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UNSW AUSTRALIA

Never Stand Still

10 Innovations that changed our world

Innovations that changed our world.

From powering our future and providing clean drinking water, to developing lifesaving HIV drugs and helping China's most vulnerable children, here are 10 UNSW innovations that have changed our world today and are helping to pave the way to an even better tomorrow.

Welcome message from Professor Les Field

Inside this special edition of Research@UNSW you will read about 10 innovations that have changed our world and about the people who made them happen.

Some of the examples are more obvious than others, such as our world-leading research in the area of silicon solar cells and photovoltaic energy, the impact of which spans across an entire global industry. Or our important work on the development of new antiretroviral therapies and treatment programs for people with HIV/AIDS.

Others are less well known, but their impact has been far-reaching. For example, a UNSW project that initiated the first national census of China's orphans, resulting in greater financial support and social assistance for more than half a million vulnerable children.

Each story has flourished from the hard work and dedication of academics, researchers and students at UNSW, and, in many cases, from partner organisations and companies that have seen value in funding and collaborating on this work. Each story, in its own way, is important to the world we live in today and the world we envision for our future.

As you may know, the institution that would become UNSW was founded in 1949 – the only research-intensive university in Australia established with a scientific, technological and professional focus. Over more than six decades, innovation has been a pillar of our success.

The 10 innovations highlighted here cross nearly every faculty, including Science, Engineering, Law, Arts and Social Sciences, Medicine and Business.

Like many of our industry and government partners, we continue to value pioneering research that will benefit the long-term health and prosperity of Australia. We remain at the forefront of many exciting disciplines including quantum computing, nanomedicine and cancer research, implantable bionics, refugee law and renewable energy. The research we are doing in these areas today will change the world of tomorrow.

It is our hope that by reading these stories – and the more in-depth articles on the website 10innovations.unsw.edu.au – you will gain a better understanding of our rich history of innovation at UNSW and the dynamic research strengths we possess.

We value our partners and encourage you to contact us if you have any questions about this edition, the innovations we have documented here, or current research projects at UNSW. For now, please enjoy the latest in our Research@UNSW series: *10 Innovations that changed our world.*

Professor Les Field AM
Vice-President and Deputy Vice-Chancellor (Research)
UNSW Australia

Memtec Membrane Technology

Chris Fell

Every time you turn on a tap for a glass of clean drinking water, chances are it has been treated using UNSW's membrane filtration technology.

In 1977, UNSW researchers led by Professor Chris Fell developed and patented an unconventional membrane filter made of hollow nylon fibres to treat wastewater. This membrane removed harmful molecules and pathogens and, importantly, worked at low pressure. This made water treatment more affordable and eventually became the industry standard. A spin-off company called Memtec Limited was established and later sold for US$600 million in 1998. It is now part of engineering giant Siemens, operating as Memcor. UNSW's world-leading expertise resulted in the formation of the UNESCO Centre for Membrane Science and Technology, which continues today.

"There is an entire global industry in hollow fibre membranes for water treatment built on the trail that was blazed by Memcor and based on Professor Chris Fell's research."

Dr Andrew Groth, the Global R&D Director with Siemens Water Technologies

Emeritus Professor Chris Fell at the UNESCO Centre for Membrane Science and Technology at UNSW. Read about UNSW's water treatment revolution at: 10innovations.unsw.edu.au

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Antiretroviral Therapies for HIV/AIDS

David Cooper

Since diagnosing Australia's first case of HIV, UNSW's Professor David Cooper has been involved in the development of every existing antiretroviral HIV drug.

"In the early days of HIV there was one drug – AZT – which came with appalling side effects," says Professor David Cooper from UNSW's Kirby Institute. "But the evolution of treatments has been nothing short of amazing." The Kirby Institute was central to the development of combination antiretroviral therapy drugs and is leading research into treating HIV early, before it damages the immune system. Evidence from this research has convinced the World Health Organization to change its treatment recommendations. Through its ENCORE study, researchers have also shown that a lower dose is as effective and possibly cheaper, putting treatment within reach for millions more people.

"The Kirby Institute is at the forefront of research on therapies and strategies that will help millions of people. Here are real heroes of science, medicine and clinical practice. I honour them. We can be proud of them."

The Honourable Michael Kirby AC CMG, former Justice of the High Court of Australia and patron of the Kirby Institute

Scientia Professor David Cooper, Director of UNSW's Kirby Institute, at its medical research labs in Sydney. Read more about the Institute's profound impact on HIV/AIDS treatment at: 10innovations.unsw.edu.au

Reverse Polish Notation

Charles Hamblin

By the mid-1970s, the majority of scientists in the Western world were using calculators based on the Reverse Polish Notation logic system developed by UNSW's Professor Charles Hamblin.

Early computers had trouble solving complex mathematical equations because of limited memory. In 1956, UNSW philosopher and engineer the late Charles Hamblin developed a set of algorithms for computers to solve problems using Reverse Polish Notation – a way of ordering mathematical expressions where the instruction follows the numbers to which it applies (the formula 2+2 is written 22+). This format eliminated brackets and meant computers could store the data for each operation in a single location, or stack, preserving precious memory. Hewlett Packard adopted Reverse Polish Notation in the 1960s for its scientific calculators and by the mid-1970s this system was being used by most scientists in the Western world.

"Reverse Polish Notation was very influential in the early days of computing…because it allowed minimal demands on memory, in a period when memory space in machines was at a premium."

Professor Peter McBurney, Head of the Department of Informatics at King's College London

Emeritus Professor Phillip Staines, colleague of the late Charles Hamblin, holding an early HP calculator at the Powerhouse Museum in Sydney.
How else did Reverse Polish Notation impact computing? Find out at: 10innovations.unsw.edu.au

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Murray-Darling Basin Plan

Richard Kingsford

UNSW research has influenced a multi-billion-dollar water management plan for the Murray-Darling Basin's iconic rivers, which support a third of Australian agricultural production and precious wetlands.

The Murray-Darling river network sustains regional communities by providing clean water for drinking and agriculture, but when too much water is removed, the environment suffers. For nearly three decades, Professor Richard Kingsford has been conducting ecological fieldwork throughout the Basin and has seen many ecosystems threatened. His work has identified key degradation problems for wetlands and flood plains, and influenced the Commonwealth's decision to increase the amount of environmental flow back into the river. Kingsford's innovative research around adaptive water management was an important element of the Murray-Darling Basin Plan.

"Richard's work has been an important input to the development of the Murray-Darling Basin Plan and to many other activities that help to get better environmental outcomes within and beyond the Basin."

Jody Swirepik, Executive Director Natural Resource Management Division, Murray-Darling Basin Authority

Professor Richard Kingsford, Director of the Australian Wetlands, Rivers and Landscapes Centre at UNSW. Read more about his contributions to the Murray-Darling Basin Plan at: 10innovations.unsw.edu.au

Silicon Photovoltaic Solar Cells

Martin Green and Stuart Wenham

UNSW engineers hold the world record for conversion efficiency for silicon solar cells. The impact of their pioneering research extends globally across the entire solar power industry.

In 1974, Martin Green began working at UNSW. One year later, Green and his team produced their first silicon photovoltaic solar cell, which converted sunlight directly into electricity. In 1985, they became the first group to reach the 20% efficiency milestone. With the addition of Stuart Wenham, the UNSW solar research group continued setting world records for module and cell efficiency, including the current record of 25% in 2008 with their PERL cell. The commercial variant is known as PLUTO and up to US$1 billion of product has been delivered annually. International solar companies including Samsung, Suntech Power and BP have all used UNSW technologies.

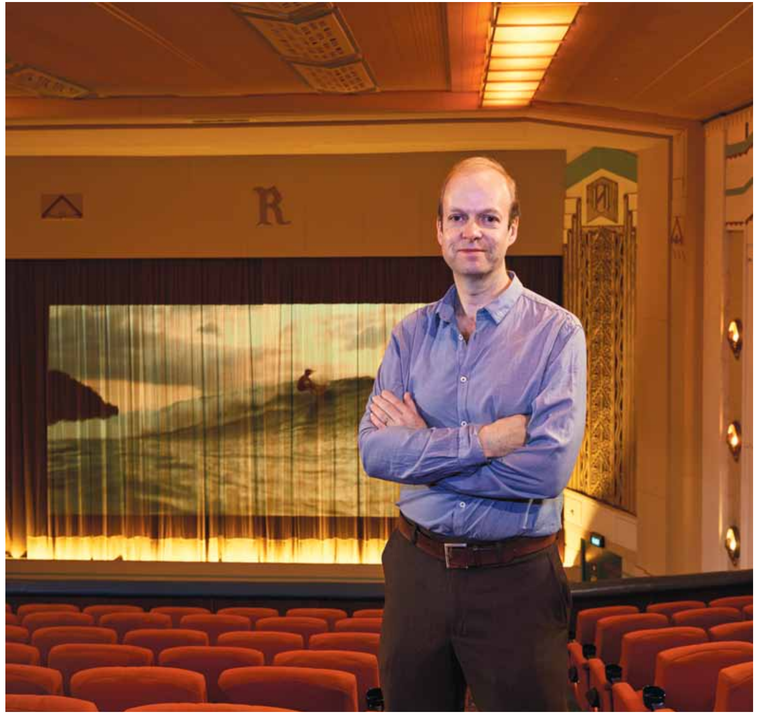
"Our international reputation means we can assemble teams of people around the world to work on projects that would be too challenging for any one group – and we can have multiple approaches going in parallel. This is a major advantage."

Scientia Professor Martin Green, UNSW School of Photovoltaic and Renewable Energy Engineering

Scientia Professors Stuart Wenham and Martin Green on the roof of the UNSW Tyree Energy Technologies Building. Read more about the innovations of these solar power pioneers at: 10innovations.unsw.edu.au

“By his election to the Royal Society of London, Martin Green’s achievements in the research and development of silicon-based solar cell technology is recognised as being of world-leading quality and world-changing significance.”

Michael Kelly, Prince Philip Professor of Technology at the University of Cambridge and Royal Society Fellow



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Kakadu Software

David Taubman

UNSW software used by more than 300 companies, including Sony, HBO and Disney, is fundamentally changing the way we interact with cinema and visual content.

At the beginning of the 21st century, UNSW’s Professor David Taubman wrote the core algorithm for the image compression standard now used by the film industry. Known as JPEG 2000, this standard enables greater interactivity for users when editing, analysing and sharing their visual content. In addition to digital cinema, it is increasingly used for medical imaging, geospatial mapping, surveillance and digital archiving. Soon after the standard was implemented, Taubman developed a powerful software kit called Kakadu, which allows developers to build compatible applications. Kakadu is the market-leading software for JPEG 2000 and has been licensed to more than 300 companies, including Disney, Warner Bros, HBO and Sony.

“The Kakadu developer toolkit has enabled us to integrate robust JPEG 2000 video format support into our media transformation solutions … meeting the requirements of our top-tier media and entertainment, and archive customers.”

Darren Gallipeau, Product Manager at Canadian media technology company Digital Rapids

Professor David Taubman at the Ritz Cinema in Randwick, NSW. Read more about the awesome power of Kakadu and how it’s changing our digital future at: 10innovations.unsw.edu.au

Support for China's Orphans

Peter Saunders and Xiaoyuan Shang

UNSW research contributed to the first census of China's orphans, and led to a significant improvement in the living standards of half a million vulnerable children.

In 2005, Professor Peter Saunders and Associate Professor Xiaoyuan Shang from the UNSW Social Policy Research Centre organised the first census of Chinese orphans. The survey found more than 500,000 children, many of them in rural areas, were receiving little or no social assistance. A second phase of research calculated the cost of raising these orphans. Based on the findings, in 2006 China's President Hu Jintao approved the establishment of a new social support system for orphans. Today, under the auspices of the new Department of Child Welfare, all orphans receive financial support for basic needs such as food, clothing and education.

"I like to use the words policy entrepreneur to describe Xiaoyuan Shang. Her research on Chinese orphans provided strong evidence to raise government and public awareness about the extent of the problem. It helped change government policy on orphans and enlightened civil society."

Guangquan Ding, China Country Director, INCLUDED (a non-profit organisation working with migrant communities in China, India and Europe)

Associate Professor Xiaoyuan Shang and Professor Peter Saunders of the UNSW Social Policy Research Centre. Read about their work to improve the lives of half a million Chinese orphans at: 10innovations.unsw.edu.au

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Silicone Hydrogel Contact Lenses

Brien Holden

Sixty million people around the world now wear safer, more comfortable contact lenses manufactured using a scientific formula developed at UNSW.

In the 1980s, UNSW scientists designed a new permeable contact lens that solved the problem of hypoxia – a condition that arises when the cornea doesn't receive enough oxygen. In 1991, the Cooperative Research Centre for Eye Research and Technology was established to engineer these breathable lenses. A team of talented UNSW scientists and clinicians, including Professors Brien Holden and Arthur Ho, led the global project. The resulting Focus Night & Day lenses from industry partner CIBA Vision (now Alcon) were made from silicone and hydrogel polymers. They allowed oxygen and essential ions to reach the eye's surface. Today, roughly 50% of contact lenses are silicone hydrogel, with cumulative sales exceeding US$20 billion.

"This development completely changed the paradigm for contact lens technology and is now the standard material for the industry, all from an innovative group of scientists, engineers and clinicians."

Tim Grant, Head of Professional Marketing for Asia Pacific, Alcon

Professor Brien Holden in one of the clinical rooms at the Brien Holden Vision Institute at UNSW. Read about the global impact of silicone hydrogel contact lenses at: 10innovations.unsw.edu.au

Equal Remuneration

Anne Junor and Ian Hampson

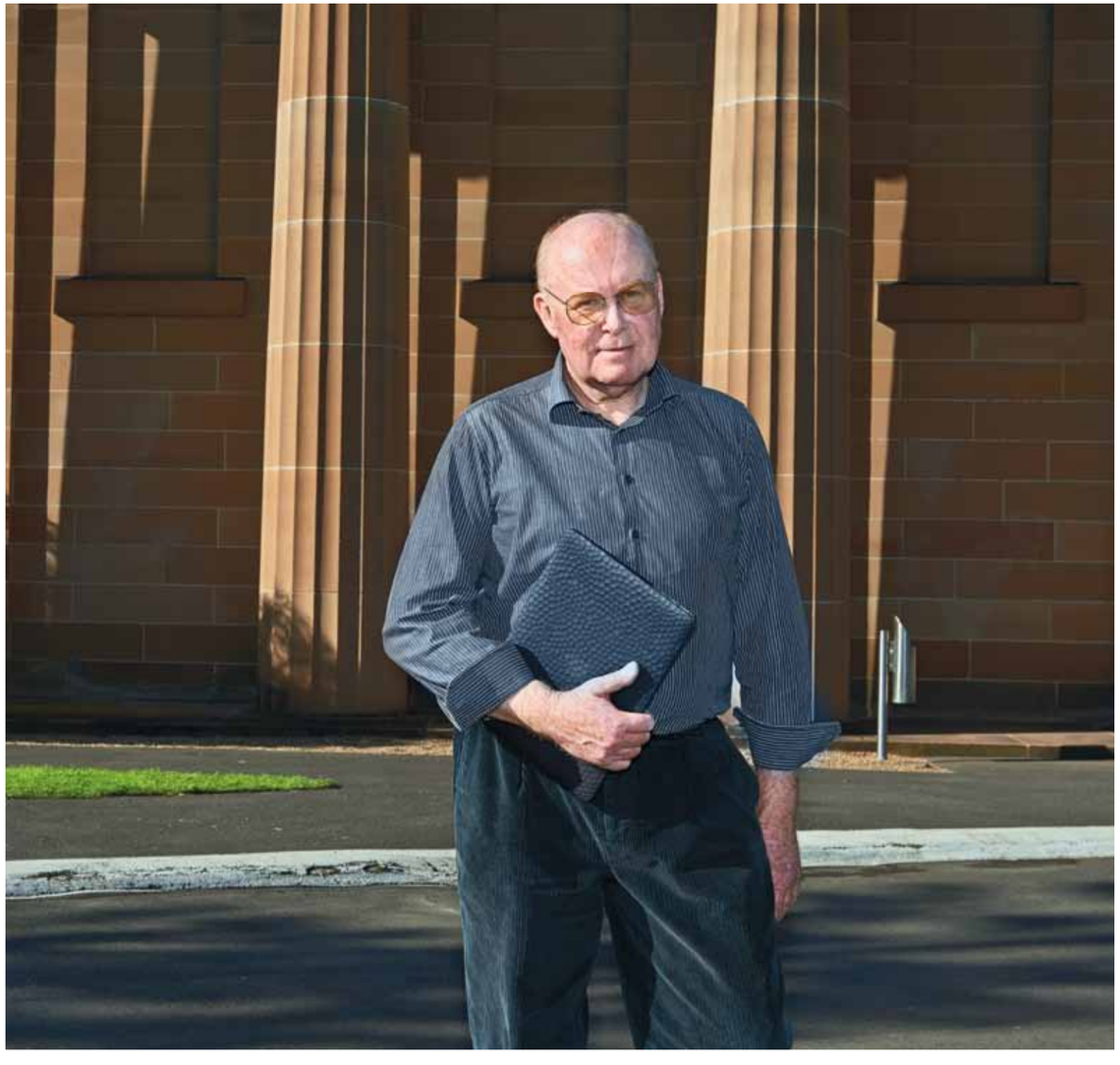
A skills-assessment toolkit developed at UNSW has helped secure pay rises of up to 45% for 150,000 workers in the community sector, the bulk of them low-paid women.

Research carried out by UNSW led to the creation of a toolkit to help identify under-recognised work skills. Developed by Associate Professors Anne Junor and Ian Hampson from the Australian School of Business, the toolkit was used to provide evidence in the landmark Equal Remuneration test case in 2012. This evidence contributed to the workplace arbiter recommending pay rises of between 19% and 45% to 150,000 social and community services workers, the vast majority of them low-paid women. It was the "first step in addressing the historical undervaluing of community sector workers", according to Australian Council of Social Service's Chief Executive Cassandra Goldie.

"It [was] the first ever successful pay equity claim in the national system, and a significant advance for equal pay for women. [It was] good for the sector, good for caring workers, good for women and good for the economy."

Former Prime Minister, Julia Gillard

Associate Professors Anne Junor and Ian Hampson from UNSW's Australian School of Business. Read about their contribution to fair pay in the community sector at: 10innovations.unsw.edu.au



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INNOVATION

AustLII

Graham Greenleaf

AustLII revolutionised access to justice and the rule of law by making a wealth of legal material freely available to anyone with an internet connection.

AustLII's 500 databases receive upward of 700,000 hits each day, making it the most popular online free legal resource in the world. Launched in 1995 by UNSW's Professor Graham Greenleaf and Professor Andrew Mowbray, from the University of Technology, Sydney, AustLII sources legal information from all Australian jurisdictions. Today, AustLII's know-how is fostering free access to legal information internationally, inspiring similar systems in the Pacific Islands, parts of Africa and also in the UK, Hong Kong and New Zealand. "AustLII has put high-quality legal research within everyone's grasp, and both legal research and practice are the better for it," says AustLII Executive Director Philip Chung.

"Thank you AustLII. You have done a great service to legal research in this state and country and to the administration of justice generally."

The Honourable T.F. Bathurst, Chief Justice of New South Wales

Professor Graham Greenleaf outside the Darlinghurst Courthouse in Sydney.
To read more about AustLII's full impact visit: 10innovations.unsw.edu.au

To read more about these 10 innovations and other important UNSW research visit: 10innovations.unsw.edu.au

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