Measuring nitrous oxide emissions from a winter wheat crop at Rutherglen, Victoria. 2. Slide resources (each with an audio explanation) from some of the 12 topics covered by the Greenhouse Science course: Greenhouse and Climate Change; Measuring Forest Carbon; and Measuring Post-harvest Carbon. 3. RangeASSESS, a decision-support tool for management of Australia's rangelands, is one of the practical tools that students use to apply greenhouse science concepts. 4. Allyson Agnew completed the Greenhouse Science unit in 2005 and is the inaugural graduate of this masters degree. (Photo: ANU photography)

CRC for Greenhouse Accounting

CRC category Environment

Core participants

University: The Australian National University, The University of Melbourne

Australian Government: Australian Greenhouse Office, CSIRO, Department of Agriculture, Fisheries and Forestry

State and territory governments: Forests NSW, Queensland Department of Natural Resources, Mines and Water, Queensland Department of Primary Industries and Fisheries, Victorian Department of Sustainability and Environment, Western Australian Department of Conservation and Land Management

Finding out how collaboration works

EDUCATION, TRAINING AND PUBLIC OUTREACH

Australian governments are investing $2.4 billion in collaborative natural resource management (NRM) over the seven years to 2006. The money is delivered through the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality, and most of it will be spent by Australia's 55 regional NRM groups. How well the groups cooperate often determines how big a bang we get for all those bucks.

While there have been other studies on collaboration in NRM, there has been little participatory research on the impact of these new regional arrangements on collaborative NRM in the Australian setting. The CRC for Coastal Zone, Estuary and Waterway Management has remedied this with its Dialogue and Knowledge Exchange Project, an on-the-ground participatory action research project involving over 300 people.

The researchers reviewed and analysed the literature, conducted interviews and made field observations at regional, state and national levels, made a detailed case study in southeast Queensland, and then took their preliminary findings back to stakeholders for feedback at all levels. In the regions, they conducted five 'think tanks' with people from grassroots NRM groups, agency personnel and the staff and board members of regional bodies. Two statewide symposiums, a 100-strong online discussion group, Coastal CRC website visitors and three international conferences provided further input.

The output was four reports, which can be used to define citizen participation processes in NRM. They identify barriers to collaboration, outline a monitoring and evaluation framework, and provide an operational model for collaboration.

Outcomes so far include changes in the actions of the case study NRM body (which now uses geographic information systems to map social capital, such as population and infrastructure, in order to prioritise investments), a submission reviewing regional arrangements for the Queensland Government, and a much more informed discussion among NRM practitioners nationally.

The researchers ran think tanks with grassroots natural resource management groups and NRM workers to find out what makes collaboration work. Their results are already changing the way communities operate to protect our natural resources.

CRC for Coastal Zone, Estuary and Waterway Management

CRC category Environment

Core participants

University: Central Queensland University, Curtin University of Technology, Griffith University, James Cook University, The University of Queensland, University of Western Australia

Australian Government: CSIRO, Defence Science and Technology Organisation, Geoscience Australia

State and territory governments: Queensland Department of Natural Resources and Water, Queensland Department of Primary Industries and Fisheries, Queensland Environmental Protection Agency

The sweet smell of success

LOUIS BRADBURY

CRC for Innovative Grain Food Products

The delightful fragrance of high-value jasmine and basmati rice varieties comes from the formidably named chemical 2-acetyl-1-pyrroline (or 2AP). Unfortunately, 2AP is highly unstable, expensive to synthesise, and impossible to use as an additive. Strain selection for the subtle fragrance in rice is very difficult for rice breeders, who often have to determine if a single grain is fragrant.

Enter Louis Bradbury, who has found the genetic cause of 2AP accumulation in fragrant rice. In ordinary rice, an enzyme known as BAD2 degrades a chemical essential for 2AP production. However, fragrant rice has a mutant gene that produces faulty BAD2, allowing 2AP to accumulate.

Louis's team has developed a genetic test, already in use in Australia's $333 million rice industry and cheap enough for use in third world countries, that will allow the breeding of fragrant rice strains suited to wider environmental conditions, and perhaps with higher levels of fragrance.

Better genes for beer lovers

TIMOTHY MARCH

Molecular Plant Breeding CRC

Each year, Australia exports about 70% of our $1.6 billion barley crop, much of it destined for beer production. Brewers want barley unaffected by the disorder known as 'black point', which blackens the grain, reduces its value by up to $50 per tonne and renders it suitable only for stockfeed. Scientists once thought that black point was caused by a fungus in rain-sodden crops; however, recent research suggests it results from a chemical reaction similar to the one that turns the exposed flesh of an apple brown.

Timothy March and his colleagues are using molecular biological techniques to track down the compounds and enzymes involved in black point. They have identified likely culprits, and will now search for the genes responsible.

Breeders will then be able to produce varieties without those genes, making black point a thing of the past and earning the plaudits of beer lovers everywhere.

POSTGRADUATE STUDENT PRESENTATIONS (10 MINUTES)

Unscrambling the secrets of the egg

BEN ROLLO

CRC for Innovative Dairy Products

Since the birth of Dolly the sheep in 1996, successful mammal cloning has proved elusive. Only a very small number of attempts are successful, when proteins in the receiving egg cell somehow 'turn back the clock', allowing the donor cell's genome to build all the cell types needed for the cloned animal.

Ben Rollo wanted to isolate and identify these proteins, but no-one knew where in the egg to look for them, or what they'd look like. Comparing the ability of cow eggs at different stages of development to produce cloned embryos, he tracked the proteins down to the small nuclear compartment of the immature egg.

By removing the compartment from some eggs and comparing their proteins with those from whole eggs, Ben has begun to identify the crucial protein components.

Ben's current work involves pre-treating donor cells with these special proteins. Pre-treatment might kick-start the winding back process, increasing the cloning success rate.

The end of the graveyard shift

STEWART WORRALL

CRCMining

Haul truck operators in mining operations work 12-hour shifts. They must stay alert the whole time—lapses of concentration can lead to deaths, accidents and lost production.

Stewart Worrall and his colleagues have devised a way to measure the performance of working haul trucks and relate it to driver fatigue. On-board sensors and computers record truck speed, how close the truck is to the correct part of the road, and how these change over the shift. When the truck drops off its load, the data is downloaded to a central database, filtered and refined. It can then be used to plan and simulate changes to mine operations and predict the results.

Another use is to predict the location of mine resources, such as trucks and other vehicles, at any time—allowing the reduction of bottlenecks and other problems.

Two mines have implemented the original system, and others are now considering implementation.

Toxin tampers with genes

PETER BAIN

CRC for Water Quality and Treatment

In summer, when water levels are low, drinking water reservoirs can host large populations of blue–green algae, or cyanobacteria. The algae produce cylindrospermopsin, a toxin known to cause liver injury and DNA damage. The toxin's mode of action was not well understood.

Using state-of-the-art DNA microarray technology, Peter Bain screened cells treated with cylindrospermopsin to find out what it does at the genetic level. He looked for changes in the activation of nearly 20,000 genes. Data mining software enabled him to identify over 300 genes turned on or off by the toxin.

Some of the genes are related to stress or inflammation, while others are responsible for repairing genetic damage. Peter's work will help us determine whether blue–green algae in our drinking water reservoirs, even at low levels, creates a risk of long-term health effects.

Healthy coasts make happy people

MELANIE COX

CRC for Coastal Zone, Estuary and Waterway Management

'Sea changers' have created a development boom along our coastline. Government spends nearly half a billion dollars a year to protect coasts and oceans, so we need to know all the costs and benefits of coastal development and protection.

Melanie Cox has developed a model quantifying the links between coastal condition and human health. Surveys of over 800 people from two coastal regions showed that people who visited the coast more often had wider social networks, exercised more, were healthier, and rated their quality of life higher than others. Healthy waterways also mean less contamination in locally grown seafood, and support industries such as tourism and fishing. In the two coastal regions studied, tourism alone added $90 million and $760 million to the regional economy.

Using Melanie's model, coastal environment managers can now take human costs and benefits fully into account as they care for our waterways.

WINNER

POSTGRADUATE STUDENT PRESENTATIONS (3 MINUTES)

Hunting treasure in a toxic world

PHILLIP POPE

CRC for Water Quality and Treatment

Therapeutic compounds are often sought in exotic locations, such as rainforests and coral reefs. Now scientists are probing microbes in pond scum (blue–green algae, better known as a health threat) in the search for new drugs. However, microbe species have differing requirements and are very difficult to culture in the laboratory—a necessary step for commercial production.

Phillip Pope uses 'metagenomics' to get at the algal metabolic products and enzymes he wants to screen. He collects naturally occurring algae, transfers pieces of their DNA into the bacterium *Escherichia coli*, and then uses various DNA manipulation techniques and expression assays to detect relevant genes and gene products.

So far, he has constructed nearly three thousand *E. coli* clones carrying pieces of algal genomes—a substantial base from which new compounds can be discovered. His preliminary screening has revealed several valuable leads, which he is now pursuing.

Telling the nasty from the nice

KELLY TIVENDALE

Australian Poultry CRC

The intestines of poultry (and humans) are home to millions of *Escherichia coli*, a bacterium that normally causes no trouble. However, some strains can set up shop outside the gut, causing serious disease that can rip through a poultry flock.

Kelly Tivendale and her colleagues have identified a number of *E. coli* genes that occur only in the virulent strains. The offending genes are carried on an extra piece of DNA called a plasmid, and improve the bacterium's chance of survival. For example, one group of genes helps the microbe get and use iron; another allows it to survive better in blood cells. Removing these genes reduces the severity of disease.

The team has developed a test that distinguishes between nice *E. coli* and their nastier cousins, based on the plasmid genes. The test will allow poultry producers to diagnose early, treat or cull birds, and reduce production losses—potentially saving the $3.5 billion Australian poultry industry millions of dollars.

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