1976

50 years of thinking differently

UNSW School of Biomedical Engineering, 1976-2026

2026

UNSW SYDNEY

The UNSW School of Biomedical Engineering respectfully acknowledges the Bidjigal peoples on whose unceded lands we have been privileged to learn, teach and work for the past 50 years. As a School, we recognise the ongoing presence and contributions of Aboriginal and Torres Strait Islander peoples, and will continue to respect Aboriginal and Torres Strait knowledges and cultures.

“Biomedical engineering at UNSW is all about the future. What does the future look like?”

– Sarah Knox

Contents

INTRODUCTION / The first fifty years 6

A discipline defined by questions 8

EVOLUTION 10

1960s-1976: DREAMERS AND DOERS The spark that started a community 10

A possibility becomes a plan 11

1977-1979: BUILDERS AND BELIEVERS Turning promise into practice 16

Leadership, industry and a new degree 17

1980-1989: EXPLORERS AND EXPANDERS The decade that opened every door 22

More space, more students, more scrutiny 23

1990-1998: STRATEGISTS AND SYSTEM-BUILDERS The Centre becomes a School 30

A home, a structure and new national networks 31

1999-2010: COACHES AND CATALYSTS Lifting performance across the board 38

Raising standards, extending reach 39

2011-2019: STEWARDS AND STRIVERS Holding ambition in balance 46

Growth shaped by values 47

2020+: HOLDERS AND HORIZON-SETTERS Finding direction under pressure 54

Crisis, cohesion and a new horizon 55

IMPACT / Fifty years of engineering for human health 62

Safer travel for children with disability 64

Gene-based diagnostics, without the lab 65

Silk, reimagined for the heart 66

Bioelectronic pathways to pain relief 68

Repairing the body from within 69

Comfort, fit and the future of prosthetics 71

The foundations of bionic vision research 72

Making dialysis more livable 73

Engineering impact where resources are limited 74

Restoring control, one step at a time 76

Surgical control, at the smallest scale 77

Teaching nerves to grow again 79

Designing drug delivery at the nanoscale 80
The next frontier of neural implants 80
From genetic data to clinical answers 82
Engineering a future beyond animal models 83
The Assistive Technology Hub 84
The original health-aware home 86
From CRC to clinic 87
Making artificial hearts responsive 89
Modelling movement, person by person 90
A very Australian experiment 91
From symptoms to signals in gut health 92
Soft robotics for cardiac support 94
Engineering the future of cell therapy 95
Precision anticoagulation for dialysis patients 97
Connecting nerves, restoring function 98
Refining a life-changing technology 99
Preserving independence 99
Rewriting the rules of contact lenses 100
Seeing disease in a new light 102
Optrodes and the future of neural sensing 103
From smartphones to clinical care 104

FOOTPRINT / Global from the beginning 106

COMMUNITY / The making of a community 108
Open-door culture and the buzz of ideas 109
People, purpose, and a place to hang 111
An academic family tree 112
“These stalwarts, these unsung heroes” 113
“So many amazing, powerful women!” 114
A roll call of leadership 115
1976-2026: Community Gallery 116

CONCLUSION / A collective future: across disciplines, beyond borders 122

The first fifty years



▶ The Roundhouse had already been a fixture of student life for more than a decade when this image was taken in 1976, the same year the Centre for Biomedical Engineering was formally established.

FIFTY YEARS AGO, a cross-disciplinary community of engineers and clinicians was recognised by the University of New South Wales (UNSW) as something new and distinct. It was called the Centre for Biomedical Engineering. What started as a small, ambitious effort to bring engineering into closer conversation with medicine has grown into a discipline that now sits at the forefront of global health innovation.

This is the story of that evolution. It traces the development of ideas, technologies and partnerships that have changed the way health is understood and supported. It also captures a distinctly Australian chapter in that history – one defined by optimism, pragmatism, and a willingness to work across boundaries that, at the time, were rarely crossed.

At its centre are the people: the researchers, students, clinicians, technicians and industry partners who built not only a discipline, but a culture. They opened doors for one another, forged lifelong collaborations, and trained generations of graduates who now contribute across healthcare, research and industry around the world.

The impact of this work can be measured in devices, therapies and systems that have improved millions of lives. It can also be seen in something less tangible but equally important: the establishment of biomedical engineering as a way of thinking and working – one that brings together scientific rigour, technical precision, expansive creativity and a deep commitment to human health.

"It's always the same question at Open Days: What is biomedical engineering? So my very simple answer is: wherever there's technology in medicine, there's probably a biomedical engineer."

– Lauren Kark





"One of the things Chris Roberts said to me many years ago was that biomedical engineering is the best degree to do because you get the hard engineering qualifications – all that analytical, numerical capacity – and then you get the biomedical aspects that help you understand human variability, and the fact that you need to think about people as individuals. It brings those two things together."

– Laura Poole-Warren

A discipline defined by questions

Biomedical engineering is a field shaped as much by questions as by answers. How might a signal be made clearer, a diagnosis made earlier, a treatment made safer? How might a device respond more gently to living tissue, or mimic more closely the movement of a musician, an athlete, an adventurer? How might cutting-edge medical care reach someone on a farm in the Australian outback, or in a floating village in Asia? How might sight, sound, mobility be restored?

Progress often begins with curiosity – with the instinct to take something apart, to understand how it works, and to imagine how it might work differently. It is a process of continual refinement and reinvention: testing ideas, learning from failure, and building solutions that move incrementally closer to what is needed. In this way, biomedical engineering is fundamentally open-ended, a discipline driven not by answers, but by the next question.



* James Lee is a pseudonym used to protect the identity of the individual.

"I think the goal is always the same in biomedical engineering: it's to bring hope for a brighter future. You might be doing that by making something that hasn't been done yet anywhere in the world, inventing a bionic eye, or by bringing a technology like 3D printing to a place where no one has seen it before. Either way, it's about bringing hope to people – that things will develop, things will get better, and that we can work towards the future we imagine if we commit ourselves to it with creativity, innovation and consistency."

– James Lee*

"The most important thing is that biomedical engineering has a translational focus. Every discovery – within electrical engineering, chemical engineering, computer engineering, mechanical engineering – gets translated into something that can improve health, that can help people. This is the difference."

– Reza Argha





"Biomedical engineering is uniquely suited to fostering interdisciplinary collaborations. It is intrinsically embedded in the discipline. It draws on a variety of disciplines without really looking at disciplinary boundaries. This ethos is the right ethos."

– Ewa Goldys



"Obviously, I'm a big fan of biomedical engineering. I think doctors are great, but they can't do anything without the tools. That's what we do. We provide the tools so those amazing people can do those great things. The fact that we're interdisciplinary – the fact that we can tap into our core disciplines and still be able to go, 'Okay, actually we need something else here' – it's that breadth, that whole biomedical spectrum, that gives us such power."

– Penny Martens



"The potential that biomedical engineering has to change people's lives on a very personal level, to help people live longer, healthier lives – that really, really captures my heart."

– Megan Lord

From these questions emerges a way of working that depends on connection: between engineers and clinicians, between research and real-world care, between technical possibility and human need. It asks its practitioners to navigate complexity and uncertainty, to design for variation, and to keep people – their lives, their experiences, their outcomes – firmly in view.

The result is a field that is both practical and imaginative, grounded in tools and systems, yet driven by the possibility of meaningful change.

Fifty years ago, those working at the intersection of engineering and medicine were still searching for the right language to describe what they were building. Today, that challenge remains. Biomedical engineering continues to evolve, defined not by a single description, but by the problems it chooses to solve and the difference it seeks to make.

1960s–1976: Dreamers and doers



▲ In 1967, as clinicians at Prince Henry Hospital pursued open heart surgery using heart-lung machines, the growing convergence of medicine and engineering was plain to see.

The spark that started a community

BEFORE IT HAD A NAME, before it had a home, before it became a world-renowned source of innovation, biomedical engineering arrived at UNSW as an instinct, shared across hospital wards and research laboratories, that the future of health would be shaped by engineers and clinicians working side by side.

Australia in the 1950s and '60s was alive with this possibility. New medical technologies were beginning to transform care for people with kidney and heart disease, early medical instrumentation was beginning to redraw the boundaries of clinical care, and a fledgling medical-technology industry was starting to take shape. The idea that engineering might belong inside medicine – as a partner – was taking hold.

At UNSW, that same curiosity sparked conversations in clinics, corridors and borrowed meeting rooms. Surgeons, engineers and scientists began meeting after hours, testing ideas, running seminars at Prince of Wales Hospital, and sketching what a shared future might look like. Piece by piece, a community formed.

By 1976, imagination had become momentum – and momentum had become an institution.

A possibility becomes a plan

The story goes that, sometime in the late 1960s, staff from the School of Mechanical and Industrial Engineering and the Faculty of Medicine joined forces to study the lubricating properties of knee-joint fluids and how they changed after surgery. With hindsight, this small, pragmatic project marks the first time clinicians and engineers at UNSW came together to consider the body as an engineered system, opening the door to new perspectives, new methods, and new solutions.

Biomedical engineering's emergence on campus was

1960s

Staff from the School of Mechanical and Industrial Engineering and the Faculty of Medicine collaborate on studies of knee-joint lubrication and post-surgical fluid distribution. At the same time, **Paul M. Trainor** – later described as the 'father of Australia's medical device industry' – establishes the Nucleus group of companies, focused on developing, manufacturing and commercialising new medical technologies. Its enterprises would later include future industry leaders including Telectronics, Domedica and Cochlear.

November 1970

Thirty academic and clinical staff meet to consider how best to coordinate and strengthen biomedical engineering collaborations across the University.

part of a story that had been building for decades.

"Australia has a rich heritage in biomedical engineering," explains **Klaus Schindhelm**, part of the discipline's first wave at UNSW. "You have to go back to the 1950s and '60s, to the guys who were basically putting these things together in their garages and starting to set things up."

By 1970, the broader momentum was proving impossible to ignore. A group of thirty academics and clinicians met in November to discuss how to promote and sustain collaborations in biomedical engineering across the University. The following year, they launched a monthly seminar series at Prince of Wales Hospital, one of UNSW's key teaching hospitals, creating a regular forum for shared problems and emerging ideas. By 1973, they had established an ad hoc committee to push ahead with plans for a 'Centre for Biomedical Engineering'. And by 1974, they had been given the go-ahead by then Vice-Chancellor, **Sir Rupert Myers**, to establish the Centre on an informal basis, under the management of an interdisciplinary committee that included both engineers and clinicians.

An ambitious beginning

The Centre's early existence was improvised: scattered rooms, borrowed labs and subsistence funding. But its activity was anything but tentative. In addition to the seminar program, the team brought international researchers to campus, hosted visits from leaders in biomechanics and orthopaedic innovation, and made themselves visible to students by staging demonstrations at University Open Days and running workshops for high-schoolers who might one day become biomedical engineers.

Research projects in these years were diverse: exploring the impacts of external stimuli on heart rate, the possibility of implants for muscular stimulation of scoliotic curves, the tendency of certain materials to cause clotting during dialysis. Some projects were exploratory, others explicitly clinical. All demonstrated a willingness to follow the problem, wherever it led, and to show, through action, what a Centre might make possible.

1971
Monthly seminars in 'Bio-Engineering' commence at Prince of Wales Hospital. The Medicheck Referral Centre, funded by a $1 million donation from the **Sir William Tyree Foundation**, opens in Sydney, offering technology-enabled health screening and a pioneering 'computerised medical questionnaire'.

1973
An ad hoc committee is formed to progress the establishment of a Centre for Biomedical Engineering.

September 1974
The Vice-Chancellor agrees to the informal establishment of the Centre for Biomedical Engineering, under an interdisciplinary management committee chaired by **Noel Svensson** from the School of Mechanical and Industrial Engineering.

December 1974
The Board of Management holds its inaugural meeting. **Peter Bason**, from the School of Electrical Engineering, is appointed Coordinator, responsible for the Centre's day-to-day activities.

Building a model for collaboration

Meanwhile, the management committee grappled with the deeper question: what should a university-based Centre look like in a field where clinical translation and commercialisation were so essential to the work?

By 1976, their thinking had crystallised into a formal proposal that was ambitious, pragmatic and characteristically well-designed. The Centre would operate across three streams: research, teaching and clinical application. Its Advisory Committee would draw members from five UNSW faculties, three teaching hospitals and three industry representatives. And it would formalise a principle of deep clinician–engineer collaboration that remains foundational today.

"Because of their close patient contact, medical staff are in the best position both to identify suitable biomedical problems and to evaluate the effectiveness of research results," read an early report.

In September 1976, almost six years after that first after-hours meeting, the proposal was approved and the Centre for Biomedical Engineering was formally recognised by the University. What began as a conversation – scattered across faculties, hospitals and disciplines – had become a community with structure, purpose and a vision large enough for the decades ahead.

November 1975
The Board presents a draft proposal outlining the Centre's future structure and purpose to a group of 'interested persons'. The Centre also takes part in the University Open Day.

April 1976
The Centre is visited by **Dhanjoo Ghista** from NASA's Ames Research Centre in California, who delivers a seminar on his pioneering work in biomechanics.

May 1976
The Centre runs a biomedical engineering workshop for secondary school students, in partnership with the School of Electrical Engineering and the Faculty of Medicine.

July 1976
The Board submits a formal proposal for the establishment of the Centre to an expanded version of the ad hoc committee. The proposal is endorsed and forwarded to the Vice-Chancellor.

September 1976
The Vice-Chancellor formally recognises the Centre for Biomedical Engineering.



◀ In 1976, under the watchful eye of Peter Bason, a youthful Branko Celler demonstrates equipment devised for monitoring heart rates.

1960s–1976: Highlights

Industry, philanthropy and the seeds of future work

In the Centre's earliest years, some of its most significant supporters sat outside the University. Among them was **Paul M. Trainor**, founder of the Nucleus group of medical-technology companies including pacemaker innovators Telectronics, dialysis specialists Domedica and, later, Cochlear, the organisation behind the 'bionic ear'. Many UNSW biomedical engineering graduates would eventually find their way into these companies, helping shape Australia's emerging medical device industry. Later, the Trainor Family would generously donate funding to establish the named Paul M. Trainor Chair in Biomedical Engineering.

Equally influential was **Sir William Tyree**, a key figure in Australia's electricity sector who contributed significant funds to the 1971 launch of Medicheck, a technology-enabled health-screening service. The initiative exposed a generation of engineers and clinicians to ideas about automated assessment, data-driven health and preventive screening.

These early external alliances helped shape not only the Centre's direction, but the ecosystem into which its graduates would step.



Founding voices, unlikely allies

The inaugural Board of Management met for the first time in 1974, bringing together surgeons, hospital leaders, and engineers from three disciplines. Orthopaedic legend, **Ron Huckstep**, contributed international stature and surgical fearlessness. **James Loughman**, from Prince of Wales Hospital, and **Michael O'Rourke**, from St Vincent's, ensured the Centre stayed anchored to real patients and real problems. **Peter Bason**, a lecturer in the School of Electrical Engineering, was appointed 'coordinator', responsible for nurturing the Centre's plans day-to-day. Also at the table was **Peter Farrell**, a dynamic young chemical engineer recently returned from post-doctoral work in the United States. His strategic instinct and industry-facing mindset would become pivotal to the Centre's story for decades to come.

Accommodation: the first unsolved problem

From its earliest days, finding space was the Centre's most persistent challenge.

"Accommodation for the Centre has remained one of the most difficult problems facing the Board," noted the inaugural Report on Activity from 1976.

The aspiration was for the Centre to sit close to the Medical School and Prince of Wales Hospital, in a stand-alone building with its own laboratories. In reality, it occupied borrowed offices in the Mechanical and Industrial Engineering Building – "the limit of its physical presence" for the foreseeable future. The vision was expansive; the footprint was not.

Building a library, building a field

The inaugural Report of Activity documented the Centre's first resources with quiet pride: "Some 70 reference texts… relevant theses in microfilm form… basic teaching aids, including a slide projector, overhead projector, screen and tape recorder."

For a discipline still defining itself, these modest acquisitions represented the beginnings of a shared curriculum, a shared language and a shared set of tools.



▲▲ The Wallace Wurth building later housed the Centre's laboratories. ▲ An overhead projector was among the modest collection of teaching aids assembled in the 1970s.

1977–1979: Builders and believers



▲ Every Wednesday morning in 1978, Peter Farrell (centre) chaired a meeting with members of the Medical Engineering Research Group including (from left) Michael Skalsky, Richard Ward, Philip Hone and Klaus Schindhelm.

Turning promise into practice

THE MOMENT UNSW formally recognised the Centre for Biomedical Engineering, the pace quickened. What had been a fragile enterprise became a hub of activity: seminars, collaborations, research breakthroughs and a steady hum of visitors from every corner of the biomedical world.

Under the leadership of **Peter Farrell**, the Centre surged ahead. External funding multiplied, industry partnerships deepened, and the nation's first Master of Biomedical Engineering program opened its doors. Students arrived from interstate and overseas, drawn to a program that felt both pioneering and practical, threaded through hospitals, laboratories and companies already shaping the future of medical technology.

By the end of the decade, the Centre had outgrown its improvised beginnings. It had a voice, a reputation, and a growing influence across the University and beyond.

The builders of this era didn't just strengthen the foundations – they established the blueprint that would guide the Centre's next decades.

Leadership, industry and a new degree

When the Centre for Biomedical Engineering finally gained formal recognition in 1976, its leadership reflected its recent history: **Noel Svensson** continued as inaugural Director, and electrical engineer **Peter Bason** remained as Coordinator. In many ways, the Centre's spiritual home still sat inside Electrical Engineering, where Bason had already been supervising work that blurred the boundaries between engineering and medicine.

By the end of 1977, however, the Centre underwent a small but significant recalibration when Peter Farrell was appointed as its first full-time Director, effective the following year. Farrell had served on the early ad

February 1977
Robert Popovich of the University of Texas presents one of the Centre's monthly seminars.

March 1977
The Centre's Advisory Board convenes for the first time.

August 1977
Richard Kitney (Imperial College London) and **James Reswick** (Rancho Los Amigos Rehabilitation Engineering Center, California) deliver guest seminars, signalling growing international engagement.

September 1977
Samuel Sideman of the Technion – Israel Institute of Technology presents the monthly seminar.



◀ From 1978, an aerial view of the Kensington Campus, looking across Anzac Parade towards Randwick.

hoc committees and was already known on campus as a dialysis expert with strong links to industry, but his appointment as Director altered the Centre's centre of gravity.

As **Klaus Schindhelm** later observed, there had "always been that nucleus there in electrical engineering, but when Peter Farrell came along, [the Centre] took on a very different drive." Chemical engineering, particularly Farrell's work on artificial organs, now stood alongside electrical engineering as a defining pillar.

Farrell brought with him a determination not to wait around for beneficent sources to come through with funding. An Engineers Australia profile in 1978 noted that he took "an aggressively entrepreneurial approach" to running the Centre.

"We are going ahead with research projects, whether we get enough money from the government or not," he told the journal.

Within a year, the Centre was receiving substantial contributions from industry and philanthropy – Asahi Medical, the Australian Kidney Foundation, Travenol Laboratories and the Wenkart Foundation – alongside new grants from the National Health and Medical Research Council (NHMRC). The sudden arrival of external investment meant the Centre's funding almost quadrupled from one year to the next, rising to more than $111,000

December 1977
Peter Farrell is appointed the Centre's first full-time Director, effective from January 1978.

March 1978
Ten students enrol in the inaugural cohort of the Master of Biomedical Engineering. Farrell's artificial-organs research group formally joins the Centre, bringing PhD researchers including **Klaus Schindhelm** and **Michael Skalsky** into the fold.

March 1979
Nine students enrol in the second cohort of the Master of Biomedical Engineering, including **Anne Simmons**.

in the first year of Farrell's tenure (a figure equivalent to $700,000 or more at the time of the School's 50th anniversary, in 2026).

A thriving community takes shape

Those resources helped accelerate growth. Farrell folded his artificial-organs team into the Centre, bringing with him promising young researchers including Schindhelm and **Michael Skalsky**. International visitors became a regular feature, sometimes staying at the Centre to pursue research collaborations for months at a time.

This period also saw the launch of a teaching agenda. In 1976, plans for a Master of Biomedical Engineering were approved, and in March 1978 the first cohort of ten students enrolled. Applications arrived from Australian and international engineers and scientists who recognised that biomedical engineering was taking off around the world. **Anne Simmons**, who joined the second cohort in 1979, remembers the time vividly.

"There were people coming into the Centre from all over the world, all the time," she says. "It was just this vibrant, industry-driven, academic space – I don't think I've ever seen anything like it, ever since."

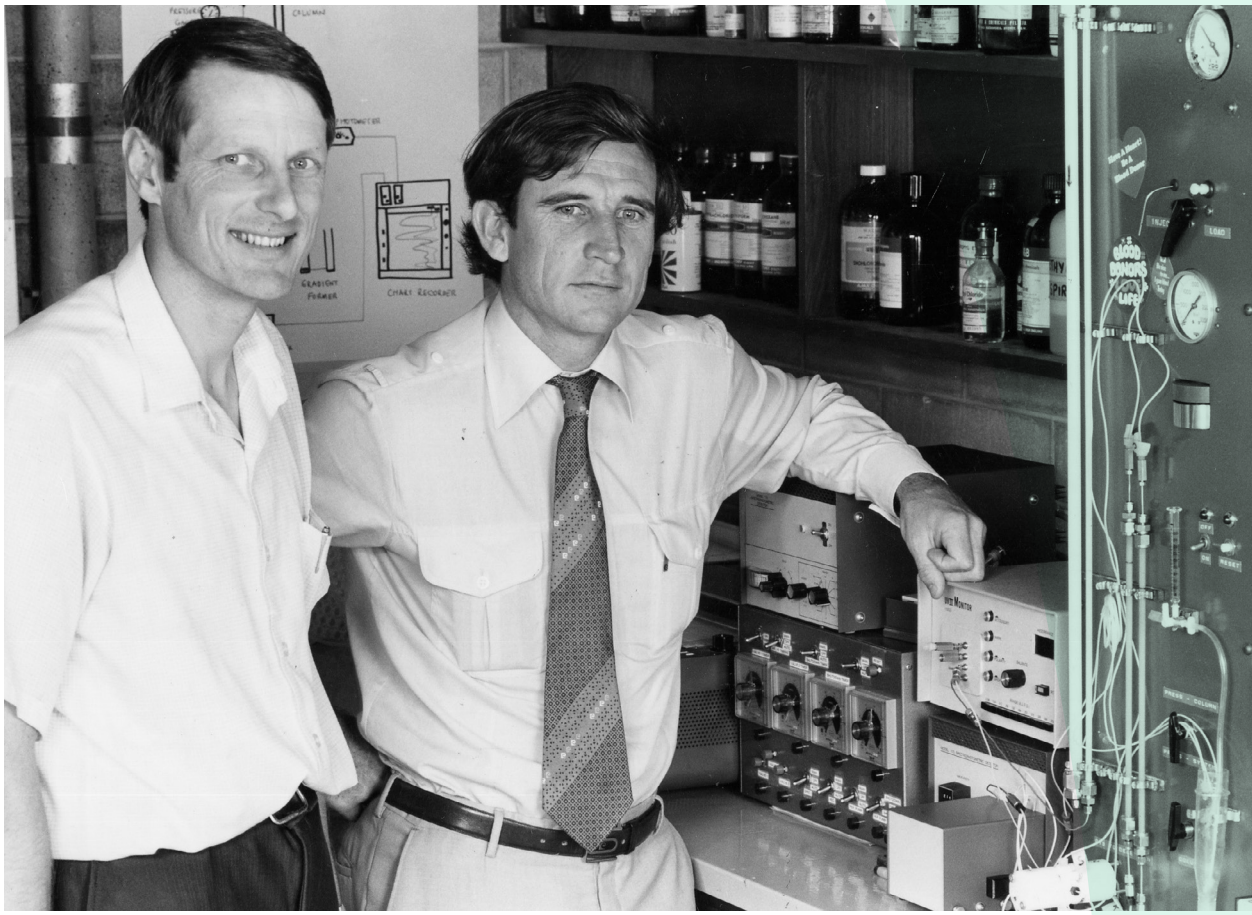
Celler recalls: "Almost everybody thought the focus on biomedical engineering was worth it – that the contributions that could be made to medicine by engineering, at multiple levels, would be transformative."

In a few short years, UNSW had moved from talking about biomedical engineering to building it – with leadership, resources and a growing community of students ready to carry it forward.

1979

The Advisory Board expands to 29 members, representing the Faculties of Applied Science, Biological Sciences, Engineering, Medicine and Science; the NSW Health Commission; teaching hospitals; and industry partner Telectronics Pty Ltd. International visitors that year include **Lee Chiao** (Chinese Academy of Medical Science, Peking); **Jonas Bergström** (St Erik's Hospital, Stockholm); **Marbo Kawamura** (Terumo, Japan); **Gab Schmergel** and **Tom Brewar** (President and Vice-President, Travenol Laboratories, Deerfield, Illinois, USA); **Yasuzo Tsukada** (Keio University, Japan); **Toru Takahashi** (Ministry of Health, Japan); **Paulo Campos** (President, National Academy of Science and Technology, Philippines); **Ryu Youngha**t (President, Korea Health Development Institute); and **Min Chang Hong** (Director, National Institute of Health, Korea).

1977–1979: Highlights



Expansion at speed: a budget that multiplied

In financial terms, the late 1970s tell a story of acceleration. In 1975, the Centre operated on a budget of around $5000. By 1976 this had risen to $24,150; by 1977, to $31,900. Then, under **Peter Farrell**'s leadership, the curve steepened. In 1978 the Centre's budget jumped to roughly $111,000, including $55,000 from external partners. By 1979, total funds approached $224,000, with close to half coming from industry, foundations and national grants. For a small, improvised unit with no dedicated building, it was an extraordinary shift – and a signal that biomedical engineering at UNSW had become a serious, externally trusted enterprise.

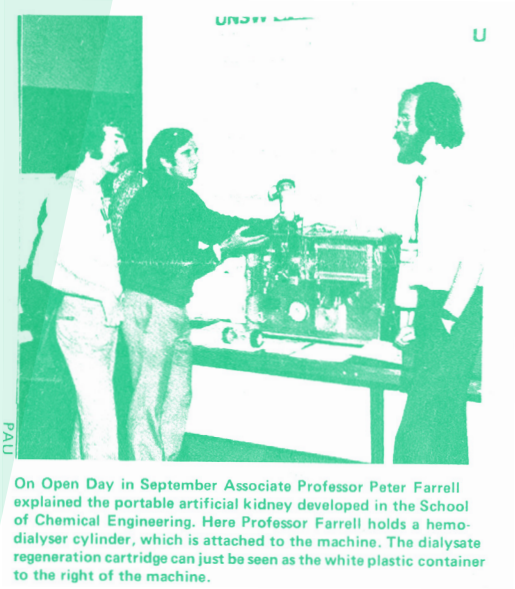
▲ Peter Farrell (right), photographed with colleague Graeme Chapman in the late 1970s.

UNIKEN

THE UNIVERSITY OF NEW SOUTH WALES

No. 19 of 1977 21 November - 4 December

NEW KIDNEY



On Open Day in September Associate Professor Peter Farrell explained the portable artificial kidney developed in the School of Chemical Engineering. Here Professor Farrell holds a hemo-dialyser cylinder, which is attached to the machine. The dialysate regeneration cartridge can just be seen as the white plastic container to the right of the machine.

◀ Improvements to dialysis technologies were a focus in the Centre's early years.

Artificial organs and a new way to think about dialysis

The artificial organs research team led by **Peter Farrell** featured a number of young researchers who would go on to shape the future of what would become the School of Biomedical Engineering. These included **Klaus Schindhelm** and **Michael Skalsky** whose work on kidney dialysis attracted national media attention.

In October 1978, the *Courier Mail* reported that the Centre was pioneering a new, more personalised approach to dialysis that reduced blood loss, improved patient energy and cut treatment time.

"Doctors have been putting every patient on the same treatment for the same amount of time," Farrell explained. "Keeping patients alive was thought to be the most important thing. But how a patient feels from day to day is just as important."

It was an early sign that UNSW's biomedical engineers were not only building devices, but helping rethink what patient-centred care might look like.

Ten minutes that changed a career

In 1977, as a third-year mechanical engineering student at the University of Queensland, **Anne Simmons** heard about a new field of study emerging at UNSW, and the charismatic figure leading it. Curious, she travelled to Sydney to ask **Peter Farrell** a simple question: why should she study biomedical engineering?

"Peter was amazing – charismatic, smart, quick, funny, incredibly well connected… vision, strategy, everything that you could ever want."

– Anne Simmons

"He just won me over, in ten minutes," she recalls. "Peter was amazing – charismatic, smart, quick, funny, incredibly well connected… vision, strategy, everything that you could ever want. He was just so connected to everything that was going on in the area around the world."

Anne moved to Sydney the following year and joined the second MBiomedE cohort in 1979 – one of many students whose trajectories were redirected by a conversation in Farrell's office.

1980–1989: Explorers and expanders



◀ Chris Bertram, photographed in 1983 with a device designed to detect blood clots.

The decade that opened every door

BY THE EARLY 1980s, the Centre for Biomedical Engineering had survived its experimental beginnings and was suddenly facing the very thing it had spent a decade preparing for: growth. The first cohorts of master's students were graduating. Alumni were returning with new skills and global experience. Clinical partners, now more familiar with the Centre's capabilities, were bringing forward a wider range of problems to solve. And a new generation of staff arrived with fresh expertise in blood compatibility, materials science, cardiovascular modelling and physiological signals.

Beyond campus, the landscape was changing just as quickly. Medical-device companies were expanding, biomaterials research was gaining international attention, and digital technologies were edging further into clinical care. Universities were being asked to demonstrate impact; industry was seeking research partners; and government was being challenged to start talking about technology industries as part of Australia's economic future.

The Centre sat at the crossroads of these pressures and possibilities. More space, more students, more collaborations – and more questions about how a young discipline should relate to industry, to clinicians, and to its own expanding ambitions.

By 1989, biomedical engineering at UNSW looked very different from the small collective imagined in the early 1970s. It was broader, busier, more visible, and ready for the transformations the next decade would demand.

More space, more students, more scrutiny

The early 1980s marked the Centre's first real test of scale. The foundational work of the 1970s – securing recognition, establishing a degree, building clinical partnerships – had given UNSW a foothold in a field that was still defining

1980
Woo Lim Ang and **Anne Simmons** become the first graduates of the MBiomedE. **Klaus Schindhelm** returns to work as a Lecturer after post-doctoral studies in Germany.

1981
Bruce Milthorpe arrives at the Centre as a Senior Research Officer. At the Nucleus group of companies, the first employees are assigned to the 'Cochlear Project'.

February 1981
The Centre moves into dedicated administrative offices on Botany Street, Randwick. PhD candidates include **Peter Spencer**, **Brett Charleton**, **Phil Hone** and **Chris Roberts**. **Wal Flicker** joins as Manager of the Centre after completing his Master of Biomedical Engineering.

December 1981
Research laboratories relocate to the basement of the Wallace Wurth Medical Building.



▲ Bruce Milthorpe testing the mechanical properties of heated bovine pericardium in 1982.

itself. Now the challenge was different: how to grow, diversify and professionalise an emerging discipline while maintaining the collaborative spirit that had allowed it to exist in the first place.

The era was marked by people power. Within the first few years of the new decade, the Centre saw the return of several early UNSW-trained engineers who had completed postgraduate or post-doctoral work elsewhere, including **Klaus Schindhelm**. Alongside them came new and returning academic and professional staff – some from other UNSW faculties, others from outside the University – including **Chris Bertram**, **Wal Flicker**, **Bruce Milthorpe**, **Ross Odell** and **Laura Poole-Warren**. Their arrival shifted the balance of expertise: the Centre now had critical mass in areas such as blood compatibility, physiological modelling, biomaterials and clinical instrumentation.

1982
Biomedical science graduate **Laura Poole-Warren** joins as Professional Officer, beginning work on blood-contacting materials and infection prevention. Centre staff including Milthorpe and PhD candidate **Greg Roger** begin studying kangaroo tendons for reconstructive knee surgery.

November 1982
NSW Minister for Health, **Laurie Brereton**, formally opens the Centre's new laboratory facilities.

1983
Funding and staffing reach record levels: the annual budget surpasses half a million dollars and staff numbers rise to seventeen. Industry sponsors include Enka, Gambro, Millipore, Organon Teknika, Terumo, Travenol Laboratories and Tuta Laboratories. Cochlear Ltd is founded as a subsidiary of Nucleus Ltd.

February 1983
As chair and spokesperson for an Australian Scientific Industry Association report, the Centre's Director **Peter Farrell** appears in national media advocating for stronger investment in high-technology industries.

"The Centre is unique in Australia with respect to its breadth of biomedical engineering activities."
– launch event program, 1982

These changes coincided with a solution – albeit imperfect – to the long-running frustration of space. In 1981, administrative offices moved into a modest building on Botany Street in Randwick. Later that year, laboratories were consolidated into the basement of the Wallace Wurth Building. Conditions were famously idiosyncratic. "Below street and sewer level," is how Milthorpe described it. But it offered a stability the Centre had not previously enjoyed. For the first time, academic, technical and clinical collaborators had a dedicated set of spaces to work from. On 8 November 1982, the new laboratories were officially opened by NSW Minister for Health **Laurie Brereton**. The event program described the Centre as "unique in Australia with respect to its breadth of biomedical engineering activities," listing work in biomechanics, orthopaedics and rehabilitation, medical instrumentation, artificial organs, cardiovascular dynamics and implant dentistry.

The graduation of the first MBiomedE cohort in 1980 added to the momentum, with alumni taking up roles in hospitals, computing, medical-device companies and research institutes. Interest in the program grew steadily and by 1988, the Centre had 98 postgraduate students, including 11 PhD candidates.

The research agenda broadens

Research programs grew more diverse, though always anchored in clinical need. Dialysis and artificial organs remained major threads, with teams refining membrane performance, investigating heparin pharmacokinetics and modelling cardiovascular responses. Clinical specialists including orthopaedic surgeon **Bernard Bloch** were important contributors to the research agenda, reflecting the founding principle that the potential for clinical application should guide the Centre's work.

March 1983
National media coverage highlights the clotting-monitoring device developed by Milthorpe and **Chris Bertram** – a significant contribution to patient-centred dialysis care.

1984
Farrell announces he will take a leave of absence to accept a senior role in Japan with global medical-device company Baxter Travenol. He publishes his essay 'Bureaucracy – that which turns energy into solid waste' in Engineering Australia, arguing for more outward-facing, action-oriented universities.

1985
Schindhelm becomes Acting Director while Farrell maintains links as Honorary Director. New South Wales introduces the Animal Research Act 1985, strengthening protections for animals used in research and reinforcing the culture of ethical and technical stewardship at the Centre for Biomedical Engineering. UNSW's **Margaret Rose** is instrumental in the development of the Act.

Two areas in particular began to take root. Biomaterials research expanded, with early projects examining the use of treated biological tissues in hernia repair and orthopaedic applications. Meanwhile, the foundations of physiological signal analysis – not yet a defined field – emerged through work on cardiovascular physiology pioneered by **Branko Celler** and his then PhD candidate, **Nigel Lovell**. These would prove pivotal in the decades that followed.

The opportunities and tensions of industry

Industry partnerships deepened as well, as portrayed in the 1982–83 Annual Report: "The Centre had an annual budget of over $500,000… one-third from outside bodies, predominantly medical device companies. As a result of close ties with manufacturers and clinicians, the Centre is able to very effectively bridge the gap between new product development and clinical use."

Yet this outward-facing model did not always sit comfortably within traditional academic structures. Biomedical engineering often fell between established funding systems – too applied for some science-driven grant schemes, yet not fully aligned with clinically oriented medical research frameworks. Strong industry collaboration and a focus on healthcare delivery gave the Centre unusual relevance, but did not always translate neatly into conventional academic recognition.

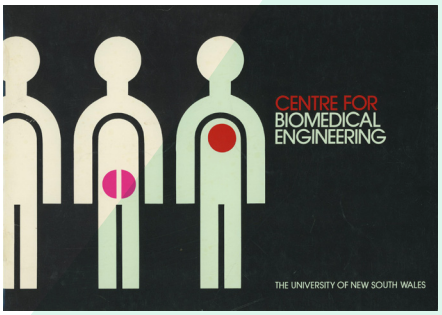
Peter Farrell, the Centre's Director and a visible public advocate for Australian high-technology industries, became increasingly outspoken in the media, urging universities to "look to the marketplace" and improve technology transfer. Some colleagues agreed. Others worried. The disagreement deepened when Farrell accepted a senior role with Baxter Travenol in Japan while remaining Honorary Director, and again when he later backed Baxter's proposed investment in a new building at UNSW, to be called the 'Baxter Centre for Medical Research'. Ultimately, the company withdrew from the arrangement, though funds already committed allowed completion of the Samuels Building, two floors of which would become the Centre's future home.

1986
Student numbers continue to rise as the MBiomedE gains national visibility.

1987
In his role with the Baxter Centre for Medical Research, Farrell invests in continuous positive airway pressure or CPAP technology for the treatment of sleep apnoea, and commences clinical trials.

1988
The Annual Report lists the Centre as operating within the Faculty of Engineering – reflecting its shift from experimental entity to established academic unit.

1989
Baxter decides not to proceed with CPAP technology, and Farrell resigns from UNSW to found CPAP developer, ResMed. **Wal Flicker** moves to the new startup as Chief Financial Officer.



▲ Promotional material for student recruitment in the early 1980s.



◀ Working on artificial kidney technology.
▼ State-of-the-art computing as it looked in the early 1980s.

1980–1989: Highlights

Growing fast: people, projects and budgets

The early 1980s transformed the Centre's scale. By 1980, staff numbers had reached 16, spanning engineers, clinicians, technical officers and research fellows. Student numbers rose even faster: from just a handful of master's candidates in 1978, to 98 postgraduate students just a decade later.

The budget told the same story. In 1979 the Centre operated on $224,000; by 1982–83 it exceeded $500,000, with roughly one-third coming from external partners. As the Annual Report noted, this mix of government grants, philanthropic support and industry investment "allowed staff to undertake research projects which contain a mix of academic, clinical and industrial significance" – a rare situation for an Australian university unit at the time.

A microcomputer in the clinic

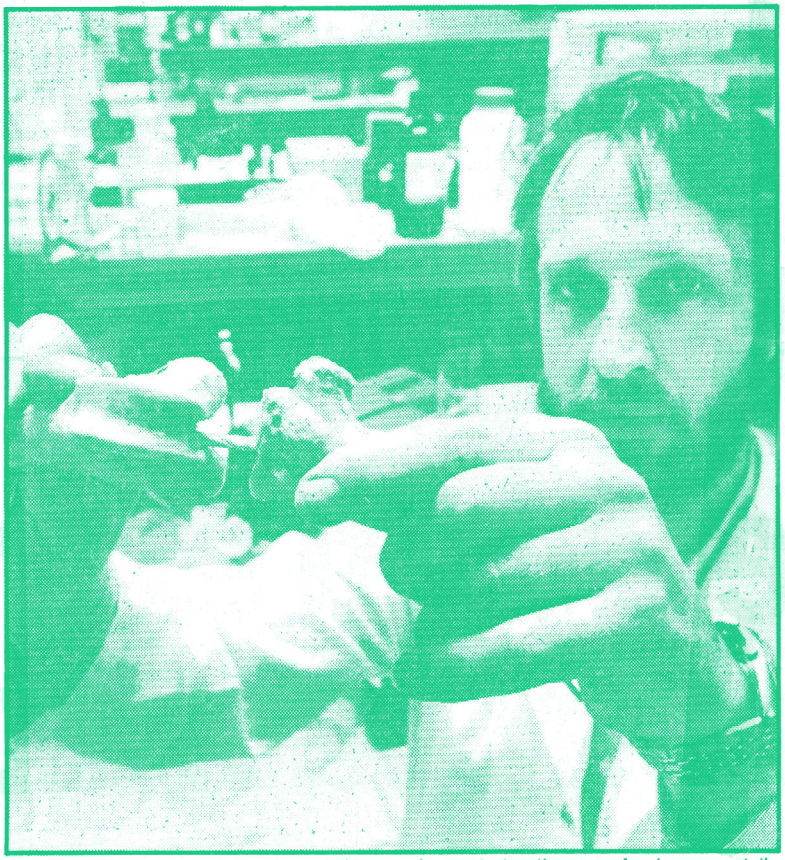
By the early 1980s, computing was edging its way into biomedical practice. While mainframes still handled heavy data analysis, UNSW researchers were experimenting with something more compact: the Tandy Radio Shack Model III microcomputer. Under a project titled 'Clinical Application of Microcomputers', staff wrote BASIC-language programs to support renal-disease management – scripts small enough to run on a desktop machine and fast enough to be useful during dialysis sessions. It was a modest project, but a revealing one. Long before 'digital health' entered the vocabulary, the Centre had begun exploring how software might sit alongside devices, instruments and biological materials. In hindsight, it reads like the first signs of the data-rich era that would transform biomedical engineering in the decades that followed.



▼ Research into the viability of using kangaroo tendons to replace damaged ligaments attracted media attention.
▶ As the 1980s progressed, capacity in biomaterials research expanded.



'Roo tails set knees hopping



Promising technique . . . Dr Bruce Milthorpe demonstrates the use of a kangaroo tail tendon to hold together a sheep's knee bone — Picture: COLIN MURTY

By MARK RAGG

SYDNEY researchers are studying a technique for use in knee operations that seems likely to have patients back on the hop in quick time.

They are investigating the possible use of kangaroo tail tendons for human ligaments in reconstructive knee surgery.

A leading researcher at the University of NSW, in Sydney, said yesterday there were potentially "40 human knees in each kangaroo tail".

The director of the Centre for Biomedical Engineering, Professor Peter Farrell, said many people were left incapacitated after skiing injuries, car accidents and contact sports, such as rugby union and rugby league, because of serious knee injuries.

"Many of these people never regain full use of their legs because ligaments are so slow to heal, and in some cases they never heal," he said.

"Surgery is the only way to get these knees moving properly again, but it has been difficult to find the right material to replace the damaged ligaments.

"The kangaroo tail, though, looks promising, as it is tough enough to withstand strains involved but a lot more flexible than the ox tendons the Americans have been using."

Professor Farrell said the tendon could be used in either of two ways — as a temporary scaffolding over which the body could rebuild its own ligament, or as a permanent ligament, which would require sophisticated chemical treatment before insertion.

The ligament, once prepared, would be inserted into holes drilled in the femur (thigh) and tibia (shin) and then stapled in place.

"The kangaroo tendons are almost ready — we are just having a few problems with the mechanics of the operation," Professor Farrell said.

"But we have surgeons in public hospitals ready to go, just waiting until the tendons become available."

Kangaroo tails and the leap into biomaterials

When groups in the USA began experimenting with bovine tendons as replacements for torn anterior cruciate ligaments (ACLs), the Centre's researchers were prompted to ask a local question: could kangaroo tail tendons work better?

The tendons were implanted into sheep at Prince Henry Hospital, and tested under cyclic loading – sometimes, as **Bruce Milthorpe** recalls, using a custom rig operating out of a former men's toilet cubicle in the Wallace Wurth basement. The tendons ultimately proved unsuitable, but the project opened the door to deeper work on polymers, bioceramics and treated biological tissues. It was an early sign that the Centre's ambitions now extended well beyond dialysis and instrumentation, into questions of biocompatibility and tissue behaviour.

“The great end of life is not knowledge but action”

In the mid-1980s, as the Centre’s industry links deepened and national debates about commercialisation grew louder, **Peter Farrell** stepped into the public conversation with a provocative essay in *Engineering Australia* titled “Bureaucracy – that which turns energy into solid waste.”

Quoting Victorian-era biologist Thomas Henry Huxley – “The great end of life is not knowledge but action” – Farrell argued that Australian universities needed to become more outward-looking and more willing to translate research into real-world impact.

“It is my belief that Australian universities are, by and large, too inflexible, unimaginative and uninnovative,” he wrote. When colleagues countered with lists of achievements and statistics, Farrell insisted they were answering the wrong question. “The real question boils down to a question of what is, and what could be.”

For supporters, it was a clear-eyed challenge to think bigger; for critics, it signalled a shift that felt too commercial. But the essay distilled a sentiment that ran throughout the decade: biomedical engineering at UNSW was looking beyond its walls, imagining possibilities not yet built – and urging the University to do the same.





From biofouling to dialysis

Marine science graduate **Laura Poole-Warren** first crossed paths with **Peter Farrell** while working at the UNSW squash club. Months later, after seeing her honours seminar on biofilm formation, Farrell made an unexpected connection: “We’ve got real problems with biofilm on medical devices,” he told her. “I’ve got a job coming up – are you interested?” Laura’s shift from ocean surfaces to implantable materials in continuous ambulatory peritoneal dialysis was emblematic of the Centre’s culture – a place where disciplinary borders were porous, and where fundamental science was quickly pulled toward clinical application.

◀ Peter Farrell takes media on a tour of the new laboratory space in the Wallace Wurth Building at the official opening in 1982.
▲ Laura Poole-Warren, third from right, in the UNSW team for the 1987 Intervarsity Squash Championships.

1990–1998: Strategists and system builders



▲ Brien Holden, Director of the Cooperative Research Centre for Eye Research and Technology, with children on the verandah of a local school in Umlazi in South Africa's Kwa-Zulu Province.

The Centre becomes a School

WHEN THE 1990S ARRIVED, UNSW's biomedical engineers were no longer inventing a discipline from scratch. They were carrying it forward into new buildings, new partnerships, new expectations and, increasingly, onto a national stage. The Centre had earned credibility, but it still lacked the form and footing required for the decades ahead.

The solution unfolded slowly. A move into the new Samuels Building gave the Centre its first true physical identity. Australia's emerging Cooperative Research Centre program drew researchers into large-scale, strategically aligned collaborations. And the transition from Centre to Graduate School created an institutional framework capable of supporting both teaching and research at the scale the field now demanded. These moves changed not only how biomedical engineering at UNSW was organised, but how it imagined its role in the health-technology landscape.

The 1990s were less dramatic than the decades that preceded them – but far more decisive. This was the era in which UNSW reconvened its people, its purpose and its ambitions, setting the stage for the School it would become.

A home, a structure and new national networks

By 1990, UNSW's Centre for Biomedical Engineering stood at an inflection point. The discipline it had helped pioneer was maturing across Australia, and competitors were beginning to emerge. The Centre had national visibility, strong clinical ties and a decade of research behind it, yet its growing responsibilities now called for an institutional shape that could carry biomedical engineering into the next era.

1990

Klaus Schindhelm is appointed Director of the Centre for Biomedical Engineering. A revised mission statement clarifies the Centre's purpose and its commitment to training professionals "at the interface of technology and health care." **Laura Poole-Warren** completes her PhD on infection in peritoneal dialysis.

1991

The Centre and the CSIRO secure funding under Australia's new Cooperative Research Centre (CRC) program for the CRC for Eye Research and Technology, building on earlier biomaterials collaborations. Founding figure **Peter Bason** retires.

The decade opened with new leadership. In January 1990, **Klaus Schindhelm** was appointed Director. One of his earliest acts was to articulate what had previously lived only in practice: a formal mission. Biomedical engineering, he wrote in the first Annual Report of the decade, existed "to enhance the quality and scope of health care," and required engineers, scientists and clinicians who could operate "at the interface of technology and health care." It was a concise expression of a broader truth – that the Centre represented a discipline with purpose and priorities.

Some of the groundwork for this next phase had been laid during the late 1980s through a major biomaterials collaboration with the CSIRO. Researchers including Schindhelm, **Bruce Milthorpe**, **Laura Poole-Warren** and **Arthur Brandwood** worked on the development of biostable polyurethanes in a partnership that helped establish biomaterials as one of the Centre's core strengths.

The CRC era begins

At the same time, the national research landscape was shifting. The Hawke-Keating Government had launched the Cooperative Research Centres (CRC) program – a model that required universities, clinicians and industry to collaborate on tightly defined, clinically driven problems. Building directly on biomaterials and clinical collaborations from the previous decade, the Centre became a crucial partner in two of the earliest CRCs: the CRC for Eye Research and Technology which later became the Vision CRC, and the CRC for Cardiac Technology.

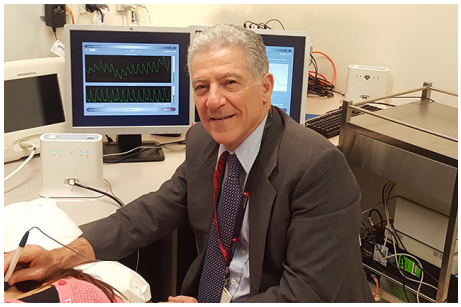
The CRCs did not simply expand the Centre's research portfolio; they redrew its expectations.

"It was all about making sure that, at the very minimum, researchers were talking with industry," recalls **John Whitelock**, who was then based at the CSIRO, and who subsequently joined UNSW. "The projects were a lot more driven to the clinic… decisions were made on a financial basis, not just an interest basis. That was important."

For **Nigel Lovell**, the experience was transformative: "It was my first opportunity to collaborate with clinicians,

1992

The Centre relocates to its new home on the top two floors of the Samuels Building, bringing staff and laboratories together for the first time. Schindhelm is appointed the Centre's first full professor. Cardiovascular-dynamics expert **Alberto Avolio** joins as Senior Lecturer. The Centre helps establish the College of Biomedical Engineers within the Institute of Engineers, with Schindhelm serving as its inaugural Chair. **Bruce Milthorpe** serves on the Biomaterials Subcommittee of the Federal Government's Therapeutic Devices Evaluation Committee. The Centre and the CSIRO secure a second grant for the CRC for Cardiac Technology.



▲ Alberto Avolio earned an international reputation for work in cardiovascular modelling, arterial mechanics, cardiovascular control, blood pressure measurement and biological signal processing.

and to understand the unmet need rather than just doing basic research. It helped me see a path to impact."

In 1992, after almost two decades scattered across basements and borrowed laboratories, the Centre moved into its new home: the top two floors of the Samuels Building. The Annual Report captured the significance with understated relief: "The new research building being erected on campus will allow the centralisation of offices and laboratories leading to more effective management of the Centre." Co-location mattered. It enabled teams, sharpened identity, and gave biomedical engineering a permanent address inside UNSW.

"It was all about making sure that, at the very minimum, researchers were talking with industry."

– John Whitelock

A new generation of clinician-engineers was also emerging at this time. Among them was **Robert Nordon**.

Nordon graduated as a doctor in the mid-80s and practised medicine for almost a decade before returning to UNSW to complete a PhD in biomedical engineering. Drawn increasingly towards technology development and translational research, he brought a distinctly clinical perspective, and a focus on how innovations might ultimately be used in patient care. In the coming decades he would help extend the School's reach into fields including cell and gene therapy translation, advanced manufacturing and emerging medical technologies.

From Centre to Graduate School

By the early 1990s, it was the view of University leadership that research centres should no longer enrol students directly. For biomedical engineering – whose teaching program was integral to its existence – this posed an existential threat.

"If we had stayed a Centre, we would have died," reflects Schindhelm. "We couldn't have employed lecturers, and we couldn't have serviced a master's degree. We would

1993
The master's program is submitted to Engineers Australia for accreditation. Accreditation indicates that graduates meet the international benchmarks for practice.

1994
The Centre becomes the Graduate School of Biomedical Engineering (GSBmE), with Schindhelm serving as inaugural Head of School. The concurrent Bachelor of Engineering / Master of Biomedical Engineering degree launches in partnership with the Schools of Electrical and Mechanical Engineering. Medical Informatics is added as a research stream. **Nigel Lovell** returns to UNSW after his tenure at UTS. **Robert Nordon** completes his PhD in biomedical engineering, beginning a long association with the School focused on cell therapies, translational manufacturing and emerging medical technologies.

1995
Computer Engineering joins the concurrent degree, expanding the program's technical breadth. Cochlear Ltd is listed on the Australian Stock Exchange. Poole-Warren joins the academic staff of the Graduate School.

have died, and that would have been the end of biomedical engineering as a potential discipline within UNSW."

The solution was to transform the Centre into the Graduate School of Biomedical Engineering and establish a concurrent Bachelor of Engineering / Master of Biomedical Engineering degree. Developed under Schindhelm's leadership, the concurrent degree was launched in 1994 with Electrical and Mechanical Engineering as partners. It gave school-leavers a direct pathway into biomedical engineering, met Commonwealth funding requirements and protected the program's academic autonomy.

"That transition from Centre to Graduate School was a seminal event," says Laura Poole-Warren.

New capabilities and national influence

Alongside these structural changes, new technical capabilities were also emerging. Researchers including **Socrates Dokos** were expanding the use of computational modelling, applying mathematical simulations to complex physiological systems and laying the foundations of future work in neural engineering, biomechanics and medical device design.

Computer Engineering joined the program in 1995; Chemical Engineering followed in 1998. As Schindhelm notes, the quality of students was striking.

"We soon discovered that the level of students we had was incredibly high. They learned how to handle ambiguity a little bit better, and that made them pretty good graduates in an engineering sense."

During this period, senior figures took on broader national roles including Bruce Milthorpe's service on the Federal Government's Therapeutic Devices Evaluation Committee, and Schindhelm's leadership of the newly formed College of Biomedical Engineers within Engineers Australia. These appointments reflected the School's widening influence – biomedical engineering at UNSW was no longer peripheral, but central to national conversations about devices, clinical safety and future health technologies.

1996

Socrates Dokos completes his PhD in biomedical engineering, developing mathematical models of cardiac electrical activity and building computational modelling as an emerging strength within the School.

1998

Chemical Engineering becomes a partner in the concurrent degree, with a young **Megan Lord** among the first cohort of 15. Schindhelm takes a three-year leave of absence from the Graduate School to join **Peter Farrell** at ResMed, while maintaining a one-day-a-week professorial appointment at UNSW.



▲ Megan Lord, one of the first students in the concurrent degree, with Bruce Milthorpe, who began his tenure as Head in 1999.

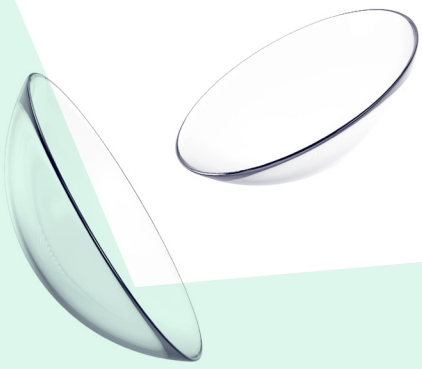
1990–1998: Highlights

The Vision CRC: collaboration by competition

The CRC for Eye Research and Technology, established in 1991 and later continuing as the Vision CRC until 2015, is recognised as one of Australia's longest-running and most commercially successful Cooperative Research Centres (CRCs).

Led by UNSW's **Brien Holden**, the CRC brought researchers from biomedical engineering and optometry together with the CSIRO and industry. It was an unusual model of collaboration: partners were encouraged to compete against each other in a race to develop a breakthrough oxygen-permeable soft contact lens, while regularly sharing their data and insights. **Klaus Schindhelm** acted as a major point of connection between UNSW and the CRC's national and international collaborators, later serving as Chairman of the Vision CRC from 2005 to 2014.

The CRC's work led to the world-first development of silicone hydrogel contact lenses while also generating a substantial stream of income from royalties. It was a clear demonstration of how university research could achieve both clinical impact and long-term commercial success.




UNIKEN, 21 February 1992-3

The Premier, Mr Greiner, about to part with a cheque to Professor Brien Holden accepting it on behalf of the Cooperative Research Centre for Eye Research and Technology.

Promised wealth via one billion pairs of eyes

▲ Brien Holden accepts a cheque from NSW Premier Nick Greiner – part of a multi-million dollar commitment to the CRC for Eye Research and Technology.

Early spark of the bionic eye

The first hint of UNSW's future role in bionic vision appeared in 1997, when PhD candidate **Gregg Suaning**, supervised by **Nigel Lovell**, began early experiments in retinal stimulation. Their early prototype – implanted not in a person, but in a sheep – recorded electrical responses from the retina to the brain, proving that stimulation could produce meaningful signals.

It was only the beginning. The team soon realised they had underestimated biology – tissue reactions, electrode interfaces and surgical complexity demanded a complete redesign, but the progress was real. The national Bionic Eye Initiative was founded on these first principles, launching a decade later with $50 million in funding.

16 May 1997

Heart Foundation makes awards to medical researchers from UNSW



Heart Foundation Research Award winners (left to right): Dr Helge Rasmussen, Dr Philip Hogg, Professor Eugenie Lumbers, Dr Judy Burrell, Dr Wendy Jessup, Dr Karen Gibson, Professor Klaus Schindhelm, Dr Natalie James and Dr David Zhang.

CRC for Cardiac Technology: preventing re-blockage

The Centre's second CRC partnership built directly on earlier biomaterials collaborations between UNSW and the CSIRO, bringing clinicians, scientists and researchers together to tackle a clinically urgent problem: preventing tissue regrowth inside cardiac stents.

Polyurethanes developed at the CSIRO underwent biological evaluation at UNSW with a team that included **Arthur Brandwood**, **Laura Poole-Warren**, **Bruce Milthorpe** and **Klaus Schindhelm**. The biostability of the materials was tested in sheep, a practice that became routine at the School – so much so that the labs often carried the smell of the farmyard, according to **Megan Lord**, a student at the time. The relationship formed between the UNSW researchers and CSIRO collaborators **John Whitelock** and **Clive McFarland** would later see both take up roles at UNSW.

Ultimately, the CRC was responsible for a family of biostable, biocompatible polyurethanes commercialised under the name Elast-Eon®. At UNSW, the initiative represented a shift from clinical collaboration to participation in a national, coordinated program of device development – a scale and structure that would shape the School's trajectory for years to come.



A School inside the Samuels Building

When Baxter Travenol rescinded its decision to establish a research centre on Kensington campus, it nonetheless honoured its financial commitment, and handed over to the University the architectural plans for what would become the Samuels Building. Two floors were designated for biomedical engineering – but not without resistance.

"We had to fight hard to maintain our presence in that building," recalls **Klaus Schindhelm**.

The struggle was worth it. For the first time, biomedical engineering had a visible home – a sign that the discipline was here to stay.

▲ In 1992, the Centre settled into the Samuels Building, bringing staff and laboratories together for the first time.

◀ In 1997, Schindhelm and colleagues received an award from the Heart Foundation for their work in designing a 3-dimensional cellular model of the artery.

"Biomedical engineering has representation across so many different areas, and I think you'll see more researchers at the interfaces of those areas. That's where we need to be."

– Jonathan Yeow

1999–2010: Coaches and catalysts



▲ Guests at the 2010 Faculty of Engineering Golden Jubilee Luncheon included Anne Simmons (second from right) who was then Head of the Graduate School of Biomedical Engineering.

Lifting performance across the board

BIOMEDICAL ENGINEERING AT UNSW was entering a confident new phase as it moved into the 2000s. The Graduate School was established, the concurrent degree was drawing students from an increasingly diverse range of engineering disciplines, and a widening community of researchers was beginning to work at genuine scale.

Under the steady consolidation of **Bruce Milthorpe**, and later the sharply focused leadership of **Anne Simmons**, the School expanded in both reach and ambition. New disciplines flowed into biomedical engineering – from materials science and computing to bioinformatics and software – reshaping classrooms, research teams and the School's sense of itself.

It was a period characterised by confidence. From world-first contact lenses to the early steps toward a bionic eye, from national conferences to bold conversations about biomedical precincts, the School was increasingly helping to shape the health-technology agenda.

It was also a time of cultural change. Women, long part of the biomedical engineering story, were now rising into influential leadership roles. Technical staff, the often unseen enablers of research quality and momentum, were becoming more professionalised and more visible. And students encountered a discipline that felt connected, collaborative and unapologetically outward-facing.

The instigators of this era did not reinvent biomedical engineering at UNSW. They made it work – strengthening its foundations, broadening its networks, and turning a thriving School into a platform for sustained impact.

Raising standards, extending reach

By the late 1990s, biomedical engineering at UNSW had moved beyond the struggle for survival. The transition from Centre to Graduate School had secured institutional

1999

Bruce Milthorpe begins the year as the new Head of School at the Graduate School of Biomedical Engineering. **Anne Simmons**, one of the first two graduates of the School, returns to UNSW after almost two decades working in industry with Nucleus Ltd. Meanwhile, **Laura Poole-Warren** exits to a medical device startup company in the US.

April 1999

The Focus Night & Day contact lens – developed through the CRC for Eye Research and Technology in partnership with CIBAVision – is launched. The lenses become available to Australian consumers from May.

2001

Telecommunications and Mechatronics join the concurrent Bachelor of Engineering / Master of Biomedical Engineering degree, expanding the program's technical breadth.



▲ Socrates Dokos brought new strengths in computational modelling to the Graduate School.

support, but a different challenge now came into view: how to build a School with the scale, coherence and credibility required for a field expanding rapidly in scope and ambition.

Milthorpe, appointed Head of School in 1998, inherited a Graduate School that was stable but still evolving. His task was not reinvention, but consolidation – strengthening the concurrent degree, broadening research capability, and ensuring biomedical engineering could accommodate the widening range of engineering disciplines beginning to engage with health. As Milthorpe later reflected, biomedical engineering was "expanding worldwide to cover not just mechanical and electrical engineering, but chemical and information technology… almost any sort of engineering you could think of." The School's challenge was to keep pace without losing coherence.

The concurrent Bachelor of Engineering / Master of Biomedical Engineering, introduced under **Klaus Schindhelm**, became central to that effort. By the mid-2000s, it had expanded beyond the Faculty of Engineering

2002

Materials Science joins the concurrent degree, marking the first cross-faculty integration, with students studying across Engineering and the Faculty of Science. **Laura Poole-Warren** returns as a full-time academic staff member. **Klaus Schindhelm** joins the Therapeutic Goods Committee of the Therapeutic Goods Administration.

July 2003

Nigel Lovell co-chairs the triennial World Congress on Medical Physics and Biomedical Engineering, co-sponsored by the Graduate School and UNSW. UNSW also hosts TechTrain 2003, the national conference for technical and scientific professionals across Australia and New Zealand. Graduate School professional staff **Lynn Ferris**, **Veronika Tatarinoff** and **Kate Noble** spearhead the planning and delivery of the event, expanding its scale and setting a new benchmark for professionalism.

to include students from the Faculty of Science, while also broadening its engineering base to encompass electrical, mechanical, chemical, computer, mechatronic, bioinformatics and software engineering.

The School's teaching culture was also evolving. Long-time academic **Ross Odell** became a central figure in the education program, helping shape the expanding dual-degree structure and earning a reputation among students for his commitment to teaching. Odell led the biomedical engineering stream of the Faculty's common first-year design course, in which students designed and built functional prosthetic hands. The subject marked a broader shift within the curriculum, from a heavily theoretical program towards one that increasingly integrated hands-on design, teamwork and real-world problem-solving.

The School's growing international standing was reflected in the appointment of internationally recognised biomaterials scientist **David Williams** as Visiting Professor from 2008 to 2013. Then Editor-in-Chief of the journal *Biomaterials* and author of the influential textbook *Essential Biomaterials Science*, Williams taught biomaterials courses within the Graduate School, giving students access to one of the field's leading figures.

Research activity broadened, too. Annual reports from this period describe a School working across tissue engineering, biomaterials, cardiovascular dynamics, signal analysis and clinical instrumentation, often in partnership with clinicians and industry collaborators. Work on bioreactors, degradable scaffolds, blood purification systems and endothelial cell biology reflected an institution increasingly comfortable operating across laboratories, clinical environments and commercial settings.

Partnerships with impact

This outward-facing posture was reinforced through large-scale collaborations. The Cooperative Research Centres (CRCs) launched in the 1990s – particularly the CRC for Eye Research and Technology, which ultimately ran until 2015 as the Vision CRC – demonstrated how biomedical engineering could operate as a full partner with industry.

2004
Bioinformatics and Software Engineering join the concurrent degree. **John Whitelock** and **Clive McFarland**, both long-time collaborators through the CRC for Cardiac Technology and earlier UNSW–CSIRO biomaterials partnerships, join UNSW.

January 2004
Inaugural Director, **Peter Farrell**, is honoured as a Member of the Order of Australia "for service to biomedical research and engineering through the invention and development of therapeutic appliances, to business as an entrepreneur and to the community through philanthropy".

May 2004
The Graduate School hosts the World Congress of Biomaterials. **Rolfe Howlett** is Chair, with **McFarland** and **Arthur Brandwood** serving as deputy chairs, and **Laura Poole-Warren** and **Bruce Milthorpe** on the local organising committee.

2005
Building work commences on upgrades to the animal research facilities.

The 1999 launch of the Focus Night & Day contact lens, developed through the CRC alliance with CIBAVision, marked a strategic milestone: Australian researchers holding equity in a global product, and a university contributing not just ideas, but sustained value. As CRC Director **Brien Holden** observed at the time, the model showed how research centres could move beyond "cap-in-hand" funding and into genuine partnership. Over time, the CRC generated substantial international royalties and became one of the country's most commercially successful CRC programs.

The same period saw new interest in implantable technologies. In 2008, the Graduate School established the Centre for Implantable Bionics – a dedicated facility bringing together laboratories, fabrication space and industry-facing infrastructure to support work on vision, hearing, cardiac and neural devices. That same year, the incoming Rudd Government's 2020 Summit identified the bionic eye as a key national health priority. Graduate School researchers **Nigel Lovell** and **Gregg Suaning**, then working within the UNSW Australian Vision Prosthesis Group, were quick to convene a national network of collaborators into what became the Australian Bionic Eye project – an effort they would pursue with determination in the decade that followed.

A new generation of leaders

These years also reshaped the School's internal culture. A generation of women rose into prominent academic and leadership roles, contributing to a working environment frequently recalled as unusually collaborative and supportive. **Anne Simmons** – one of the first two graduates of the Master of Biomedical Engineering in 1980, and later a senior figure in the Nucleus Group of companies founded by Paul M. Trainor – had returned to UNSW, sharing hard-won regulatory and industry knowledge with students in the concurrent degree. **Penny Martens**' faculty-wide reform of undergraduate thesis processes quietly extended the School's influence beyond its own cohort. **Laura Poole-Warren**'s leadership in biomaterials and

2006
Milthorpe is appointed Deputy President (Academic) of UNSW Asia. **Anne Simmons** starts as Head of the Graduate School of Biomedical Engineering. The Graduate School honours the passing of **Paul M. Trainor**, founder of the Nucleus group of companies and a long-time champion of biomedical engineering in Australia.

2007
The UNSW Annual Report cites the School's development of polymer films that seal surgical wounds – potentially eliminating sutures in brain and nerve surgery – as one of the "research breakthroughs" of the year.

2008
Internationally renowned biomaterials scientist **David Williams** joins as a Visiting Professor. Editor-in-Chief of the journal *Biomaterials* and author of the textbook *Essential Biomaterials Science*, Williams teaches biomaterials courses and strengthens the School's international profile. The Centre for Implantable Bionics is established within the Graduate School, supported by University, government, industry and philanthropic funding.

international collaboration helped anchor the School's research reputation.

Emerging researchers such as **Lauren Kark** and **Rylie Green** encountered biomedical engineering as a discipline where industry engagement was not theoretical, but embedded in coursework, guest lectures and everyday conversation.

"The guest lectures that were given by people from Cochlear and ResMed and real biomed companies, talking about the devices they'd made and why they made them and what they do – that's what I remember," says Green now. "It was that integration with industry and the fact that you can see how things are translated very directly – I found that fascinating."

The School comes of age

In 2006, Simmons was appointed Head of School, bringing decades of industry experience and a focus on performance. Her aim, she later reflected, was to recapture the energy of the School's early decades – growing teaching and research, strengthening collaborations, and expanding the School's presence both within the University and beyond it. Under her leadership, budgets were professionalised, financial sustainability became explicit, and expectations sharpened around delivery and impact.

By the end of the decade, biomedical engineering looked markedly different from the small, improvisational Centre of the 1970s. It was larger, more interconnected and more confident in its role within the health-technology landscape. Just as importantly, it had become a place where ideas moved between disciplines, between institutions, and increasingly between laboratory and life.

The instigators of this era did not define the final form of biomedical engineering at UNSW. But they created the conditions in which it could connect, accelerate and endure.

April 2008
At the national 2020 Summit in Canberra, the bionic eye is identified as a key health priority for Australia.

2009
The government awards $50 million to the Bionic Vision Australia consortium, with the UNSW team led by Lovell and **Gregg Suaning**. **Penny Martens** wins a NSW Young Tall Poppy Science Award for her work on polymers designed to replace damaged body parts.

January 2009
UNSW hosts the Third Indo-Australian Conference on Biomaterials, Implants, Tissue Engineering & Regenerative Medicine, with Poole-Warren as Australian Co-Chair.

2010
Megan Lord receives an Australian Research Council (ARC) Australian Postdoctoral Fellowship, working with industry partner HemCon to develop the hemostatic bandages now used by the US army. The TeleMedCare Health Monitor developed by **Branko Celler** and Lovell and commercialised through the early UNSW spinout TeleMedCare, receives an Australian International Design Award.



◀ The Randwick Health & Innovation Precinct, linking the University with Prince of Wales and Prince Henry Hospitals, was first discussed in 2001.

1999–2010: Highlights

The art of academic infrastructure

With the concurrent degree up and running, biomedical engineering students began to notice that their undergraduate thesis experience looked very different from that of their peers in other schools. Expectations, supervision and assessment varied widely across the Faculty of Engineering.

Working closely with students and colleagues, **Penny Martens** realised that this was more than a local irritation; it was a structural problem. Drawing on her connections across chemical, mechanical and other engineering schools, she convened a faculty-wide working group to redesign the undergraduate thesis experience.

The result was a common set of rules, guidelines and expectations for all engineering theses – a framework that brought much-needed consistency and clarity. What began as a question from a handful of biomed students became a quiet reform affecting the entire Faculty, and an early example of the Graduate School's influence.

Dreaming of a BioHub

In 2001, UNSW began talks with the NSW Government on an ambitious idea: a Sydney BioHub centred on the Randwick campus, linking the University with Prince of Wales and Prince Henry Hospitals, research institutes and industry partners.

The proposal imagined a biomedical precinct where researchers could move ideas from laboratory to clinic to industry, supported by shared infrastructure. For the Graduate School – long accustomed to working across medicine, engineering and industry – the concept felt like a natural extension of its existing operations.

While the BioHub did not materialise in exactly this form, the conversations helped shape what is now the Randwick Health and Innovation Precinct – home to major clinical, research and translation initiatives, including the Tyree Foundation Institute of Health Engineering.

What began as blue-sky thinking ultimately linked biomedical engineering into the physical and strategic future of the University.

Technical staff raising the bar

As the Graduate School expanded, so too did the role of its technical and scientific staff – and by the early 2000s, a professional transformation was under way.

Inspired by a national technical staff retreat hosted by the University of Technology Sydney (UTS) in 1999, UNSW staff including **Lynn Ferris**, **Veronika Tatarinoff** and **Kate Noble** began re-imagining what technical leadership could look like inside their own workplace. With mentoring from UNSW staff development leader **Adrianne Harris**, they developed skills in governance, advocacy and strategic planning.

In a discipline as inherently interdisciplinary as biomedical engineering, the Graduate School's technical team was well placed to strengthen connections across research groups and specialisations. Their involvement in the launch of TechNet, a development network for technical staff, helped formalise those connections at scale, and foster a national community of practice.

In July 2003, that momentum culminated in TechTrain 2003, the TechNet national conference hosted at UNSW with strong support from then Deputy Vice-Chancellor, **Mark Wainwright**. Determined to set a new standard, the TechNet UNSW committee, with Ferris, Tatarinoff and Noble at the helm, staged the event in the new Scientia Building, complete with awards, multiple study streams and professional presentation.

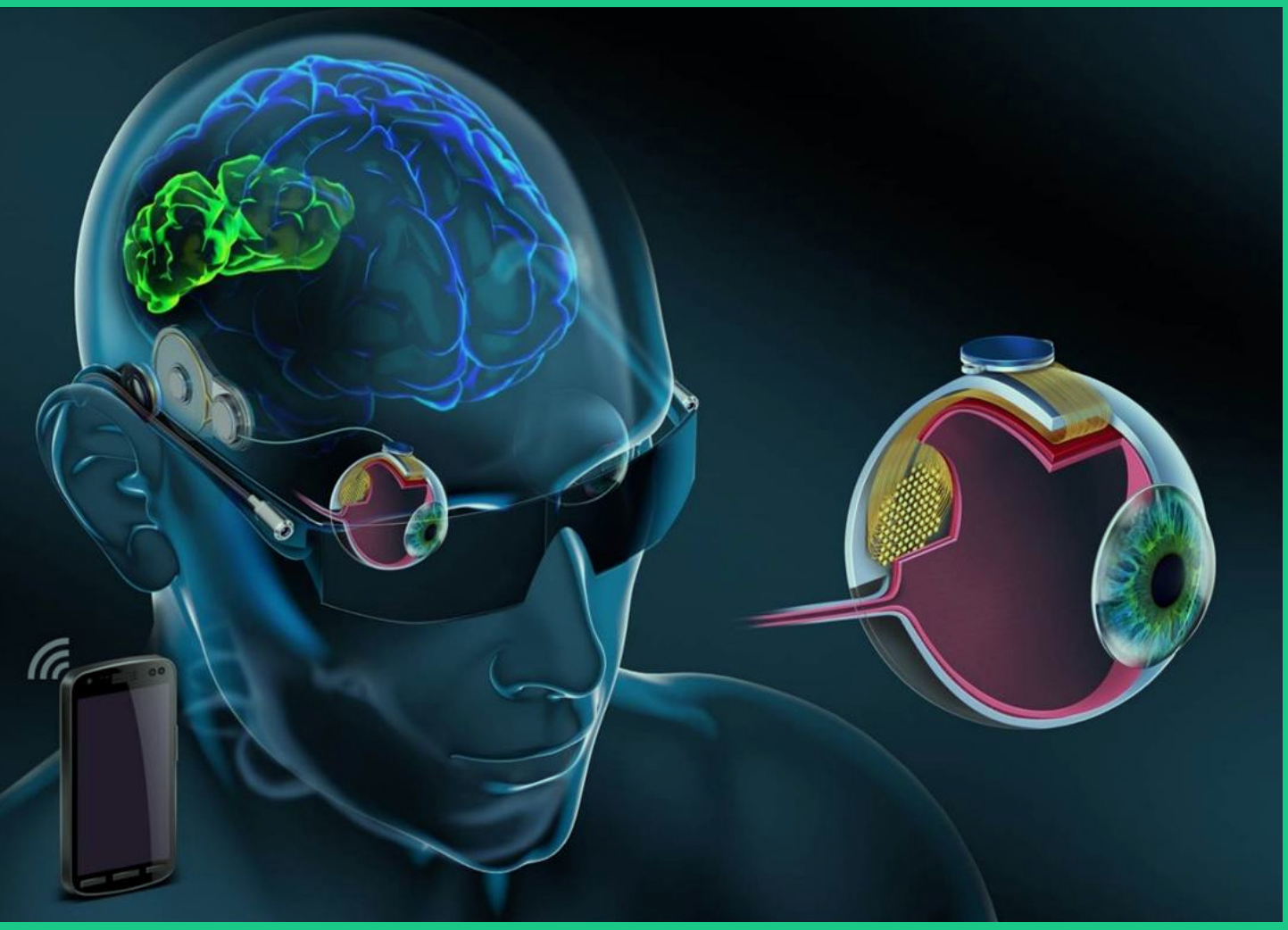
"By mimicking the style of an academic conference, we elevated the role of technical support into this whole new realm of professionalism," recalls Ferris now. "We said: tech staff are vital, and this is what we can achieve when we work together."

Covering areas from medical science and nursing to occupational health, management and advanced techniques, the conference elevated not just UNSW's profile, but the standing of technical staff nationally – underlining the essential role these professionals play in the quality, efficiency and ambition of biomedical research.



▼ The School's technical team, photographed in 2025: (left to right) Lynn Ferris, Stephen O'Brien, Marija Kordanovski, Ayad Anwer, Tresne Chesher.

2011–2019: Stewards and strivers



▲ An artist's representation of the bionic eye – an implantable device designed to restore vision to people with retinal degeneration.

Holding ambition in balance

AS THE NEW DECADE BEGAN, the Graduate School was larger, more complex and more visible than it had ever been before, with students, staff and collaborators working across an expanding set of disciplines and ambitions.

The question was no longer whether it could make a difference, but how large, how responsibly, and how far that difference might reach.

Flagship projects with national attention sat alongside work in teaching, organisational culture and emerging research areas. Student demand surged, gender diversity became increasingly normalised, and new forms of engagement, from global health placements to assistive technologies, began to influence how biomedical engineering understood its role in the world.

Taken together, these years marked a phase of momentum and maturity as the Graduate School learned how to manage complexity and purpose – just before circumstances would force it to do so under far more challenging conditions.

Growth shaped by values

When **Anne Simmons** handed over the Graduate School in October 2011, she left it in rare shape for an academic unit: not just energetic and outward-facing, but financially disciplined. **John Whitelock** stepped into the role with a strong platform for growth – and an expectation that the momentum would continue.

"Anne was a great leader, and a great mentor," he recalls. "She was really good at the financial side of things and she certainly honed my skills in financial management."

For Whitelock, this firm footing meant the School could take on ambitious work while keeping budgets under control – and there was perhaps nothing more ambitious than the national Bionic Vision Australia program. In

April 2011
Gregg Suaning, a project leader in the Bionic Vision Australia (BVA) consortium, unveils a 98-channel microchip expected to power Australia's first bionic eye – a major step towards a functional retinal implant.

October 2011
Anne Simmons concludes her term as Head of the Graduate School, and is replaced by **John Whitelock**.

2012
Stephen Redmond wins a NSW Young Tall Poppy Science Award for his work on wearable monitoring technologies to assess falls risk in older adults, enabling remote, home-based clinical assessment.

January 2013
Simmons, now Head of the School of Mechanical and Manufacturing Engineering, is appointed a Member of the Order of Australia (AM) for significant service to biomedical engineering as an academic and administrator.

2011 the School was home to the kind of milestone that makes a moonshot feel suddenly close: **Gregg Suaning** unveiling a tiny microchip expected to power Australia's first bionic eye – "mind boggling," as he put it at the time.

But Whitelock understood the double-edge of a flagship. The bionic eye budget, he notes, "was as big as the budget for the whole School – it dwarfed the other research projects." The risk was obvious. "You could easily have become the Department of the Bionic Eye," he says. The mission he defined for himself was to keep the bionic eye program moving and accountable – while making sure the rest of the School continued to grow alongside it.

That balancing act shaped the decade. On one side were projects with national scale and public visibility. On the other were the steady, often less visible strands that make a School resilient: early-career researchers finding their footing; teaching evolving; new capabilities forming around biosensing, rehabilitation, biomaterials and remote monitoring. Recognition followed. **Stephen Redmond** received a NSW Young Tall Poppy Science Award in 2012 for work on wearable monitoring; **Megan Lord** followed in 2014 for biomaterials research aimed at improving how implantable devices integrate with the body; and in 2018 **Jelena Rnjak-Kovacina** received the award for biomaterials designed to help repair or regenerate damaged heart tissue.

More women, more role models

By 2014, those snowballing successes were showing up in the student pipeline. Whitelock described an almost unheard-of spike in first-preference applications – close to 40% up on the previous year – and a sharp rise in the number of women applying for the concurrent degree. Inside the School and across the Faculty, staff worked deliberately to make that momentum stick. Initiatives to support women in engineering had been building for some time, including the UNSW Women in Engineering program and associated outreach activities such as the Women in Engineering Camp, which introduced high school girls to the discipline. Lord led these efforts, helping to build communities and support networks within the Faculty.

2013

Megan Lord receives the Maria Skyllas-Kazacos Young Professional Award for Outstanding Achievement. **Melissa Knothe Tate** joins UNSW as the inaugural Paul M. Trainor Chair in Biomedical Engineering.

March 2014

First-preference applications to biomedical engineering at UNSW jump by almost 40% compared with the previous year – a surge Whitelock describes as unprecedented.

2014

Lauren Kark establishes the UNSW chapter of the not-for-profit organisation Engineering World Health, and launches the Summer Institute, enabling students to work alongside local clinical staff in low-resource settings. Lord is awarded a NSW Young Tall Poppy Science Award for her work in biomaterials and medical devices.

2015

Nigel Lovell is named one of Engineers Australia's Top 100 Most Influential Engineers.



▲ John Whitelock (right) was Head of the Graduate School between 2011 and 2017.

Over time, programs like these contributed to a broader shift in participation, with the proportion of women entering engineering rising from a longstanding 20% up to 28% by 2026. Alongside this, the School's growing cohort of female academics made leadership feel visible and attainable.

Whitelock was proud, too, of what was happening within the staff profile: "When you looked at the numbers across the whole school, we were actually fifty-fifty female. I think what that does, is it helps maintain those levels because the young students then see their mentors, the senior women, and they think, 'Well, that's what I'd like to do.'"

Engineering with purpose

That same period saw the School begin to see itself not just as a force for innovation, but as a force for good. **Lauren Kark** – already building a reputation in rehabilitation engineering and biomechanics – began assembling new ways for students to connect their technical training with the uneven realities of healthcare delivery around the world.

In 2014, she launched the UNSW chapter of the not-for-profit Engineering World Health, followed soon after by the School's first Summer Institute placements, a program that embedded students in frontline clinical settings in Cambodia and Uganda. Her logic was straightforward: many students were drawn to biomedical engineering because they wanted to make a difference, so it was essential to make that difference visible – and achievable – during their studies.

2016
Lord joins the Standards Australia Committee for the Biological and Clinical Evaluation of Medical Devices and works on the global standard for medical devices, the ISO10-993. **Alex Patton** and **Jelena Rnjak-Kovacina** receive NSW Fresh Science Awards. Rnjak-Kovacina also receives a Heart Foundation Future Leadership Fellowship.

January 2017
Lovell is appointed Acting Head of the Graduate School.

2017
Lovell is named President of the Institute of Electrical and Electronics Engineers (IEEE) Engineering in Medicine and Biology Society (EMBS). Kark receives an Australian Award for University Teaching for promoting global citizenship through international and community-engaged engineering education.

January 2018
Ewa Goldys joins the Graduate School through UNSW's Strategic Hires and Retention Pathways (SHARP) program, bringing internationally recognised leadership in biophotonics, biosensing and translational diagnostics.

The work was practical: repairing equipment, supporting local technicians, keeping hospitals running. But it also carried a deeper lesson in design: technologies only matter when they fit the context they're meant to serve.

In early 2017 the School's leadership baton was passed on again as Whitelock took up the Leverhulme Trust Visiting Professorship at the University of Nottingham, and **Nigel Lovell** stepped in as Acting Head of School. That same year, Kark received a national Citation for Outstanding Contributions to Student Learning for "promoting global citizenship" through domestic and international programs that enabled engineering students to contribute meaningfully to healthcare improvement. In 2018, Lovell became Head in his own right.

Growing capacity, growing confidence

This period also coincided with a significant strengthening of the School's research and translational capacity through the appointment of **Ewa Goldys**, who arrived at the University as Deputy Director of the Australian Research Council (ARC) Centre of Excellence for Nanoscale Biophotonics (CNBP), a $40 million national initiative. With its distinctive 'bench-to-boardroom' philosophy, CNBP was designed to accelerate the translation of photonics research into real-world applications.

By then, the School had learned how to carry multiple kinds of ambition at once: flagship projects with national funding; people-and-culture shifts that normalised gender diversity and visible role models; and the deliberate broadening of what counted as biomedical engineering work – from assistive technologies to new biosensing approaches and emerging commercialisation pathways.

The School was growing up. The platforms were there. The people were there. The confidence was there. What no one could see was how suddenly the world was about to change.



▲ Ewa Goldys.

July 2018
Lovell is appointed Head of the Graduate School.

2018
Rnjak-Kovacina receives a NSW Young Tall Poppy Science Award for research into bioengineered cardiac patches. **Iman Roohani** receives a NSW Fresh Science Award. **Klaus Schindhelm** returns to UNSW as Senior Deputy Dean of Engineering.

2019
Kark teaches the inaugural Assistive Technology course. UNSW Precincts approves plans for a multi-storey extension to the Acute Services Building for "clinical innovation and research in biomedical engineering". The extension would feature co-located laboratories to be used collaboratively with Prince of Wales clinical staff.



▲ Inside the School laboratories.

2011–2019: Highlights

The benefits of SHARP

For decades, biomedical engineering lived with the stop–start rhythm of competitive grant funding. Research advanced, but the pressure of the next application, the next deadline, the next staffing risk was ever present.

In 2018, that pattern shifted – not completely, but meaningfully – with the arrival of **Ewa Goldys** through UNSW's Strategic Hires and Retention Pathways (SHARP) program. Introduced under UNSW's 2025 Strategy, SHARP was designed to attract and retain world-leading researchers by adding a layer of university-backed support alongside traditional grants.

The flexibility provided by SHARP enabled the sustained growth of highly specialised research teams, supporting an expansion in PhD training and research capacity to 25 doctoral candidates and 65 research staff across interconnected programs.

This expanded the School's capacity to pursue high-impact research and build long-term platforms in biosensing, diagnostics and environmental monitoring – generating intellectual property, deepening industry engagement, and reinforcing a growing culture of translation and real-world impact.

"If you look at the way the world is headed, you can see all these systems becoming a little bit more biological in their own way. Think about artificial limbs, for example, and the potential to tap into individual neurons so you can control that prosthetic with your brain.

That integration of technology and biology will be absolutely fascinating."

— Klaus Schindhelm



The mechanics OF WINNING

Biomedical engineers led by Professor Anne Simmons have golden ambitions for our Paralympians, writes Myles Gough.

The Chuffed story

The analytical, human-centred mindset of biomedical engineering led some graduates to entirely different pursuits.

Prashan Paramanathan completed the concurrent degree in 2006. A decade later, he founded Chuffed, a crowdfunding platform designed specifically to support social causes, from environmental protection and disability access to refugee settlement and international development.

Launched publicly in 2013 with seed funding from the Telstra Foundation, Chuffed set out to help people doing good work raise money quickly, transparently and without the overheads of traditional fundraising. Its first major campaign, The Refugee Garden, raised $15,000 in just 50 hours and soon surpassed its $30,000 target – a signal that the model was working.

By 2015, Chuffed had expanded into the UK, the United States and Europe. By mid-2016, the platform had helped raise more than $10 million for community-led initiatives. Today, it operates across multiple countries, supporting hundreds of causes and millions of dollars in grass roots impact.

Biomechanics on the Paralympic stage



▲ You don't have to be knee deep in grease to be an engineer ... Professor Anne Simmons.

In the lead-up to the Rio 2016 Paralympic Games, biomedical engineering at UNSW was making its mark beyond the laboratory. Working in partnership with the Australian Institute of Sport, **Lauren Kark** from the Graduate School of Biomedical Engineering and **Anne Simmons**, then Head of the School of Mechanical and Manufacturing Engineering, focussed their attention on how adjustments to prosthetic design and training could support performance in elite athletes.

The collaboration combined biomechanics, materials expertise and close engagement with athletes, exploring how adjustments to prosthetic materials and dimensions might influence performance. Kark, a specialist in rehabilitation engineering, also focused on training approaches that targeted the muscle groups used by lower-limb amputees.

This work built on earlier research by Kark and Simmons, who had developed practical walking tests to help people assess whether their prosthetics were well suited to their bodies. At the Paralympic level, similar principles were applied in a more specialised context.

2020+: Holders and horizon-setters



▲ In work spaces at the new Integrated Acute Services Building, the team from Tyree IHealthE worked with clinicians to produce a 3D-printed model of a child's skull ahead of brain tumour surgery.

Finding direction under pressure

BIOMEDICAL ENGINEERING at UNSW had reached a point of real consequence by the early 2020s. The Graduate School was no longer proving its legitimacy or its breadth; it was deciding how far, how responsibly and how visibly it could extend its reach. Long-standing investments in clinical engagement, translation and people had positioned the Graduate School for growth – but they also raised new questions about scale, structure and identity.

Those questions sharpened abruptly as the COVID-19 pandemic reshaped daily life across universities, hospitals and health systems. Disruption arrived swiftly, routines were upended, and decisions that once felt theoretical became immediate and personal. Yet the defining story of these years is not interruption, but resilience: holding a community together under pressure; turning deeply collaborative work into lived practice; and making choices that shaped not just survival, but direction.

Out of constraint came clarity. Relationships with clinicians deepened, new forms of partnership took hold, and the foundations were laid for a larger public role. By the middle of the decade, the Graduate School was preparing for its next reinvention.

Crisis, cohesion and a new horizon

In March 2020, everything changed overnight. Within weeks of the World Health Organization declaring COVID-19 a global pandemic, university students across the country were told to stay home. UNSW campuses emptied. Teaching shifted online. Labs and workshops – so central to the Graduate School's work – were suddenly out of reach.

At first, the challenges were logistic. But as the months unfolded, the deeper pressure of financial uncertainty became impossible to ignore. For the Graduate School,

January 2020
Laura Poole-Warren is made a Member (AM) of the Order of Australia for "significant service to education and to biomedical engineering".

March 2020
The World Health Organization declares COVID-19 a global pandemic. UNSW President and Vice-Chancellor **Ian Jacobs** announces the suspension of face-to-face teaching, with all classes shifting to online delivery.

December 2020
The Tyree Foundation Institute of Health Engineering (Tyree IHealthE) is launched, supported by a $10 million philanthropic gift from the Sir William Tyree Foundation. **Nigel Lovell** is named as the inaugural Director; Poole-Warren is Deputy Director.

this was not an abstract institutional concern. It posed a real threat to staffing, teaching, research programs – and to the very proposition of remaining a stand-alone School.

As Head of School, **Nigel Lovell** carried the weight of that responsibility.

"That was definitely the hardest period of my professional career," he says.

The stress was widely felt, but the accountability rested with him: ensuring the continuity of teaching and research programs, protecting staff as much as possible, and looking for ways to hold the whole structure together.

The leadership group still speaks openly about the severity of the moment. There were proposals circulating that biomedical engineering – seen by some as small and therefore manoeuvrable – could be split across other parts of the Faculty of Engineering, absorbed into Medicine, or even disbanded. Keeping the Graduate School intact meant having difficult conversations about budgets and capacity. Senior staff were asked to consider reductions in pay or workload, others were asked to find new income sources, and redundancies were on the table. It was a painful period, and it took time to stabilise. But the aim was always to preserve the School's integrity long enough for it to recover.

Remote monitoring meets the moment

COVID tested the School's resilience, but it also helped clarify its value.

One of the most consequential examples was the impact of TeleClinicalCare (TCC), the remote monitoring platform co-led by Lovell and cardiologist **Sze-Yuan Ooi**. For years, the smartphone-based system had been developing on the foundations of the biosensor-based, home-monitoring work pioneered by Lovell and **Branko Celler**. With the arrival of COVID, that work became suddenly urgent and sharply relevant. TCC was built and refined under pressure, at a time when health systems needed tools that could be deployed quickly, safely and at scale.

As the pandemic unfolded, the TCC team recognised that their existing capability – supporting patients at home while keeping them connected with their clinicians

2020

Ewa Goldys receives the NSW Premier's Prize for Science and Engineering (Leadership in Innovation). **Jelena Rnjak-Kovacina** is awarded the NSW Premier's Prize for Science and Engineering (Early Career Researcher of the Year). **Guozhen Liu** receives the Georgina Sweet Award for Women in Quantitative Biomedical Science. **John Whitelock** is appointed Emeritus Professor.

2021

Fatemeh Karimi is awarded a NSW Fresh Science Award. Rnjak-Kovacina receives an Australian Research Council (ARC) Future Fellowship for her work on biomaterials that promote blood vessel growth.

2022

UNSW welcomes students back to campus. **Megan Lord** receives an ARC Future Fellowship for work on nanoparticle drug delivery systems. Lord also works with the Australian Graduate School of Engineering (AGSE) to establish the AGSE PhD program for industry-engaged research degrees. Goldys is a key contributor to the Centre for Advanced Defence Research and Enterprise – Operating in Chemical, Biological, Radiological and Nuclear Environments (CADRE-OCE).

– could play a critical role in easing pressure on hospitals. The platform was adapted rapidly and used to support the remote monitoring of COVID-positive patients. The effect was tangible: it helped health services care for people safely at home, while still enabling timely clinical intervention when needed – at precisely the moment hospital capacity was most under strain.

"I don't need to know [the solution]. I just need to be a clinician, in a room with people who have expertise in the solution-building."

– Sze-Yuan Ooi

TCC demonstrated a new kind of partnership – one where engineers and clinicians were working together, from the outset, alongside health administrators and policy-makers.

Celler – who had worked with Lovell on the long, often frustrating effort to gain traction for remote monitoring – gives credit to Ooi not just as a clinician, but as someone who genuinely understood "the value that biomedical engineers bring to medicine."

Ooi frames the relationship as shared capability, saying: "It's a pretty formidable step to go from idea generation to solution," he says. "How do I build that? How do I get it tested? I'm still not sure that I know – but the thing is, I don't need to know. I just need to be a clinician, in a room with people who have expertise in the solution-building."

In this model, translation is not the responsibility of any single person or specialist acting alone; it is a collective responsibility, designed to be carried together.

Introducing Tyree IHealthE

Even as the Graduate School responded to the immediate pressures of the pandemic, the foundations for recovery were beginning to emerge. The Tyree Foundation Institute of Health Engineering (Tyree IHealthE) was launched in late 2020 with a $10 million gift from the Sir William Tyree

2023
Construction begins on the Integrated Acute Services Building (IASB), a cornerstone of the Randwick Health and Innovation Precinct and future home of Tyree IHealthE. Poole-Warren is appointed Co-Director of Tyree IHealthE.

2024
Plans progress for a four-year undergraduate degree in Biomedical Engineering. The program is approved by the Faculty of Engineering in September, followed by University approval later in the year.

April 2024
Lord receives the Australian Council of Graduate Research (ACGR) Award for Excellence in Graduate Research Leadership.

August 2024
Thanh Nho Do receives a NSW Young Tall Poppy Science Award for breakthrough research in biorobotics, cancer and cardiovascular therapies, and advanced wearable technologies.

Foundation. It was built in deliberate relationship with the School, and dedicated to co-design, implementation, and real-world delivery. This commitment to collaboration became more tangible – and more visible – with Tyree IHealthE's move into purpose-designed, co-located spaces within the Randwick Health and Innovation Precinct: engineers, clinicians, students, patients, and health-system stakeholders working close enough for cooperation to become a matter of routine.

Tyree IHealthE became part of the platform for the School's recovery and renewed growth. But it would be too neat to describe what followed as inevitable: crisis, response, renewal. The lived reality was messier and harder. Looking back, **Laura Poole-Warren** reflects on how narrow the margin was. There was a real risk, she recalls, that decades of experience, expertise and capability could be diluted or lost.

"It didn't happen," she says. "But that was probably the closest we came."

Culture played a role here, too. Initiatives like PASS (Pastoral Academic and Social Support), and the careful rebuilding of community through informal gatherings were essential for a School that had been at risk of splintering. **Jonathan Yeow**, a researcher and PASS organiser, recalls senior leaders regularly joining lunches and coffee catch-ups – small, but heartfelt gestures that helped rebuild a sense of connection.

By the mid-2020s, the School was positioned for a new kind of future: more clinically enmeshed, more translation-capable, and more visible inside UNSW and beyond.

A new degree for a new era

The appointment of biomechanical engineer **Lynne Bilston** as the Paul M. Trainor Chair in 2025 signalled a deliberate investment in the School's next phase of growth. Following more than two decades at Neuroscience Research Australia (NeuRA), Bilston joined the School with a focus on strengthening biomechanics research, building critical mass by mentoring younger academics and fostering new collaborations across the Randwick Health and Innovation Precinct. Education was a focus,

September 2024
The IASB officially opens at Prince of Wales Hospital, marking a major milestone in UNSW–hospital collaboration. UNSW signs a Memorandum of Understanding with Tonga's Christ's University to explore collaborative education and research initiatives.

2025
The School is a significant contributor to UNSW's total of 22 patent filings, helping position the University as Australia's equal fourth-ranked organisation for innovation, according to IP Australia. Building on earlier work with Engineering World Health, **Lauren Kark** launches the Global Engineering Impact Program, enabling students to support medical equipment repair and capacity-building in low- and middle-income countries.



▲ Lynne Bilston, Paul M. Trainor Chair



▲ Tyree IHealthE has taken up residence in the UNSW Integrated Acute Services Building, part of the Randwick Health & Innovation Precinct.

with Bilston helping shape courses for undergraduate and master's students that connected engineering training more directly to clinical problems, regulation, commercialisation and entrepreneurship.

The decision to introduce an undergraduate degree from 2026 marked another significant step in the School's evolution – an investment in scale, identity and community. After five decades of building, adapting and holding its ground, biomedical engineering at UNSW was positioned to take on a larger public role – within the University, the health system, and the community it serves.

May 2025
Lynne Bilston is named the Paul M. Trainor Chair, having collaborated with the School's researchers over many years in her previous role with NeuRA (Neuroscience Research Australia).

August 2025
The Australian Research Council awards Goldys a prestigious Industry Laureate Fellowship, recognising her leadership in translating biosensing research to develop low-cost water testing technologies with environmental and commercial impact.

November 2025
NSW Premier **Chris Minns** officially opens the UNSW Health Translation Hub – a world-leading integrated medical, research and health innovation centre within the Randwick Health and Innovation Precinct, designed to operationalise translational health at scale.

2026
The School celebrates 50 years of technical innovation and community-building – and welcomes its first cohort of students into the undergraduate degree.



◀ Students and staff repurposed ventilators from non-hospital settings, ready for use during the COVID-19 pandemic.

2020+: Highlights

Building the conditions for collaboration

For decades, UNSW's biomedical engineers worked alongside clinicians – but rarely within the same physical space. The Randwick Health and Innovation Precinct changed that.

Anchored by the Integrated Acute Services Building (IASB) and the UNSW Health Translation Hub, the precinct has brought researchers, educators, clinicians and industry partners into daily proximity. Ten floors of shared laboratories, teaching spaces and clinical facilities have created the conditions for collaboration to become the default process.

Three floors are occupied by Tyree IHealthE, with spaces for prototyping, software development, computational modelling and co-design. Surgeons can move between operating theatres and labs. Engineers can test ideas with clinicians in real time. Students can see – and support – translation as it happens, not as a concept, but as a workflow.

Nigel Lovell describes the impact simply: "It's the corridor coffee conversation. You wouldn't think geography matters that much – but it does."

Ready when needed: the ventilator response

When COVID-19 projections suggested hospitals could soon be overwhelmed, one of the most immediate fears was equipment scarcity – particularly ventilators. In response, UNSW worked with NSW Health, the University of Sydney and industry partners to establish a rapid-response ventilator recovery and refurbishment program.

Students and staff worked together to assess, clean and prepare ventilators from non-hospital settings, including veterinary clinics. The James N. Kirby Makerspace was repurposed into a processing facility, with workflows designed around infection control and clinical safety.

The program was precautionary rather than reactive – a back-up supply intended for the worst-case scenario. But it mattered. For the students involved, it was an early, sobering lesson in what real-world responsibility looks like for biomedical engineers.

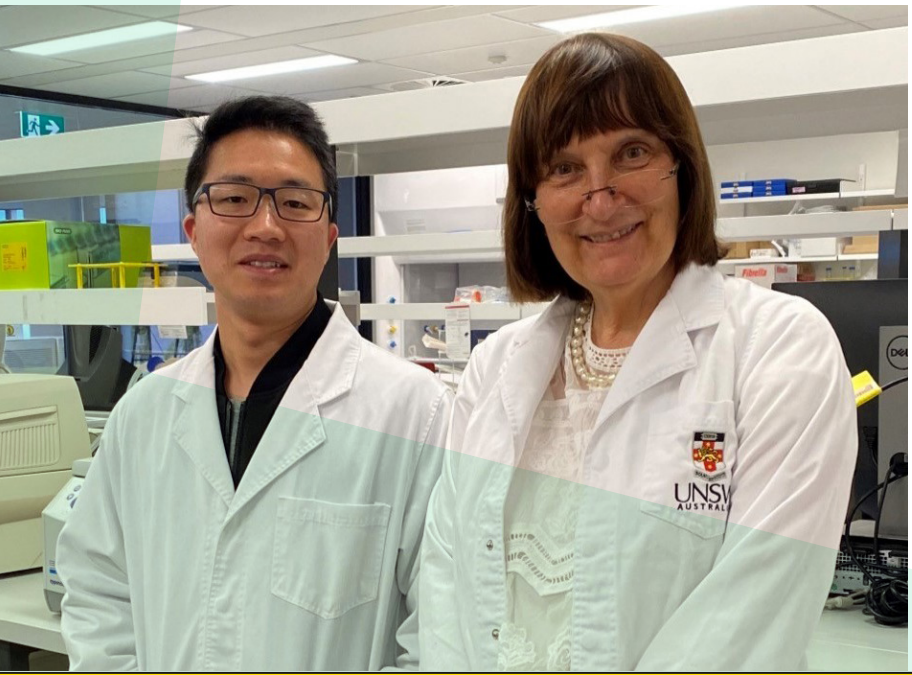
From research to real-world application

Industry collaboration, intellectual property and commercial pathways were increasingly embedded within everyday research practice at the School of Biomedical Engineering throughout this period.

This approach was particularly visible in programs led by **Ewa Goldys**, where early career researchers were able to work closely with collaborators across industry, healthcare and government, taking responsibility for the partnerships connected to their projects. The model helped researchers understand how relationships are built and maintained, how opportunities are identified, and how research can be positioned to move beyond the laboratory.

Over time, this environment supported a range of valuable outcomes. Researchers connected to programs supervised by Goldys went on to establish startup ventures including EosGene Therapeutics and CasBio Pty Ltd, while others moved into industry leadership roles in manufacturing, biotechnology and diagnostics.

"The aim is to give people ownership early," Goldys explains. "Once they see how their work fits into a bigger picture, they start to think differently about what they are building – and where it can go."



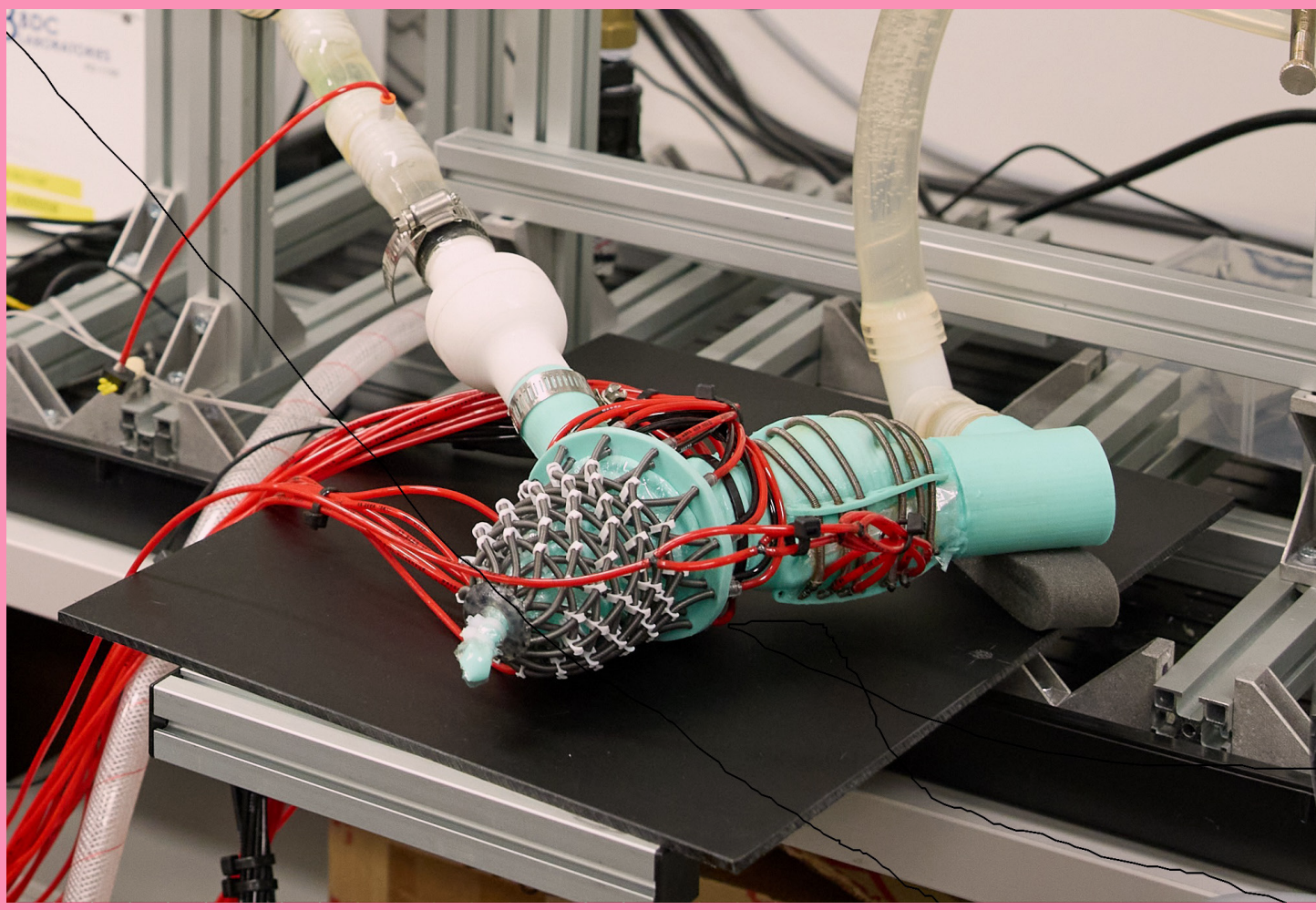
The quiet work of holding people together

When campuses closed, something intangible was lost alongside physical space: the casual conversations, shared lunches and informal mentoring that build connections across an academic community.

As staff and students returned, the School invested deliberately in rebuilding that sense of community. The Pastoral Academic and Social Support initiative, or PASS, introduced ChewsDay lunches, weekly coffee catch-ups and low-key social rituals, creating regular points of reconnection that reached across research groups, career stages and roles. After isolation, togetherness mattered more than ever.

◀ Goldys inside the lab she runs, with team member Fei Deng.

Fifty years of engineering for human health



▲ The soft robotic heart sleeve augments the heart's natural motion, supporting the twisting motion that plays a critical role in each heart beat.



▲ Nigel Lovell displays one of the prototype models for the bionic eye developed in collaboration with Gregg Suaning.

FOR HALF A CENTURY, the School of Biomedical Engineering has worked to harness the full creative power of engineering and place it in the service of human health. Its researchers and students have drawn on the analytical precision and problem-solving capabilities of multiple engineering disciplines, applying them to the complexities of the body, the realities of care, and the pursuit of healthier, more fulfilling lives.

At various times, in various different hands, that goal has taken different forms. Sometimes, it has reshaped fundamental understanding, revealing new insights into how tissues respond to implants, how electrical signals move through nerves, or how genes influence disease. At other times, it has translated directly into devices and systems that change daily life: a cochlear implant that restores hearing, a remote monitoring platform that keeps a patient safely at home, a bioelectronic implant that relieves pain without drugs.

The result is an extraordinary legacy that can be traced not only in publications and patents, but in hospital wards, rehabilitation clinics and family homes. Over five decades, the School's impact has been measured in stronger health systems and in human moments, too – independence preserved, participation restored and lives lived more fully.

CASE STUDY:

Safer travel for children with disability

For many children with physical disabilities, travelling safely in a car requires additional postural support. Occupational therapists and families often modify standard child restraints using extra padding or positioning aids to help children sit comfortably and securely. Yet for many years, little evidence existed about how these modifications affected crash protection in a real collision.

Biomechanical engineer and Paul M. Trainor Chair, **Lynne Bilston**, has spent decades investigating how mechanical forces affect the human body, with research spanning injury prevention, spinal fluid disorders and respiratory biomechanics. Among her longstanding interests has been the prevention of injury in children, particularly children whose needs are not fully addressed by standard safety systems.



▲ Research into how car seat modifications affect the safety of children with disability has informed new national guidance.

Bilston supervised PhD research by occupational therapist **Lyndall Cook** examining how supplementary padding influences the crash performance of child restraints for children with disability. Using crash-testing and biomechanical analysis, the work evaluated the safety implications of different positioning approaches and highlighted the risks associated with some commonly used modifications.

The findings have since informed national guidance developed by Mobility and Accessibility for Children and Adults (MACA), helping provide clearer recommendations for organisations and clinicians involved in modifying child restraints.

Building on Cook's research, a biomedical engineering undergraduate student has since developed prototype support pads designed to provide safer, more consistent postural support for children with disability during car travel. The work aims to replace the improvised solutions often used in practice – such as rolled towels – with reproducible supports that are designed specifically with crash safety in mind.

CASE STUDY:

Gene-based diagnostics, without the lab

During the COVID-19 pandemic, PCR testing demonstrated just how powerful gene-based diagnostics could be. It also made clear how dependent that power was on laboratories, specialised equipment and complex logistics, constraints that limited access, delayed results and, in many parts of the world, placed accurate testing out of reach altogether.

Led by **Ewa Goldys**, researchers at the School of Biomedical Engineering set out to rethink that model, developing a gene test strip that delivers PCR-level accuracy in a simple, portable format. The aim was to make sophisticated genetic testing possible outside the laboratory, using a device that could be deployed anywhere and used by almost anyone.

At its core, the technology detects tiny fragments of genetic material that signal the presence of a virus, bacterium or mutation. Specially engineered circular DNA constructs interact with CRISPR-based proteins to trigger highly sensitive detection cascades, producing a clear result in minutes, at room temperature.

Because the test requires no laboratory infrastructure, it has particular value in settings where resources are limited and logistics are challenging. The same platform could be used to support disease surveillance, cancer monitoring, agricultural biosecurity or biodiversity protection in regions where conventional testing is impractical or unavailable.

By shrinking advanced gene detection into a low-cost, easy-to-use format, this work expands who can access reliable diagnostics, and where critical health decisions can be made.



▲ The research team led by Ewa Goldys has developed new technology, similar to COVID-era diagnostic tests, that offer rapid, on-the-spot disease detection.

CASE STUDY:

Silk, reimagined for the heart

Bypassing blocked coronary arteries can prevent heart attacks, but the conventional surgical approach – grafting a healthy vein from a patient's leg or chest wall – has its limitations. For many of the people who need bypass most, particularly older patients and those living with Type 2 diabetes or obesity, healthy vessels may be in short supply.

Against this backdrop, **Jelena Rnjak-Kovacina** and colleagues explored a strikingly different alternative: a biomaterial engineered from silk.

Silk offers an entirely different starting point. Like many of the structural materials in the human body, it's a protein. Crucially, it is also abundant and already produced at industrial scale.



▲ Jelena Rnjak-Kovacina and her team are engineering silk-based grafts (below) for use in heart surgery.



Synthetic grafts made from plastics have been explored in the past, but they are generally too unwieldy for bypass surgery, and prone to rejection. Silk offers an entirely different starting point. Like many of the structural materials in the human body, it's a protein. Crucially, it is also abundant and already produced at industrial scale.

Blood vessels engineered from silk may prove to be a viable substitute for grafts – but the possibilities don't stop there. Rnjak-Kovacina and her team also aim to develop a silk-based graft that functions immediately as a bypass, but also acts as a scaffold that encourages the body to grow new tissue. Over time, the scaffold could biodegrade, leaving behind regenerated blood vessels and more natural blood flow.

The same design logic is also being applied to other cardiovascular targets, including silk-based heart valve leaflets for aortic stenosis, the most common heart valve disease. It adds to the School's legacy of maximising materials science to not just replace failed body parts, but to work with the body's own capacity for repair.

"Being able to regrow spinal cords and address quadriplegia and paraplegia – that's on the horizon.

If we can bring together the things we already know about small molecule control of inflammation, tissue engineering for cell regrowth, bionics for electrical stimulation to guide and grow tissue, rehabilitation therapies – if someone puts the effort into bringing them all together and doing the crosshair projects that bring in everybody's expertise within really robust science – there is a solution. And we can find it."

– Rylie Green

CASE STUDY:

Bioelectronic pathways to pain relief

Chronic pain is one of the most pervasive and least visible health challenges. Affecting millions of people in Australia alone, it can disrupt sleep, limit mobility and place strain on mental health and relationships.

At the School of Biomedical Engineering, researchers have been developing bioelectronic approaches that target pain at its source: the neural signals that carry pain information from the body to the brain. Work led by **Mohit Shivdasani** has focused on forms of pain that do not respond well to existing treatments, particularly 'nociceptive' pain arising from damage to skin, muscle or bone.

Spinal cord stimulation has long been used to treat neuropathic pain caused by damage to the nervous system, but it offers little benefit for many post-surgical pain conditions. The team from the School of Biomedical Engineering has been developing an implantable device that delivers a carefully controlled electrical current to peripheral nerves close to where pain originates. By interrupting pain signals before they reach the spinal cord, the approach aims to reduce suffering without relying on medication.

Initial work has focused on pain following knee-replacement surgery, one of the most painful orthopaedic procedures and a common stepping stone to over-reliance on opioids. By suppressing pain in the critical weeks after surgery, this form of electro-analgesic therapy has the potential to improve recovery and reduce the risk of long-term opioid dependence.

These advances point towards a future in which chronic pain is managed not only with drugs, but through precise, targeted bioelectronic intervention.

By suppressing pain in the critical weeks after surgery, this form of electro-analgesic therapy has the potential to improve recovery and reduce the risk of long-term opioid dependence.



▲ The tiny, flexible bioprinter developed by Thanh Nho Do and his team could be used to 3D print biomaterial directly onto organs inside a human body.

CASE STUDY:

Repairing the body from within

Gastric wall damage and disease across the gastrointestinal tract are common and persistent problems that often require invasive surgical treatments. 3D-printed patches that contain living cells or medication represent a step forward, but they're typically made outside the body and then implanted. That added handling increases complexity and elevates the risk of infection.

In the early 2020s, biomedical engineers in the UNSW Medical Robotics Lab began sketching a different future: one in which the repair tissue is printed inside the body, at the site of the wound.

Their prototype device, F3DB, combines soft robotics with a miniature 3D-printing nozzle on three flexible fibres, mounted to a slim, snake-like tool that can be introduced like an endoscope. It can reach hard-to-access sites, print material exactly where it's needed, and shape and apply the patch under the supervision of the clinician.

"Existing 3D bioprinting techniques create the patch outside the body," said lab director **Thanh Nho Do**. "That increases infection risk, plus the risk of the patch being contaminated or damaged during manual handling. Our F3DB prototype will avoid all those issues."

The tool was developed to proof-of-concept by Do and PhD student **Mai Thanh Thai**, with collaborators including **Nigel Lovell**, **Hoang-Phuong Phan** and **Jelena Rnjak-Kovacina**.

From the outset, the team's ambition extended beyond printing alone. They envisaged F3DB evolving into an all-in-one endoscopic tool: able to remove lesions, clean the site, and immediately print biomaterials, reducing the need for instrument swaps that can add time and increase infection risk.

With a provisional patent secured and animal testing identified as the next step, the F3DB device feels both futuristic and practical: a tool designed to make advanced tissue repair possible, without opening the body to do it.

"Biomedical engineering may end up putting a bit of sanity into where AI goes in medicine. It will help triage information reliability while continuing to develop new technologies."

– Bruce Milthorpe

CASE STUDY:

Comfort, fit and the future of prosthetics

For people who rely on prosthetic devices, performance is shaped more by comfort and fit than perhaps any other criteria. A prosthesis can be technically sophisticated, but if it doesn't integrate well with the human body, then it's unlikely to be worn, or to deliver on its promise of restoring the independence of those it has been designed to assist.

That insight has long guided prosthetics research at the School of Biomedical Engineering. Research into amputee biomechanics, driven by **Lauren Kark**, brought sustained attention to a persistent challenge: the prosthetic socket, where small variations in shape, pressure or movement can mean the difference between mobility and pain. Fluid changes in residual limbs, shifting activity levels and individual anatomy all complicate what remains a careful balance between engineering precision and human variability.

Recent advances have helped ease some of those constraints. Patient-specific scanning and 3D printing now allow sockets to be designed and manufactured remotely, reducing fitting bottlenecks and enabling donated prosthetics to be adapted more effectively in low-resource settings.



▲ Lauren Kark and one of the cutting edge prostheses being developed at the School.

Alongside this, UNSW researchers are also exploring longer-term possibilities for prosthetic control. Work on optical neural sensing, using light rather than electrodes to read nerve signals, points toward denser, more stable interfaces between nerves and devices, a foundational step for more responsive prosthetic limbs.

From everyday mobility to elite sport – including a notable collaboration with Australian athletes attending the Rio 2016 Paralympic Games – the School's work in prosthetics reflects a sustained commitment to supporting people with disability to move through the world with confidence and comfort.

CASE STUDY:

The foundations of bionic vision research

The futuristic goal of restoring sight through electronics moved closer to reality in the late 1990s, when **Gregg Suaning** and **Nigel Lovell** began exploring whether carefully patterned electrical stimulation of the retina could generate meaningful visual signals.

Early laboratory and animal studies demonstrated that the damaged retina could, in principle, respond to artificial stimulation. It was a crucial proof point. Over time, that foundational work contributed to the formation of a national effort, culminating in the Australian Bionic Eye project, supported as part of a broader government research initiative.

Drawing on expertise developed over decades, **Socrates Dokos** led the modelling component of the bionic vision program, developing simulations that explored how different electrode array designs would interact with retinal neurons. His team modelled what patients might realistically perceive under different stimulation conditions, helping identify practical limitations that were not immediately apparent through experimental work alone.

The path proved more complex than first imagined. Replicating the richness and clarity of natural vision required not only more electrodes, but a deeper understanding of how retinal tissue responds to long-term stimulation. Surgical challenges, tissue reactions and interface design prompted continual refinement.

> "Our bionic eye research was something that had significant impact," says Lovell. "It was definitely well before its time, and it progressed the whole field of neural engineering."
>
> – Nigel Lovell

In 2011, a 98-channel microchip designed to power a retinal implant marked a significant technical milestone, reflecting years of interdisciplinary collaboration between engineers, clinicians and neuroscientists.

"Our bionic eye research was something that had significant impact," says Lovell. "It was definitely well before its time, and it progressed the whole field of neural engineering."

Today, work continues to improve the biological interface between device and retina, alongside advances in modelling and materials. While a fully restorative bionic eye remains an ongoing ambition, the project established the School as a serious contributor to neural engineering and shaped decades of innovation in stimulation technologies.

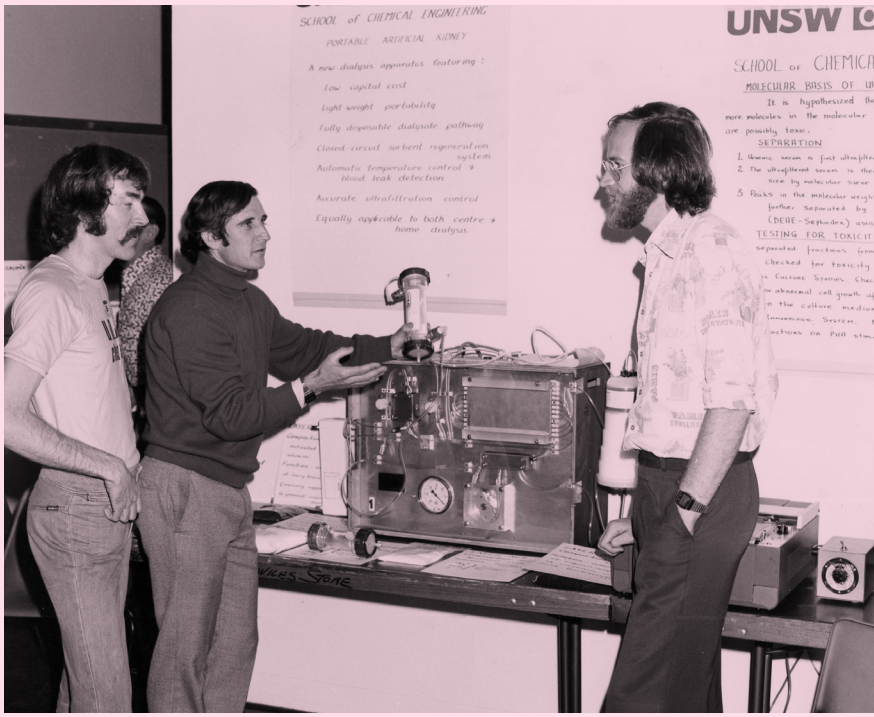
CASE STUDY:

Making dialysis more livable

For people living with end-stage kidney disease, dialysis has long meant being tethered to large machines for hours at a time, several days a week. In the late 1970s and early 1980s, researchers at what was then the Centre for Biomedical Engineering were closely involved in evaluating an alternative that promised something profoundly different: a form of dialysis that could be carried out while patients went about their daily lives.

Led by **Peter Farrell**, the Centre's researchers played a central role in the early Australian evaluation of continuous ambulatory peritoneal dialysis (CAPD). Rather than relying on an external machine, CAPD uses the body's own peritoneal membrane to filter waste products from the blood. Dialysis fluid is introduced through a permanent catheter, left in place for several hours while diffusion occurs, and then exchanged, allowing patients to remain mobile between treatments.

Farrell's group coordinated a multi-year study involving renal units across Australia, collecting detailed biochemical, physiological and rehabilitation data from dozens of patients. At the time, it represented one of the most comprehensive datasets anywhere in the world on waste removal efficiency and long-term patient outcomes using CAPD. Researchers also examined the engineering challenges that would determine whether the technique could succeed at scale, including membrane performance, fluid composition and filtration efficiency.



▲ At a University Open Day in the 1970s, Peter Farrell demonstrates a portable device for kidney treatment.

The underlying aim of the work was to understand where CAPD could best fit in – for which patients, under which conditions, and with which trade-offs. In doing so, it helped establish an evidence base that informed dialysis practice around the world, and contributed to more flexible, patient-centred models of kidney care.

CASE STUDY:

Engineering impact where resources are limited

In hospitals where resources are limited and health services are stretched, the real challenge is often not the absence of medical equipment, but what it takes to keep it working. In countries including Cambodia, Uganda, Nepal and across the Pacific, devices are frequently donated with good intentions, yet manuals arrive in unfamiliar languages, plugs and parts are incompatible, and local staff are left without the training or spare components needed to keep equipment running.

In 2014, **Lauren Kark** set out to address this gap by establishing the UNSW chapter of Engineering World Health, a not-for-profit dedicated to improving healthcare outcomes in low-resource settings by repairing equipment and training local technicians. Two years later, UNSW launched its first Summer Institute, sending students to Phnom Penh in Cambodia. Uganda soon followed, with later programs extending to Nepal and, more recently, Pacific nations.

"I've always been very impact-driven," says Kark. "I realised quite quickly the power of engineering and the fact that you don't need high-tech engineering to deliver high impact."

Students spend weeks learning how to repair common hospital equipment – things like autoclaves, suction pumps, oxygen concentrators, and incubators – while also receiving language and cultural training. They then work in regional and remote hospitals, repairing devices, sharing skills, and responding to local needs. Around 150 UNSW students have so far helped restore close to 2,300 pieces of equipment, representing millions of dollars in recovered value for health systems operating under extreme constraints.



▲ Outreach programs initiated by Lauren Kark see Biomedical Engineering Students travelling to under-resourced countries to help install and repair medical equipment.

For **James Lee**, who participated in the Cambodia program as a student, the experience was deeply formative. What stayed with him most was the ingenuity of the local teams.

"These people had been working in these contexts for a long time. They came up with really ingenious solutions. I thought, 'I want to work alongside these people. I want to learn from them.'"

Over time, the Summer Institute became as much about mindset as mechanics. Students leave with technical confidence, cultural humility, and a deeper understanding of equity in healthcare. For the School, it's a powerful expression of biomedical engineering's capacity to work in and with communities, changing the world, for the better.

"The population centres of the world now are around Asia and Africa.

If we really want to utilise our full ingenuity, innovation and creativity as humans – to work together for a common, brighter future – then we're going to have to utilise all the people.

That means being brave about going into those places and connecting, understanding context, looking at the real humans in front of us and understanding their lives as deeply as we can in order to benefit their health, not just in a physical way, but in every facet of their being."

– James Lee

CASE STUDY:

Restoring control, one step at a time

For most people, walking is automatic. For someone living with Parkinson's disease, it can become a conscious, exhausting task. Gait dysfunction affects quality of life, undermining confidence and safety, with falls a common and serious risk.

Led by UNSW biomedical engineer **Matthew Brodie**, the Walking Tall smartphone app was co-designed with people living with Parkinson's. Its core feature is a metronomic beat that guides stepping at different speeds, helping to stabilise gait while reducing the mental effort required to walk. Prompts like 'walk tall', 'shoulders back', 'focus on big steps', along with audio encouragement, provide helpful cues that users can act on real-time.

The app grew out of a clinical trial funded by the Shake It Up Australia Foundation and the Michael J Fox Foundation, with additional support from a Tyree IHealthE Catalyst Grant. Trial results showed that participants using the app spent more than twice as much time exercising as those following a conventional walking program, highlighting the impact of thoughtful, user-centred design.

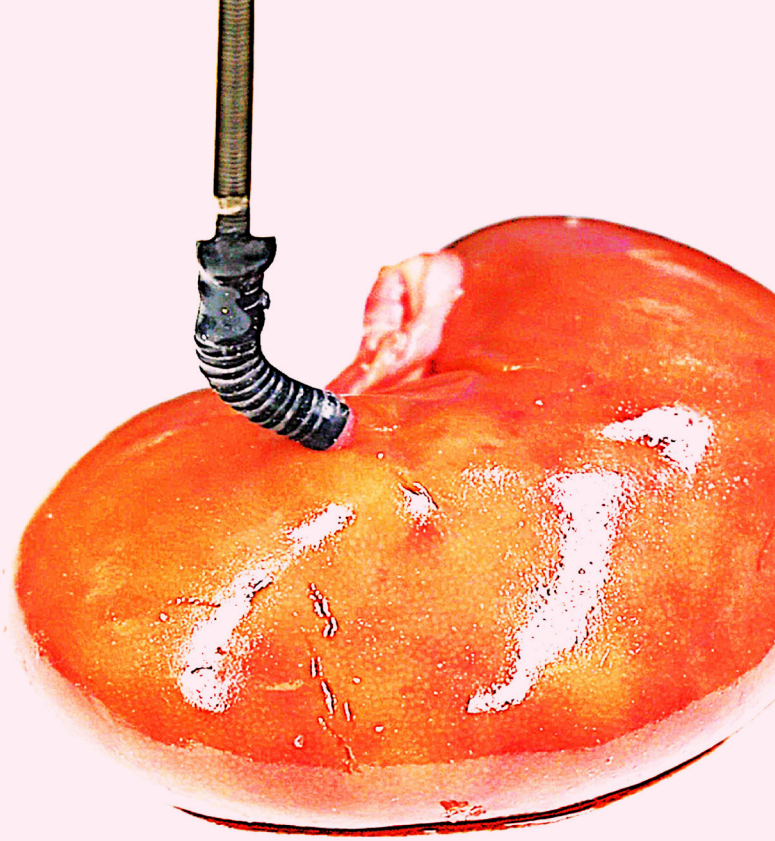
Walking Tall isn't a cure, but for people living with Parkinson's today, it's a tool that can be used to regain a sense of control, and the feeling of a body that can still do what it's asked.

"My goal is to have an impact now, not an impact in 10 years' time," says Brodie. "I believe this app can help people with Parkinson's disease all around the world, right now."

> "My goal is to have an impact now, not an impact in 10 years' time. I believe this app can help people with Parkinson's disease all around the world, right now."
> — Matthew Brodie



◀ Matthew A Brodie developed the Walking Tall app in collaboration with people who are living with Parkinson's disease.



CASE STUDY:

Surgical control, at the smallest scale

Navigating the body's smallest and most delicate pathways demands extraordinary control. In procedures such as endovascular surgery, where microcatheters are guided through narrow blood vessels, even tiny movements can have outsized consequences. Traditional robotic systems can assist, but they often rely on complex electronics, motors and power sources that add bulk and cost, and introduce points of failure.

Researchers in the UNSW Medical Robotics Lab have explored a different approach. Led by **Thanh Nho Do**, the team have developed a soft robotic control system that replaces electricity and motors with hydraulics and mechanics alone. Known as the Soft Fibrous Syringe Architecture (SFSA), the system uses pairs of soft, artificial muscles linked by fluid-filled channels. When one muscle is stretched, pressure changes are transmitted through the system, causing the other to move with precise, scaled-down motion.

The result is a flexible robotic mechanism that can be smaller, lighter and more intuitive to operate. Because motion can be mechanically dampened, the system can reduce hand tremor, enhancing precision in microsurgical tasks. Built-in sensing also allows the device to detect force and texture, opening possibilities for identifying abnormal tissue or guiding targeted interventions.

The team's work demonstrates how biomedical engineering can solve complex clinical problems not by adding layers of technology, but by rethinking how fundamental engineering principles can be applied inside the human body.

▲ A team led by Thanh Nho Do have developed a new soft robotic system that works without electricity or motors, allowing for more precise surgeries at lower cost.

"I think that our School may be one of the few places doing a really good job in multidisciplinary science.

This is important because, especially in biomedical engineering, the future will be about connecting different technologies and different skills together – not just AI, but AI and physics, AI and materials, AI and tissue engineering."

– Hamid Alinejad Rokny

Participating patients received a cochlear implant device designed not only to restore hearing, but to guide therapeutic genes directly to targeted cells with the aim of stimulating the regeneration of auditory nerve fibres.

CASE STUDY:

Teaching nerves to grow again

Nerve damage from disease, injury or ageing can permanently reduce movement and sensation, especially when the central nervous system is involved. UNSW biomedical engineers approached the problem from a cross-disciplinary angle, not only designing devices that stimulate nerve cells to communicate with the brain, but also working with highly targeted gene therapies to prompt the regeneration of damaged nerve tissue.

At the centre of this work is BaDGE®, the Bionic array Directed Gene Electrotransfer DNA/RNA Therapeutics Delivery Platform developed by **Gary Housley** from the School of Medicine with collaborators **Amr Al Abed** and **Nigel Lovell** from Biomedical Engineering. The platform uses a localised electric field to steer therapeutic DNA or RNA molecules to targeted tissue with an uncommon level of control.

Cochlear Limited and an expert consortium spanning the Macquarie University Hearing Hub, the University of Sydney, Royal Prince Alfred Hospital, NextSense, and the University of Melbourne partnered with the team to conduct the first human clinical trial of BaDGE®. Participating patients received a cochlear implant device designed not only to restore hearing, but to guide therapeutic genes directly to targeted cells with the aim of stimulating the regeneration of auditory nerve fibres and improving long-term hearing outcomes.

The ambitions of the platform now extend beyond hearing. Researchers are exploring potential applications in epilepsy and eye disease, as well as broader uses in nerve repair, vaccines and other targeted therapies. BaDGE® stands as a compelling example of the School's distinctive approach, bridging devices and genes, electrical engineering and biology, to give damaged nerves a genuine second chance.

CASE STUDY:

Designing drug delivery at the nanoscale

The human body contains almost 100,000 kilometres of blood vessels – an immense transport network that services every organ and tissue. For biomedical engineers working in drug delivery, that network presents both an opportunity and a challenge: how to design therapies that can successfully use these blood vessel highways to reach the cells that need them most.

Over recent decades, nanomedicine has emerged as a major area of biomedical research, using tiny engineered particles to transport drugs, proteins, genetic material and other therapies through the body with far greater precision than conventional treatments. Yet an important problem remains: most nanomedicines never reach their intended target. Cleared rapidly by the liver and kidneys, only a small fraction successfully pass through the blood vessel wall and into surrounding tissue.

Megan Lord's research has contributed to an important shift in how this challenge is understood. Central to her work is the glycocalyx – a dense coating of sugars and carbohydrates that surrounds the surface of cells lining blood vessels. Long overlooked within the field, this microscopic 'forest' of sugars is increasingly recognised as the key interface between nanomaterials and the body, shaping how therapies move through blood vessels and into tissue.

Lord and her team investigate how factors such as size, shape and surface chemistry influence the movement of nanoparticles through the body. The research supports applications ranging from cancer therapies and vaccines to tissue repair and inflammatory disease, with some of these novel approaches progressing into clinical trials involving people who live with cystic fibrosis.

CASE STUDY:

The next frontier of neural implants

Neural implants have already reshaped modern medicine, yet researchers continue to look for ways to make them more precise, less invasive and better able to work with the body's own signals.

David Tsai is supporting that aim by developing tools that can help researchers understand how nerves respond to stimulation before devices ever reach the clinic. By modelling and interpreting neural signals, these systems allow new neural interfaces to be tested and refined more efficiently.

While many existing implants interact directly with the brain, Tsai is particularly interested in the opportunities presented by the peripheral nervous system – the vast network of nerves that carries signals between the brain, organs and limbs. Carefully designed interfaces could one day help diagnose and treat conditions such as neuropathic pain, while responding to the body in real time.

This work sits within a wider field of neural interface research at the School of Biomedical Engineering, where colleagues have contributed advances in biomaterials, implantable sensors and microfluidic technologies that improve how electronic devices interact with living tissue.

Together, these efforts point toward a future of smarter, more responsive bioelectronic technologies – devices that can both measure and treat disease, opening up new possibilities for restoring function and improving quality of life.

"If you think about the way we replace physiological functions at the moment, it's so clunky. We've managed to use engineering principles to replace kidneys with dialysis, but it's an engineer's answer to a kidney – and it's not an ideal experience for patients. It's the same thing with artificial hips and knees – they're still lumps of metal. It all works, but it's not the end game.

The end game is: 'You've got renal failure? Well, we're going to get you a new kidney, and you won't even notice the difference.' Think about how an embryo develops. From one egg and one sperm, an embryo develops kidneys and other organs that work. We need to think differently here."

– Anne Simmons

CASE STUDY:

From genetic data to clinical answers

Advances in genomics have given clinicians unprecedented insight into patient biology, but translating that data into clear diagnoses has typically been a slow, complex and uncertain process. A single test can reveal thousands of genetic variations, leaving clinicians to search painstakingly through the literature to determine which, if any, are responsible for a patient's condition.

At the School of Biomedical Engineering, researchers have been exploring how artificial intelligence (AI) and machine learning can change that equation. Led by **Hamid Alinejad Rokny**, the Biomedical Machine Learning Laboratory focuses on tools that support faster, more reliable diagnosis by integrating genetic data, clinical tests and observable traits into a single analytical framework.

One strand of this work is the development of what Rokny describes as a "visual biopsy": computational models that simulate how cells interact and behave, allowing clinicians to distinguish healthy tissue from disease without invasive sampling. Building on this, the team has developed GPT-based systems – similar to conversational AI tools like ChatGPT – that allow clinicians to interact directly with diagnostic models, asking questions, testing hypotheses and exploring treatment pathways through conversation.



▲ Dr Hamid Alinejad Rokny leads the Biomedical Machine Learning Laboratory.

Another major initiative, developed in collaboration with NSW Health Pathology, addresses rare and complex genetic conditions. The platform, known as Argos, analyses blood tests and genetic data to identify the most likely causal variation in minutes rather than weeks. Early evaluations showed that even experienced clinicians often disagreed on diagnoses in complex cases, while AI-assisted analysis helped resolve that uncertainty more consistently and far more quickly.

Together, these tools point to a new diagnostic paradigm in which machine intelligence augments clinical judgement, accelerating decisions while keeping expertise, accountability and care firmly in human hands.

CASE STUDY:

Engineering a future beyond animal models

Throughout its five-decade history, the School of Biomedical Engineering has used animal models to test and refine new ideas – from dialysis technologies and tendon repair to retinal stimulation and neural devices. Since the introduction of the Animal Research Act 1985, this work has been conducted within one of the most tightly regulated research environments in the country, requiring detailed scientific justification, ethical oversight and rigorous documentation.

Working with animals was, and remains, highly regulated in Australia. For laboratory managers and researchers, it demanded not only scientific rigour but ethical clarity. As former facilities manager Veronika Tatarinoff has recalled, the culture that developed was one of "respect" – for the animals, for the law, and for the responsibility inherent in experimental work.

Over time, however, the field began to change. Advances in computational modelling, biomaterials and tissue engineering opened the possibility of answering some research questions without relying on animal experiments at all.

At the School of Biomedical Engineering, researchers including **Laura Poole-Warren** and **Tianruo Guo** have developed sophisticated computer simulations and three-dimensional tissue models that replicate aspects of human organs. Neural stimulation strategies can now be tested in silico before a single implant is fabricated. Bench-top cochlea models allow electrode designs to be evaluated in controlled biological environments. Organ-specific scaffolds and multi-organ 'chips' make it possible to study disease and drug responses in human-like tissues.

These approaches do not eliminate animal testing altogether, particularly where regulation still requires it. But they shift it later in the development process, reduce the number of animals used, and in some cases replace it entirely. By joining the NSW Government's Non-Animal Technologies Network in 2024, UNSW signalled its commitment to accelerating this transition.



▲ Over many decades, biomaterials and biomedical devices were tested at the Sheep Research Unit at Prince Henry Hospital.

CASE STUDY:

The Assistive Technology Hub

Too often, assistive technology is conceived at a distance, solving theoretical problems while missing what actually matters in the daily life of the person who will use it.

The Assistive Technology (AT) Hub was established as a space where people with disability can work with engineers and students to shape solutions around their own goals, routines and identities. Led by **Lauren Kark**, the Hub champions co-design, ensuring that devices are informed by real needs, real contexts and real lives. Every project begins with an individual.

"It will be someone who has a very specific thing that they love doing, or used to be able to do and can't do now," says **Jasmine Zeng**, a mechatronics graduate. "They come to us with a problem, and we help them solve it."

At the Hub, students learn to interrogate not only the functional requirements of a project, but also what it means to address issues of comfort, dignity, cost, and the realities of daily use. For Kark, this human connection is essential.

"One of the reasons for the Hub was that our students often graduate without ever having met the person who will use their technology," she says. "I think it's really important that we develop empathy in our design practices."

"One of the reasons for the Assistive Tech Hub was that our students often graduate without ever having met the person who will use their technology. I think it's really important that we develop empathy in our design practices."

– Lauren Kark

That approach has led to a wide range of outcomes: from musical instruments adapted for tremor, to low-cost communication devices, to assistive tools shaped for specific environments and communities, including work across the Asia Pacific region. In each case, the technology is only part of the story. Just as important are the skills transferred, the assumptions challenged, and the relationships built.

The Hub offers students the chance to see their work make a tangible difference before they graduate. For participants, it offers agency and collaboration. And for the School, it represents the capacity of biomedical engineers to deliver true impact – applying their technical skill and creativity in ways that expand choice, participation and independence, so people can enjoy health and wellbeing, on their own terms.

"The modelling and the computing power are getting sophisticated enough now that we can start to expand the spatial scales. We can combine and connect things – from a cell to an organ to a body in one direction, or from a metabolome down to a genome in the other direction. That gives us the link from the genes to the person and even to their external environment, so we can figure out how a particular person's genes will impact their health over their lifespan.

This is going to happen over the next 10 years – and I can see that the tools we're developing in biomedical engineering are the enablers for that. It's all happening. It's incredibly exciting. And I'm going to be retired – that's the problem!"

– Nigel Lovell



◀ The early days of telehealth and home monitoring: Branko Celler (right) with Nigel Lovell (left), and a prototype remote medical monitoring device.

CASE STUDY:

The original health-aware home

Long before remote care entered the mainstream, **Branko Celler** was exploring how patients could be supported to manage chronic illness from home, with clinicians closely connected behind the scenes.

"I pushed forward with the idea that you could make a home 'health aware', identifying a clinical exacerbation before it happened, and then doing something about it before the patient ended up in hospital."

Celler and colleague **Nigel Lovell** secured a series of major grants for the development of a home telemonitoring system which, In 2010, won an Australian International Design Award. The resulting workstation allowed patients to record lung function, blood oxygen levels, ECGs, blood pressure, temperature and weight using a single tabletop device, with results transmitted directly to clinicians. Patients could also answer questionnaires, receive medication reminders, and communicate with carers via built-in messaging and video conferencing.

Many patients were older and unfamiliar with computers, so the system prioritised simplicity, requiring minimal technical skill. From a clinical perspective, it supported trend analysis enabling clinicians to see whether a patient was stable, deteriorating slowly, or showing early signs of acute risk, and intervene accordingly.

The technology later formed the basis of TeleMedCare, one of UNSW's earliest biomedical engineering spinout companies. Following his departure from the University in 2006, Celler led the company as Chairman and CEO, helping expand the reach of the platform through major telehealth initiatives, including a large-scale CSIRO-supported deployment across six local health districts from Townsville to Launceston. The trial demonstrated that home telemonitoring was practical and acceptable for both patients and clinicians, while also delivering significant reductions in healthcare costs and hospital admissions.

CASE STUDY:

From CRC to clinic

Operating through the 1990s, the Cooperative Research Centre (CRC) for Cardiac Technology brought together clinicians, engineers, materials scientists and industry partners to address urgent problems in cardiac care, with a strong focus on outcomes that could move beyond the laboratory.

One of its most significant outputs was Elast-Eon®, a family of biostable polymers designed specifically for long-term implantation in the human body. Developed through collaboration between CSIRO scientists and researchers from the School of Biomedical Engineering, including **Klaus Schindhelm**, **Laura Poole-Warren** and **Arthur Brandwood**, the material overcame longstanding trade-offs between durability, flexibility and blood compatibility. Existing materials used in cardiac devices often forced compromises between longevity and safety; Elast-Eon® offered a new option that could withstand the biological environment over time.

Royalties have provided an ongoing funding source for a $15,000 per annum scholarship, awarded annually to one of the School's top-performing PhD candidates.

Crucially, the CRC structure enabled this work to move efficiently from discovery to application. The material was commercialised through spin-off company Elastomedic, later acquired by AorTech Biomaterials, and went on to receive regulatory approval. Elast-Eon® has since been used in thousands of implanted devices, including cardiac pacemaker leads, with further applications extending into other areas of implantable medical technology. Royalties have provided an ongoing funding source for a $15,000 per annum scholarship, awarded annually to one of the School's top-performing PhD candidates.

The CRC helped transform how biomedical engineering was practised within the School. Technical and laboratory staff played a central role by establishing the quality systems, safety protocols and documentation practices that would meet emerging industry and regulatory standards. These foundations strengthened the School's ability to support large, multidisciplinary projects and set expectations for good laboratory practice that endured beyond the life of the CRC.

"I find it hard to predict the future, to say 'this is what's going to happen', because science is a never-ending process.

If you can develop and create something right now that has really strong implications for human health, then people are going to build on that.

The way I see it, we're building these tiny little blocks of knowledge that will help move us forward – and we're never going to get to the other end of that. That's the exciting bit."

– Sarah Knox

CASE STUDY:

Making artificial hearts responsive

Heart failure remains one of the world's most serious health challenges, with donor hearts in chronically short supply. Artificial hearts are sometimes used as a bridge to transplant, keeping patients alive while they wait for a suitable donor. It's an approach that can be lifesaving, but it also introduces a fundamental challenge. Unlike a living heart, most artificial hearts and heart pumps cannot automatically respond to the body's changing needs, adjusting blood flow as activity levels demand.

Addressing that shortfall has been a longstanding focus for biomedical engineers at UNSW. Research led by **Michael Stevens**, for example, has explored adaptive control systems including how heart pumps might better match blood flow to the body's moment-to-moment requirements. Using simulated cardiovascular models and large-scale data analysis, his team has investigated how devices can sense, interpret and respond to physiological change.

That expertise came into sharp focus in 2025, when a patient awaiting a heart transplant at St Vincent's Hospital in Sydney was supported for 100 days with an artificial heart.

This work feeds into the School's broader expertise in monitoring and control systems – technologies that allow cardiac support devices to operate more intelligently, while enabling clinicians to remotely oversee performance and intervene when needed.

That expertise came into sharp focus in 2025, when a patient awaiting a heart transplant at St Vincent's Hospital in Sydney was supported for 100 days with an artificial heart. While the heart itself was developed by an external team, a UNSW team led by **Nigel Lovell**, contributed to the remote monitoring and control systems that underpinned its safe clinical use.

CASE STUDY:

Modelling movement, person by person

Human movement is profoundly individual. Subtle differences in anatomy, strength and coordination can determine whether an intervention restores mobility or introduces new problems. For clinicians, anticipating those outcomes can be difficult, particularly when treatment decisions are guided by population averages rather than by the body in front of them.

At the School of Biomedical Engineering, computational modelling is being used to make clinical care more precise. Researchers are using biomechanics to create patient-specific digital models that capture how an individual moves, and how forces are distributed across bones, joints and muscles during everyday activities.

Work led by **Luca Modenese** has focused on automating the creation of these 'digital twins' using data from routine medical imaging such as MRI and CT scans. In minutes, clinicians can access a detailed model of a patient's musculoskeletal system, reflecting both their anatomy and movement patterns. That model can then be used to explore different clinical options, testing surgical approaches, rehabilitation strategies or assistive devices before they are applied in the real world.

By allowing interventions to be explored virtually, computational modelling strengthens clinical decision-making processes. It gives practitioners a way to tailor treatment to the individual, increasing the likelihood that an intervention will support mobility, comfort and recovery.

As these tools move closer to everyday clinical use, they are reshaping how care is planned, bringing precision to decisions that once depended on experience alone, and aligning treatment more closely with the way each person actually moves.

Researchers are using biomechanics to create patient-specific digital models that capture how an individual moves, and how forces are distributed across bones, joints and muscles during everyday activities.

CASE STUDY:

A very Australian experiment

In the early 1980s, as researchers overseas began experimenting with chemically treated bovine tendons to replace torn anterior cruciate ligaments (ACLs), the team at the Centre for Biomedical Engineering asked themselves a characteristically Australian question: could kangaroo tail tendons do a better job?

Beginning in 1982, a team including **Bruce Milthorpe** set out to investigate. Kangaroo tail tendons were implanted into sheep as ACL replacements and subjected to rigorous mechanical testing.

The work unfolded across unlikely settings, from the Sheep Research Unit at Prince Henry Hospital to the basement of the Wallace Wurth Building where the fledgling Centre had been allocated laboratory space.

There, cyclic loading rigs thumped away for hours at a time, housed in what had most recently been men's toilet cubicles, complete with urinals.

"There was this really high-tech analytical machine set up on a table with two feet in the urinal trough and two feet sticking outside, sitting on a pair of bricks," recalls long-time laboratory manager, **Veronika Tatarinoff**. "It was the weirdest thing for a research establishment – but they were just using what they could at the time."

Ultimately, kangaroo tail tendons proved unsuitable for long-term ligament replacement, but the project pushed the Centre into deeper questions about how materials behave inside the body, laying the foundations for UNSW's enduring strength in biomaterials and tissue engineering.



MEDICAL LEAPS AND BOUNDS

◄ The therapeutic powers of kangaroo-tail soup may be a matter of opinion but medical research using tendons from the animal's familiar appendage has offered surprising results. Researchers at the University of NSW have been experimenting with roo tendons for several years since it was suggested they could be used as grafts to repair damaged human tendons. The researchers are experimenting on sheep to develop methods of attaching the tendons and chemically modifying them so they will not be rejected once implanted and will dissolve as a new tendon forms. It is hoped the roo tendons will be used in trials on humans within three years. "There is no such thing as an artificial tendon so a tendon has to be sacrificed from another part of the body," says Dr Klaus Schindheim (left), a member of the research team. "This is fine for sharp cuts, but when a person has a major injury, it is a lot more difficult. There is a need for something off-the-shelf which can be adapted to any situation."

A. COLTIER/SYDNEY FREELANCE

▲ Klaus Schindhelm was interviewed for the *Good Weekend* supplement of the *Sydney Morning Herald*, sharing insights into the Centre's investigation of kangaroo tendons.

Unlike intermittent tests or symptom-based assessment, the sensor operates within the gastrointestinal tract itself, providing ongoing insight into disease activity.

CASE STUDY:

From symptoms to signals in gut health

The gastrointestinal tract is one of the body's most complex and least accessible systems. For conditions such as inflammatory bowel disease (IBD), that complexity makes diagnosis and treatment especially challenging. Symptoms often fluctuate, and clinicians are frequently forced to adjust treatment only after a patient has already entered a painful and debilitating flare-up.

At the School of Biomedical Engineering, researchers have been exploring how continuous, precise monitoring could change that dynamic. Work led by **Mohit Shivdasani** focuses on developing technologies that make inflammation inside the gut visible in real time, enabling earlier and more informed clinical decisions.

In collaboration with clinicians and colleagues across UNSW and partner institutions, the team developed AutoGut: an implantable biosensor designed to detect cytokines, the chemical signals that indicate inflammation. Unlike intermittent tests or symptom-based assessment, the sensor operates within the gastrointestinal tract itself, providing ongoing insight into disease activity.

The ability to monitor inflammation continuously opens the door to more personalised care, making it possible for clinicians to adjust treatment based on an individual's biological signals, intervening earlier as required, and avoiding unnecessary interventions.

More broadly, the work illustrates how advances in monitoring can help make medical care more proactive than reactive. By capturing what is happening inside the body as it happens, technologies like AutoGut point toward a future where treatment decisions are guided by timely, patient-specific data.

“I think the future lies in the continual hybridising of different fields to make better, more eloquent solutions.”

– Rylie Green

CASE STUDY:

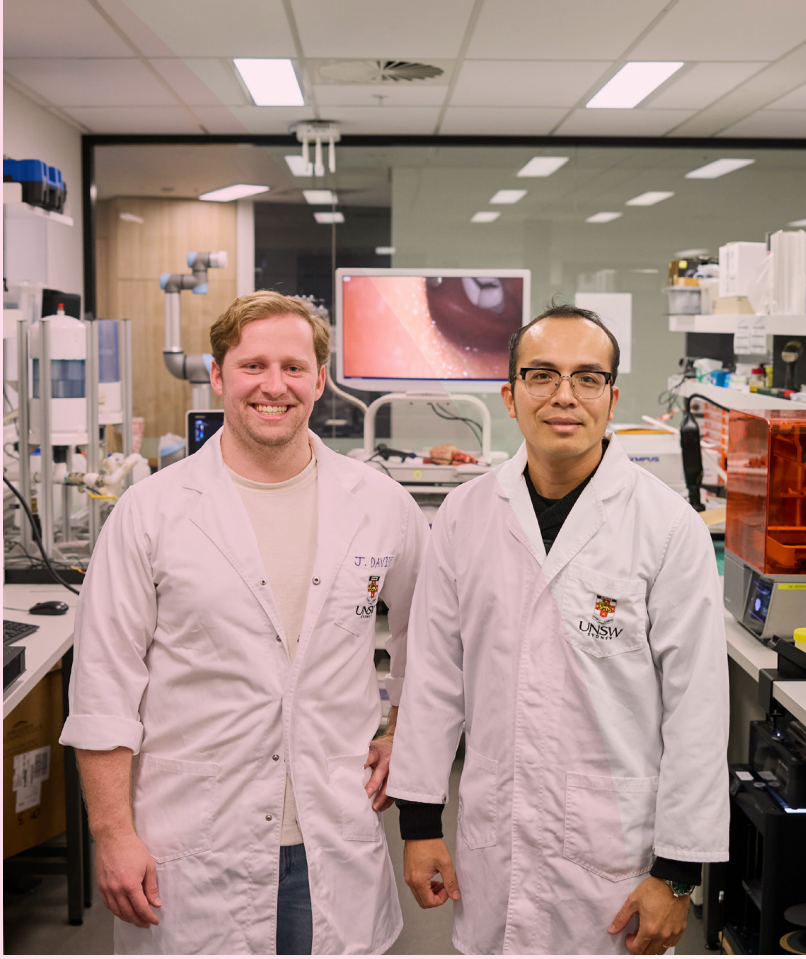
Soft robotics for cardiac support

Heart failure affects millions of people worldwide, yet for many patients a heart transplant is not possible. Mechanical assist devices can help support circulation, but they are often bulky, noisy and invasive, bringing risks of infection, clotting and reduced quality of life.

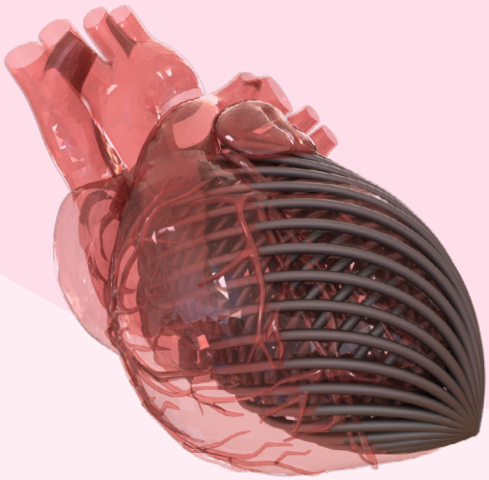
These limitations have driven efforts to find alternatives that can support the heart more simply and safely.

At the School of Biomedical Engineering, **Thanh Nho Do** and colleagues have been developing a soft robotic heart sleeve designed to augment the heart's natural motion. Rather than replacing the heart's pumping action, the sleeve surrounds the organ in a woven structure made from artificial muscle filaments, applying carefully controlled hydraulic compression that assists each beat.

The design is closely informed by cardiac physiology. One set of filaments provides gentle circumferential compression, while another follows the heart's spiral muscle fibres, supporting the twisting motion that plays a critical role in efficient pumping. Because the sleeve does not come into direct contact with blood, it avoids many of the complications associated with conventional assist devices.



▲ Thanh Nho Do (right) with James Davies in the lab where the soft robotic heart sleeve (below) was developed.



Early proof-of-concept studies have shown that the sleeve can reproduce natural patterns of cardiac movement under controlled conditions. As the design continues to be refined, the focus is on customising the sleeve for different hearts and progressing towards pre-clinical testing.

By aligning soft robotics with the mechanics of the living heart, this approach opens the door to assistive technologies that support cardiac function in ways that are quieter, less invasive and more attuned to the body itself.

CASE STUDY:

Engineering the future of cell therapy

In the early 1990s, cell therapies were showing enormous medical promise – but growing fragile human cells safely, consistently and at clinical scale was still slow, labour-intensive and difficult to standardise.

Robert Nordon's research helped change that. Drawing on his combined background in medicine and biomedical engineering, Nordon developed one of the first closed, automated bioreactor systems for large-scale human cell manufacturing. Originally emerging from his PhD work in cell separation, the technology evolved into the Quantum Cell Expansion System – a hollow-fibre bioreactor platform designed to grow therapeutic cells under tightly controlled conditions.

Licensed internationally and later commercialised by Terumo BCT, the Quantum system became widely adopted in clinical and industrial cell therapy manufacturing, supporting the production of stem cells and other advanced therapies around the world.

Today, Nordon's work continues to focus on the next generation of cell and gene therapy manufacturing systems. His research explores microfluidic bioreactors designed to automate increasingly complex cell culture processes. The aim is to reduce the enormous cost of manufacturing these therapies, bringing personalised treatments such as CAR T-cell therapy for cancer within reach of far more patients.

The work points to the next phase of a field that biomedical engineers at UNSW helped shape over decades. As cell and gene therapies move closer to mainstream clinical use, attention is increasingly turning to the challenge of manufacturing – how highly personalised treatments can be produced safely, efficiently and at a scale that makes broader access possible. Nordon's late-career research reflects that continuing shift from proof of concept towards practical clinical translation.

Drawing on his combined background in medicine and biomedical engineering, Nordon developed one of the first closed, automated bioreactor systems for large-scale human cell manufacturing.

"Right now, stem cell research still faces significant ethical and technological barriers. We don't currently possess the technology to utilise stem cells as a healing factor, however I believe regenerative medicine has enormous potential.

In the next fifty years, stem cell therapies could become far more routine, almost like taking Panadol. Whether it's treating severe burns or repairing damaged liver tissue, we may one day be able to use stem cells to help the body regenerate and heal itself."

— Sean Wang

CASE STUDY:

Precision anticoagulation for dialysis patients

In the early 1980s, dialysis was already a life-sustaining treatment for people with kidney failure, but it carried persistent risks. One of the most difficult to manage was clotting. As blood passed through the dialyser, it needed to be anticoagulated with heparin to prevent clots forming in the machine. Too little heparin could block the equipment; too much could leave patients at risk of bleeding, long after treatment ended.

At the time, dosing decisions were largely made in real time, guided by experience rather than precise measurement. By 1982, **Bruce Milthorpe** was part of a small UNSW team working under the direction of Peter Farrell, to investigate how heparin actually behaved in individual patients during dialysis.

Milthorpe and colleagues spent long hours in dialysis units measuring clotting times, building up a detailed picture of how anticoagulation rose and fell over the course of a three to four-hour session. They also studied heparin pharmacokinetics more broadly, examining how the drug bound to blood components, and how it varied from person to person.

From this data, the team developed a quantitative framework that allowed heparin doses to be tailored to the individual. The aim was precise timing, ensuring that anticoagulation protected the dialyser while blood was circulating through it, but wore off as treatment concluded.

The result was safer dialysis, reduced bleeding risk, and better protection of expensive equipment. It was an early example of biomedical engineering bringing measurement, modelling and clinical partnership together to solve a real and urgent problem in patient care.

The aim was precise timing, ensuring that anticoagulation protected the dialyser while blood was circulating through it, but wore off as treatment concluded.

CASE STUDY:

Connecting nerves, restoring function

The nervous system relies on precise electrical signalling to control movement, sensation and perception. When those signals are disrupted by injury, ageing or disease, the effects can be life-altering. Researchers at the School of Biomedical Engineering have been investigating stimulation technologies that interact directly with neural circuits, creating new ways to restore function when natural pathways are no longer reliable.

This work centres on bioelectronic devices that deliver carefully controlled electrical stimulation to targeted parts of the nervous system. Rather than attempting to reverse damage, these technologies focus on enabling communication between brain and body, or between neural signals and external devices.

These approaches make it possible for people with paralysis or neurological injury to control assistive technologies such as wheelchairs, communication tools or powered exoskeletons using their own neural signals.

One area of impact has been the development of brain–machine interfaces and related stimulation systems that translate neural activity into action. These approaches make it possible for people with paralysis or neurological injury to control assistive technologies such as wheelchairs, communication tools or powered exoskeletons using their own neural signals. In other cases, stimulation supports movement directly, reinforcing or bypassing disrupted neural pathways.

Across these applications, progress has depended on close collaboration with clinicians and patients, ensuring that stimulation technologies respond to real needs, and are focussed on outcomes that support agency, mobility and independence in the flow of everyday life.

CASE STUDY:

Refining a life-changing technology

Since their launch in the 1980s, cochlear implants have restored hearing for millions worldwide. Over time, however, their performance can be affected by fibrosis – the body's natural tendency to form scar-like tissue around an implant – and by the dissipation of the platinum used in the device's electrodes. Both processes can interfere with how electrical signals travel in the body, affecting how sound is ultimately perceived.

Working closely with Cochlear Limited, a multidisciplinary team led by **Laura Poole-Warren** has explored how next-generation implants might perform better, for longer. One stream of work investigates new protective coatings for the platinum electrodes. Another explores alternative materials, including conductive polymers, that may be more compatible with living tissue.

Looking further ahead, the team has also helped lay the groundwork for tissue-engineering approaches that could one day reduce the fibrosis response around implants – or even transform implants into therapeutic platforms, capable of delivering drugs or genes to enhance auditory function.

Progress in this field depends on credible testing environments. To that end, **Ulises Aregueta Robles** has been developing customised cochlea models that combine biomaterials and stem cell technologies, creating what he describes as "humanised" platforms for high-volume testing and, potentially, surgical training.

This work is incremental, but it reflects a deeper commitment to making a proven technology work better for longer, building on an innovation that has already transformed millions of lives.

CASE STUDY:

Preserving independence

Falls are a major cause of injury, loss of independence and hospitalisation among older people, particularly in aged care settings. Preventing them depends not only on responding quickly when a fall occurs, but on recognising subtle changes in movement that signal increased risk. The challenge has long been how to monitor those changes continuously, without compromising comfort, dignity or privacy.

At the School of Biomedical Engineering, researchers sought to address that challenge with the development of unobtrusive monitoring technologies that can detect changes in mobility well before a fall happens.

Work led by **Reza Argha**, with support from **Nigel Lovell**, has explored the use of millimetre-wave (mmWave) radar to track human movement without relying on wearables or cameras.

Unlike traditional monitoring systems, mmWave radar uses high-frequency radio waves to capture motion patterns as people move through space. Machine-learning models analyse these signals to identify changes in gait, balance and posture that may indicate declining stability. Over time, the system can build personalised mobility profiles, allowing both gradual deterioration and sudden risks to be recognised. By identifying early warning signs, caregivers can intervene sooner, adjusting care or modifying environments before a fall occurs.

CASE STUDY:

Rewriting the rules of contact lenses

For decades, soft contact lenses posed a stubborn trade-off. Made from water-filled polymers, they were comfortable to wear, but limited the flow of oxygen to the cornea. That restriction made long-term or continuous wear unsafe, placing real limits on how contact lenses could be used in everyday life.

Through the 1990s, the School's researchers played a key role in overcoming that barrier as part of the Cooperative Research Centre (CRC) for Eye Research and Technology. Led by UNSW optometry professor **Brien Holden**, the CRC brought together researchers from UNSW, the CSIRO and major academic and industry partners in an ambitious collaboration focused on next-generation contact lens technologies. **Klaus Schindhelm** played a central role in coordinating relationships across the program's many national and international partners.

The work at the School centred on biomaterials testing, clinical validation and biological evaluation. Researchers examined how new polymer formulations and surface coatings behaved in contact with living tissue, helping to identify materials that could deliver both high oxygen permeability and biocompatibility. This progress depended on meticulous laboratory work – batches of lenses tested, stained, counted and assessed – and close coordination between engineers and technical staff to ensure promising materials were not just effective, but safe.

The outcome was a new class of silicone hydrogel lenses, launched commercially in 1999 as Focus Night & Day. For the first time, soft contact lenses could safely deliver enough oxygen to support continuous wear.

This progress depended on meticulous laboratory work – batches of lenses tested, stained, counted and assessed – and close coordination between engineers and technical staff to ensure promising materials were not just effective, but safe.

"At the moment, we are taking Large Language Models that can process text and combining them with other deep learning models. We call these multimodal Large Language models.

So, for example, we currently have a deep learning model that can process electrocardiograms (ECGs). If we combine that with a Large Language Model, then we have something that can look at an ECG and not only classify it, but generate a report explaining the diagnosis and the possible treatments. Essentially, this is something like ChatGPT, but with expertise in cardiology.

The future will be the application of Large Language models in different fields of expertise."

— Reza Argha

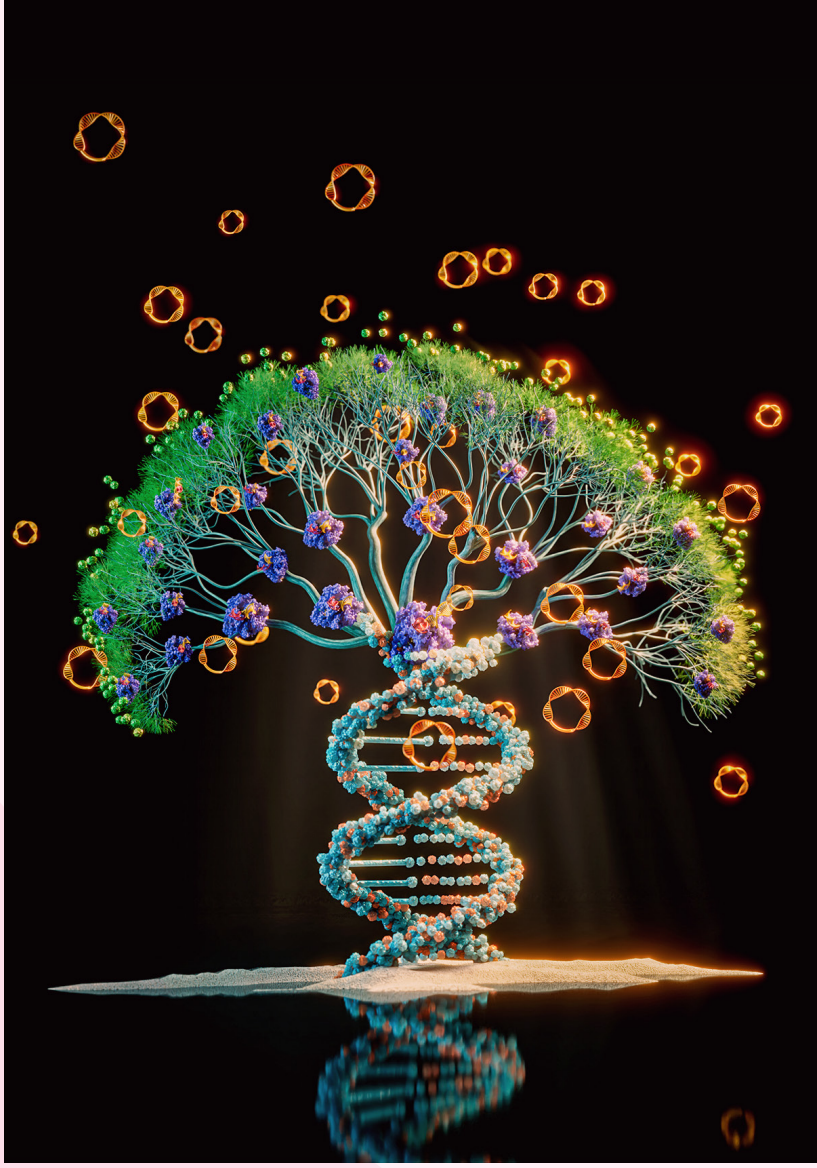
CASE STUDY:

Seeing disease in a new light

In the early 2000s, biomedical diagnostics relied heavily on samples removed from the body and analysed in laboratories. While effective, these approaches made it difficult to observe subtle biochemical changes as they unfolded inside living tissue. Then, **Ewa Goldys** made a field-defining observation: that cells themselves carry optical signals capable of revealing their molecular state.

Through her pioneering work in biophotonics, Goldys demonstrated that the natural fluorescence of cells and tissues – their colour – could act as a sensitive indicator of oxidative stress, a biochemical imbalance linked to conditions ranging from cancer and diabetes to cardiovascular disease. Her research established that changes in cellular metabolism produced distinct, measurable shifts in colour, effectively turning light into a read-out of molecular health.

To capture those signals, Goldys and her team adapted fluorescence imaging techniques to precisely record and analyse cellular colour patterns. Using advanced data analysis, they were able to 'unmix' the colours into their molecular components, allowing oxidative stress to be quantified without removing cells from the body.



▲ Digital imagery, developed by Ewa Goldys to help illustrate the principles behind her ground-breaking work in biophotonics.

"We found that colour is like a thermometer for oxidative stress," she says.

Recognised with a 2016 Australian Museum Eureka Prize, this discovery paved the way for new approaches in optical diagnostics. It laid the groundwork for non-invasive approaches to monitoring disease progression and treatment response, and established fluorescence imaging as a powerful bridge between physics, biology and medicine that continues to influence research into biosensing.

CASE STUDY:

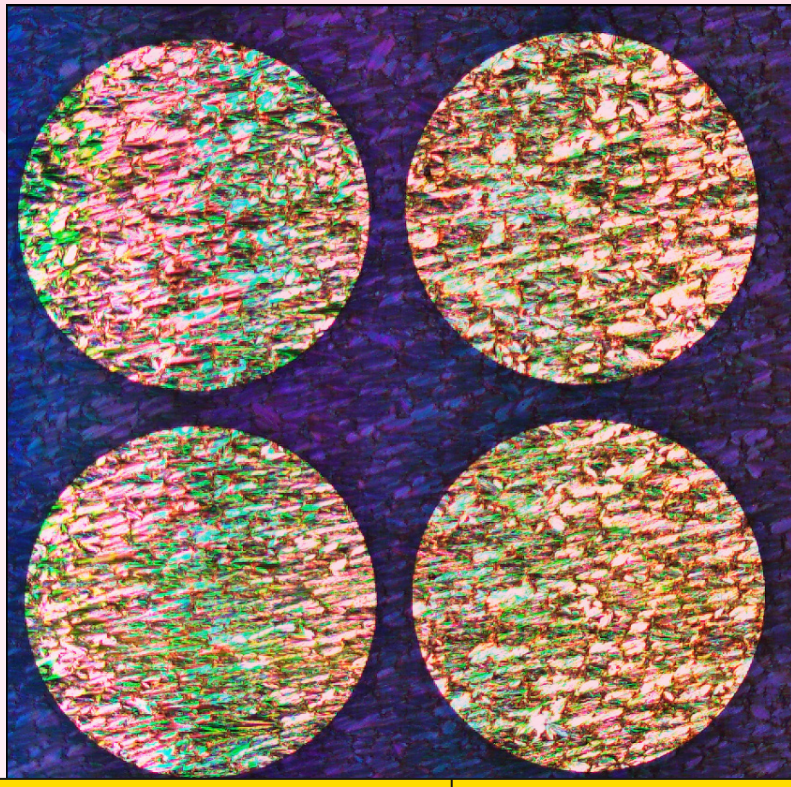
Optrodes and the future of neural sensing

For some time, it has been understood that monitoring electrical signals in the brain and heart can improve the diagnosis and treatment of neurological and cardiac disorders. The challenge has been technological, with the signal quality of conventional electrodes degrading as devices become smaller and more densely packed.

Researchers at the School of Biomedical Engineering have addressed that constraint by developing optical electrodes, or 'optrodes'. Rather than relying on electrical wiring, optrodes use liquid crystals and optical fibres to convert electrical activity in tissue, into light signals. This moves sensing into the optical domain, allowing far greater data capacity without interfering with the body's own electrical signals.

Since 2016, a cross-disciplinary UNSW team including **Amr Al Abed**, **François Ladouceur** and **Nigel Lovell** has demonstrated that optrodes can detect neural and cardiac signals at extremely high resolution, down to the level of individual cells. Early studies showed the technology could reliably record activity from nerve and heart tissue, opening new possibilities for understanding conditions such as epilepsy, Parkinson's disease and heart rhythm disorders.

Beyond clinical monitoring, optrodes have also enabled new laboratory tools that allow researchers to observe cellular electrical activity without dyes or genetic modification. Together, these advances have changed how electrical signals in living tissue can be observed, measured and interpreted.



▼ Optrodes use liquid crystals and optical fibres to convert electrical activity in tissue, into light signals.

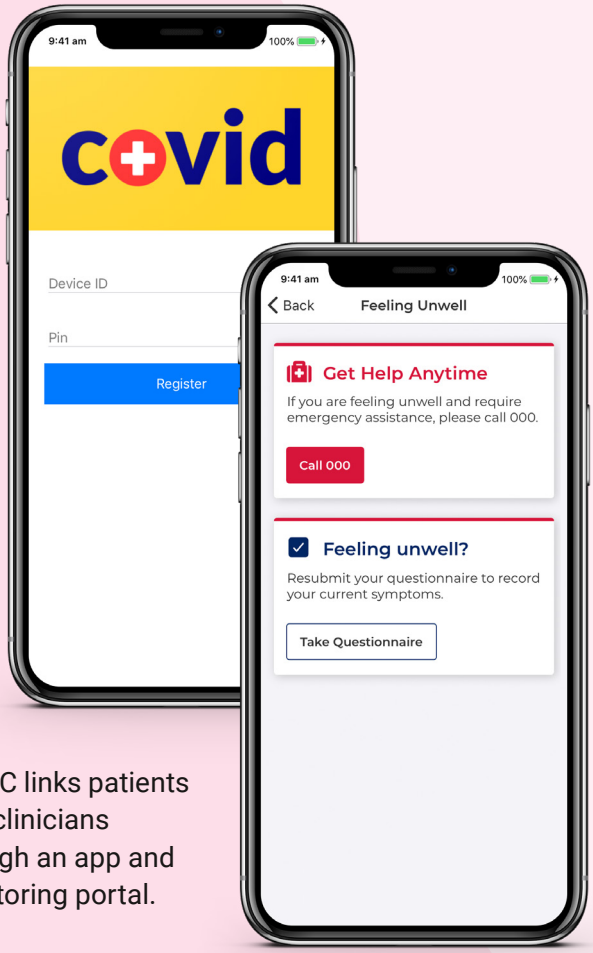
CASE STUDY:

From smartphones to clinical care

In the early 2000s, as mobile devices became more capable and ever more ubiquitous, researchers at UNSW began exploring whether everyday technology could be used as a clinical tool – collecting, integrating and interpreting health data beyond hospital walls.

That thinking was crystallised in the development of TeleClinicalCare (TCC), a smartphone-based remote monitoring platform co-led by **Nigel Lovell** and cardiologist **Sze-Yuan Ooi**. The concept was to use the smartphone as a hub, integrating patient-reported information with physiological data from low-cost sensors, and making it available to clinicians in real time.

Early versions focused on cardiac care. Patients measured vital signs at home, completed tailored questionnaires and received education and reminders, while clinicians viewed trends through a monitoring portal that helped prioritise those most at risk. Clinical trials showed a significant reduction in hospital readmissions.



▲ TCC links patients with clinicians through an app and monitoring portal.

When COVID-19 arrived, years of groundwork suddenly became urgent. The TCC platform was rapidly adapted to support the remote monitoring of COVID-positive patients, enabling thousands of people to be safely cared for at home while clinicians tracked symptoms and oxygen levels in real time. Alerts flagged deterioration early, helping hospitals focus resources where they were most needed.

Subsequent analysis of 5000 patients monitored through the TCC-COVID app revealed a death rate five times lower than among 250,000 non-monitored patients.

Since then, TCC has continued to evolve. New modules support stroke recovery, gestational diabetes, neonatal care and rehabilitation, with ongoing work exploring unobtrusive monitoring using radar and AI-based movement analysis.

"Every time we discover something, we discover ten things we don't know.

Regardless of how those discoveries get made, there will always be something new to learn. Maybe that's true across science generally, but it's especially true in medicine, where so many complex things are happening at the same time."

– Jonathan Yeow

Global from the beginning

FROM ITS EARLIEST DAYS, the School of Biomedical Engineering has been connected to the world. Researchers, students and industry partners travelled between Australia, Europe, North America and Asia to build collaborations beyond campus. These exchanges helped place the School at the centre of global conversations about how engineering could transform medicine, and contributed to breakthroughs in medical devices, biomaterials and digital health.

Over time, those connections have expanded into partnerships across every continent. Today, the School's students and academic staff continue to work alongside universities, hospitals and communities around the world, sharing knowledge, developing technologies and supporting the next generation of biomedical engineers.

In this way, the School is helping to ensure that advances in biomedical engineering are developed through global collaboration – and that their benefits are shared as widely as possible.

1 SAN FRANCISCO, USA

In 2012, UNSW alumna Sarah Knox moved to the University of California, San Francisco, to continue her research in cancer biology and biomedical science. She now heads the Knox Labs at the Helen Diller Family Comprehensive Cancer Centre.

2 SAN DIEGO, USA

ResMed, founded by Peter Farrell, was established in Australia in June 1989, and opened an office in San Diego in 1992. It remains the company's global headquarters.

3 NEW JERSEY, USA

Laura Poole-Warren spent part of her career at the New Jersey Center for Biomaterials at Rutgers University in the late 1990s, contributing to international research on biomaterials and medical devices.

4 NEW YORK, USA

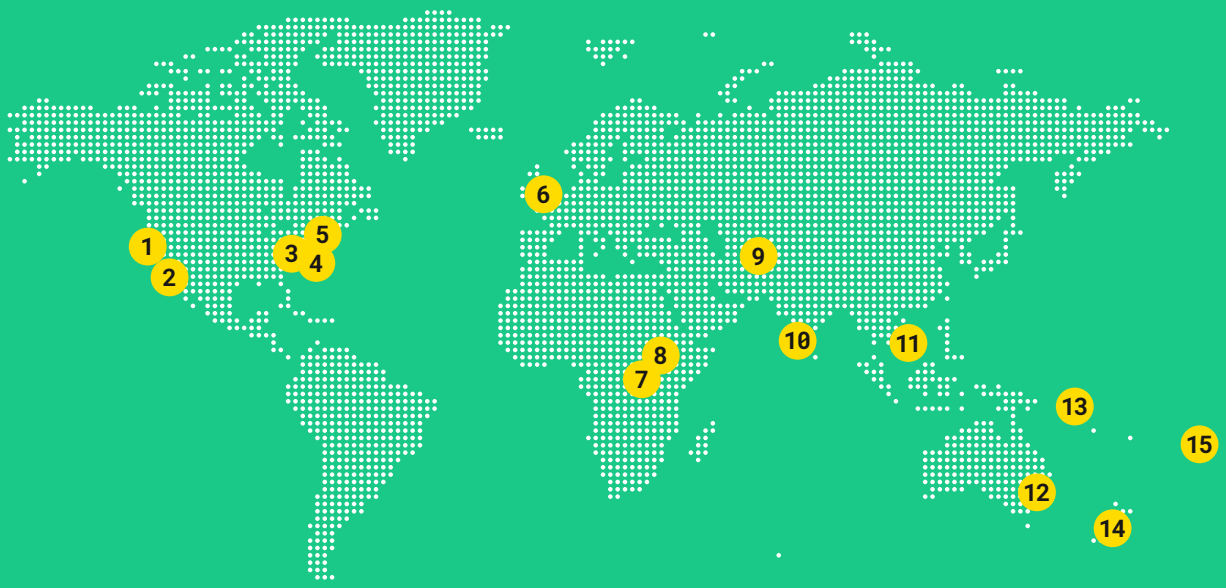
The Institute of Electrical and Electronics Engineers (IEEE), headquartered in New York City, appointed Nigel Lovell President of the Engineering in Medicine and Biology Society for 2017 and 2018.

5 CAMBRIDGE, USA

Peter Farrell's career included advisory roles with the Harvard–MIT Health Sciences and Technology Program, linking UNSW biomedical engineering with leading US research institutions.

6 LONDON, UK

In 2016, UNSW alumna Rylie Green moved to London to join the Bioengineering Department at Imperial College London. She now heads the department.



7 MASAKA, UGANDA

In partnership with Engineering World Health, students travelled to Uganda to support staff at Masaka Regional Referral Hospital and Kitovu Hospital. Between 2016 and 2019, more than 150 students helped repair over 2000 pieces of medical equipment.

8 KAMPALA, UGANDA

Students from UNSW and Makerere University collaborated on the design and development of an affordable prosthetic hand for people with upper-limb amputations.

9 KABUL, AFGHANISTAN

After taking part in the Engineering World Health Summer Institute, biomedical engineering graduate James Lee relocated to conflict-affected regions in the Middle East and South Asia to support health services in challenging environments.

10 COIMBATORE, INDIA

In 1998, the Chancellor of the Avinashilingam Institute for Home Science and Higher Education for Women travelled to Australia to meet with the School's Head, Bruce Milthorpe.

11 CAMBODIA

Between 2016 and 2019, students from UNSW travelled to Cambodia to help repair and maintain medical equipment in regional hospitals. The program restored hundreds of devices while giving students firsthand experience of biomedical engineering in resource-constrained healthcare systems.

12 SYDNEY, AUSTRALIA

The 2003 World Congress on Medical Physics and Biomedical Engineering and the 2004 World Congress of Biomaterials were hosted by the School.

13 HONIARA, SOLOMON ISLANDS

In 2025, students tested early prototypes of a low-cost communication aid with collaborators at the Red Cross School and Solomon Islands National University.

14 CHRISTCHURCH, NEW ZEALAND

UNSW and the University of Canterbury partnered on a project to design and prototype low-cost, retrofittable wheelchairs.

15 NUKU ALOFA, TONGA

In 2024, UNSW and Christ's University in Pacific (CUP) signed a Memorandum of Understanding to ongoing collaborations. Lauren Kark later spoke at the CUP Science Conference.

The making of a community



▲ Preparing for the academic procession at the Biomedical Engineering graduation ceremony: Mohit Shivdasani, Nigel Lovell, Laura Poole-Warren, Ulises Aregueta Robles, Tianruo Gui, Dorna Esrafilzadeh, Robert Nordon and Jelena Rnjak-Kovacina.

THROUGHOUT ITS HISTORY, the students, researchers, technicians and teachers of the School of Biomedical Engineering have built a community defined by generosity, curiosity and a shared sense of purpose.

Mentors have encouraged new talent. Colleagues have challenged and supported one another. Lifelong relationships have formed. And students have found the confidence to pursue grand ideas of their own.

Together, these connections have created a place where collaboration comes naturally, where careers are nurtured, and where the ambition to improve human health through engineering continues to grow. It is something to be cherished.

Open-door culture and the buzz of ideas

The School of Biomedical Engineering is a friendly and informal place. Doors stand open. Conversations start easily. People from very different backgrounds find themselves working side by side.

Hamid Alinejad Rokny made that discovery when he arrived in Australia from Iran to begin his career at UNSW, introducing himself in the simplest way he knew how.

"I sent emails to people saying, 'I am starting a new job here. I would be happy to meet you and see if we can work together' – and almost 80 percent of people replied to my email!"

> "It is competitive, but it's collaborative. And it should be competitive, because that helps you grow"
>
> – Hamid Alinejad Rokny

What he found was an environment that was both ambitious and generous.

"It is competitive, but it's collaborative. And it should be competitive, because that helps you grow. If you want to do something big, you should be in an environment that is competitive, but collaborative."

Penny Martens remembers arriving from the United States and being struck immediately by the welcoming atmosphere.

"It was open, collegial, friendly – we went to the pub all the time," she says. "People left the doors open. There were lots of corridor conversations. It was just this beautiful mix. Everyone was there and we were all in it together."

Biomedical engineer **James Lee** remembers the impact of having lecturers step straight from the lab into the classroom, brimming with ideas.

"They would say, 'Hey, I was just doing this really cool thing rebuilding tissue on a lamb's bone because we want to see how we can apply that to the regrowth of bones in humans.'"

Rylie Green was also struck by the sense of openness.

"You could wander through anybody's lab, have a chat with anybody, and there would always be someone to help you out," she says. "If you needed something, they'd help you build it."

It's a culture that makes discovery possible, says **Sarah Knox**.

"There was always a really strong, happy, interesting, collaborative feeling at the School," she says. "If it doesn't feel like that, then it's not going to be a place where discoveries come easily. It takes a network of people to invent things. It takes a lot of connection."

For **Lauren Kark**, that collaborative instinct is more than culture – it is the discipline's defining strength.

"Through knowing who we are, through our collaborative capabilities, we can really start to take the lead in finding the right problems to solve," she says. "I think that's one of the super powers of biomedical engineering."

"Through knowing who we are, through our collaborative capabilities, we can really start to take the lead in finding the right problems to solve. I think that's one of the super powers of biomedical engineering."

– Lauren Kark



◀ A motley crew of master's and PhD students in 1983. Garvan Williams, Peter Spencer, and Brett Charlton, occupy the top row. The bottom row includes Wal Flicker, Margie Smith, Mike Griffiths, and Anne Simmons.

People, purpose, and a place to hang



▲ The School has always had a reputation as a friendly, social place, boosted by initiatives like the Biomedical Engineering Students' Society.

Every generation of biomedical engineers at UNSW starts out roughly the same way. Long before they become professors, industry leaders or pioneers of new technologies, they are simply students, trying to find the right lecture room, getting to grips with unfamiliar principles and techniques, and ultimately finding the people who will help shape their careers.

For most of the School's history, that journey has unfolded within a small cohort of students with one foot in biomedical engineering and the other in one of the more established disciplines. They moved between buildings and departments, learning different technical languages while discovering they had something important in common: the desire to save lives, reduce suffering and restore wellbeing through engineering.

Initiatives like the Biomedical Engineering Students' Society (BESS) have helped turn that scattered cohort into a community. What started out as a series of friendly get-togethers has evolved into something more substantial. **Sean Wang**, a second-year student and 2026 Co-President, is proud of the role BESS plays in filling gaps in knowledge, boosting skills, and exposing students to the people and workplaces where their careers will one day flourish.

"It's not just drinking on a Friday night," he laughs. "It's also about hosting very meaningful events, seeing people regularly, asking them questions, learning about the opportunities and talking to industry reps as well."

Following the disruption of COVID-era shutdowns, the School introduced the Pastoral Academic and Social Support (PASS) initiative for higher-degree researchers. Weekly coffee meet-ups, 'ChewsDay lunches' and occasional events brought students and staff together in ways that blur hierarchy.

"Even Nigel Lovell comes, although sometimes he only brings an apple," says PhD student **Sophie Lim**. "I just feel like we're really welcomed here. Everyone's friendly and they're always happy to have a chat."

With the launch of a new undergraduate biomedical engineering degree in 2026, that sense of belonging will become even more important.

"We need to establish, in the longer term, a presence for our students," says Lovell. "They should be hanging out here, but we need to create the space – a space that will be linked to our identity. That's the next challenge."

An academic family tree

Across fifty years, the School of Biomedical Engineering has grown something like an academic family tree. Students become mentors, mentors guide the next generation – and along the way, people look out for each other's careers, opening doors and creating opportunities.

In many ways, it begins with **Peter Farrell**. In the early days of the Centre for Biomedical Engineering, he built an unusually open network of students, visiting researchers and industry partners. People arrived from around the world and stayed for months or years. Others were sent overseas, building connections between UNSW and the world.

When a young **Anne Simmons** finished her master's degree in 1980 – one of the Centre's first two graduates – she turned to Farrell for career advice.

"He said, 'You belong in industry, Anne. I need to get you out into industry somewhere.'"

He introduced her to colleagues in the emerging medical technology sector, launching a career that would span two decades in industry before she returned to the School in a leadership role.

People arrived from around the world and stayed for months or years. Others were sent overseas, building connections between UNSW and the world.

That instinct to mentor, advocate and open doors soon became part of the culture. Farrell supported the early careers of researchers including **Klaus Schindhelm** and **Bruce Milthorpe**. That generation carried the tradition forward in turn. Over time, those students began shaping the field themselves, leading laboratories, building companies and teaching the next generation.

Simmons has watched that process unfold many times. When asked about the people she is most proud of mentoring, her composure slips.

"I may cry here," she says, naming **Megan Lord** and **Lauren Kark**. "They're both professors. They're both as smart as all get out. They're both just lovely people, and they've both done really well."

For Kark, that encouragement came at exactly the right moment. After finishing her PhD, she was planning to leave academia altogether.

▼ Open Day 2003: Anne Simmons, Klaus Schindhelm and Ross Odell.





◀ A lu'au party, one of many festive events that helped build a strong and welcoming culture at the School of Biomedical Engineering.

"Anne called me into her office and said, 'What are you going to do next year?' I told her I was going to coach gymnastics and travel," Kark recalls.

"And she just said, 'Absolutely not. You're going to come work here for a year.'"

A small vote of confidence. The kind that changes a career – and keeps the family tree growing.

"These stalwarts, these unsung heroes"

For decades, technicians and laboratory managers have helped students take their first uncertain steps in the lab, transforming enthusiasm into expertise. They teach the fundamentals of technical practice, workplace health and safety, and budget management. They act as the guardians of ethics and accountability. And they guide generations of researchers through their earliest academic milestones.

Many alumni remember those essential lessons vividly. Some of the most basic skills – how to prepare samples, use equipment, or handle delicate materials – were learned at the lab bench from technicians whose patience shaped countless careers.

Technicians like **Lynn Ferris**.

"The School has these stalwarts, these unsung heroes, and Lynn Ferris is one of them," says **Rylie Green**. "You will not find a PhD thesis that's come out of that department where Lynn is not thanked, I guarantee you."

For **Veronika Tatarinoff**, who spent four decades with the School, the reward has always been seeing where those students end up.

"I really love having worked with so many PhD students and master's students," she says. "To be part of their development and then see them move on to roles like Provost or Dean has been really exciting and satisfying."

Sometimes, she still hears from them.

"They'll send an email and say, 'Can you send me your notes from that training session?' It's nice to know I've left my mark."



"Outstanding track record of leadership": The inaugural UNSW Provost, Professor Anne Simmons.

Simmons appointed inaugural Provost

▲ The School has produced leaders in academia and industry, including Anne Simmons who in 2019 was appointed inaugural UNSW Provost.



▲ Generations of experience, expertise and leadership are shared by the women of the School of Biomedical Engineering.

"So many amazing, powerful women!"

When **Penny Martens** arrived at the School as a young post-doctoral researcher, one thing was clear.

"There were just so many amazing, powerful women in biomed," she recalls. "It was very obvious that the women ruled."

For Martens, the influence was both visible and personal. Senior figures including **Anne Simmons** and **Laura Poole-Warren** made time for regular lunches with younger colleagues, creating space for conversations that were informal and supportive.

"I was this baby postdoc," she laughs, "and I was getting to have lunch with the professors."

Those moments reflected something deeper about the School, about all the women who had helped shape its culture, and in particular about Poole-Warren who has played a central role in the careers of many young researchers. Indeed, it was Poole-Warren who encouraged Martens, later appointed Pro Vice-Chancellor at the University of Technology, Sydney, to get involved in teaching and supervision, building the experience she needed to establish an academic career.



▲ Women have played a crucial role in the School's leadership group across the past 50 years.

Rylie Green, too, recalls how deliberately Poole-Warren championed women stepping forward as leaders.

"Laura was very encouraging about women in leadership," Green says. "It meant I could walk into anything and say, 'Yes, sure, I can do that.'"

For **Megan Lord**, the connection stretches back even further. As a teenager considering engineering, she attended an Open Day at UNSW and met Poole-Warren for the first time.

"I met Laura when I was 16," she recalls. "Then when I came back the next year to Open Day, she remembered me. I thought, 'This is a good sign!'"

Lord would go on to study biomedical engineering at UNSW and build her entire career there.

"To meet Laura at 16 and still be working with her almost 30 years later is pretty special for me."

A roll call of leadership

ACROSS ITS HISTORY, the School of Biomedical Engineering has been shaped by many outstanding contributors whose work has advanced both science and human health. Among them are three leaders who have been recognised by appointment as Members of the Order of Australia (AM), one of the country's highest civilian honours.



Professor Laura Poole-Warren AM (2020)
Laura Poole-Warren was appointed a Member of the Order of Australia in 2020 for significant service to education and to biomedical engineering. A longstanding member of the UNSW biomedical engineering community since her student days in the early 1980s, she helped shape the field through pioneering research in biomaterials and neural interfaces, as well as through major leadership roles including Pro Vice-Chancellor, Research Training and Dean of Graduate Research at UNSW.

Emeritus Professor Anne Simmons AM (2013)
Anne Simmons received her AM in 2013 for significant service to biomedical engineering as an academic and administrator. Beginning her association with UNSW as a postgraduate student in 1979, Simmons built a distinguished career spanning both industry and academia, including senior leadership roles within the University. She later became UNSW's inaugural Provost, the senior deputy to the Vice-Chancellor.





Dr Peter Farrell AM (2004)
Peter Farrell was appointed a Member of the Order of Australia in 2004 for service to biomedical research and engineering, to business as an entrepreneur and to the community through philanthropy. A pioneer of biomedical engineering in Australia, Farrell combined academic insight with entrepreneurial vision, founding ResMed and helping translate research into therapies that have improved the lives of millions of people worldwide.

1976–2026: Community gallery







● Innovations developed on early computers and collaborative whiteboards. Relationships developed in the lab – and on the dance floor.









Over half a century, the School has seen students full of curiosity and enthusiasm develop into academic leaders and biomedical engineers of world-renown.



















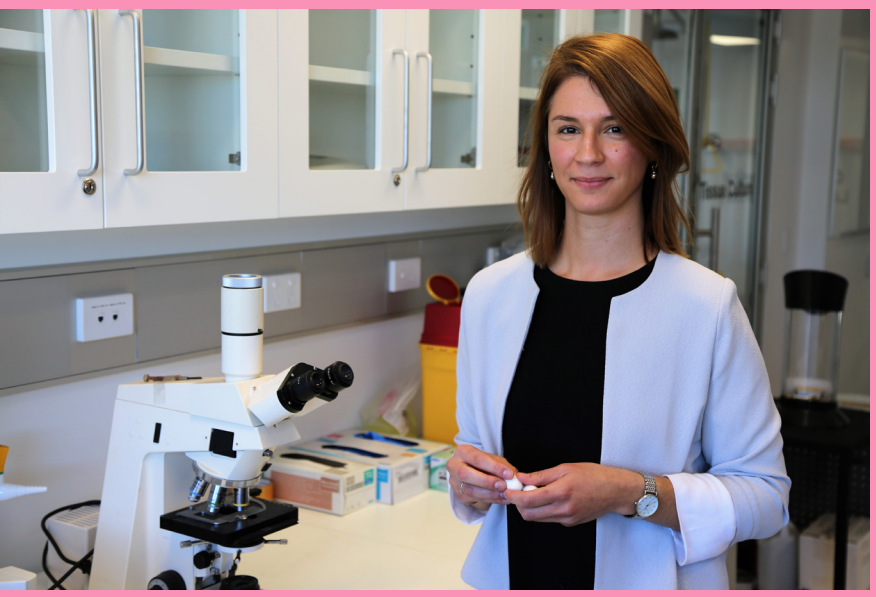
● The School has produced both scientific breakthroughs – and lifelong friendships.



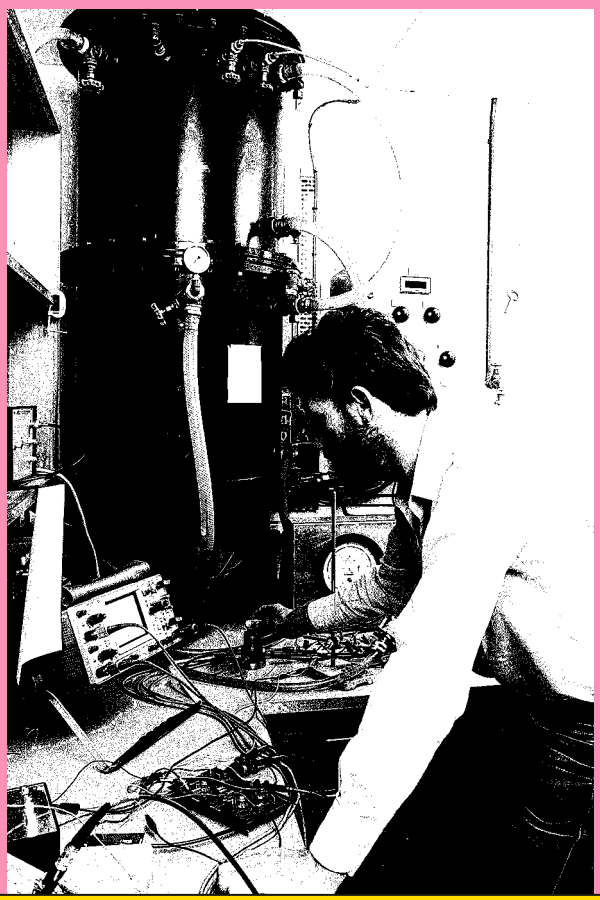


Throughout its history, the School of Biomedical Engineering has attracted staff and students with curious minds, outstanding technical ability and a passion for learning.





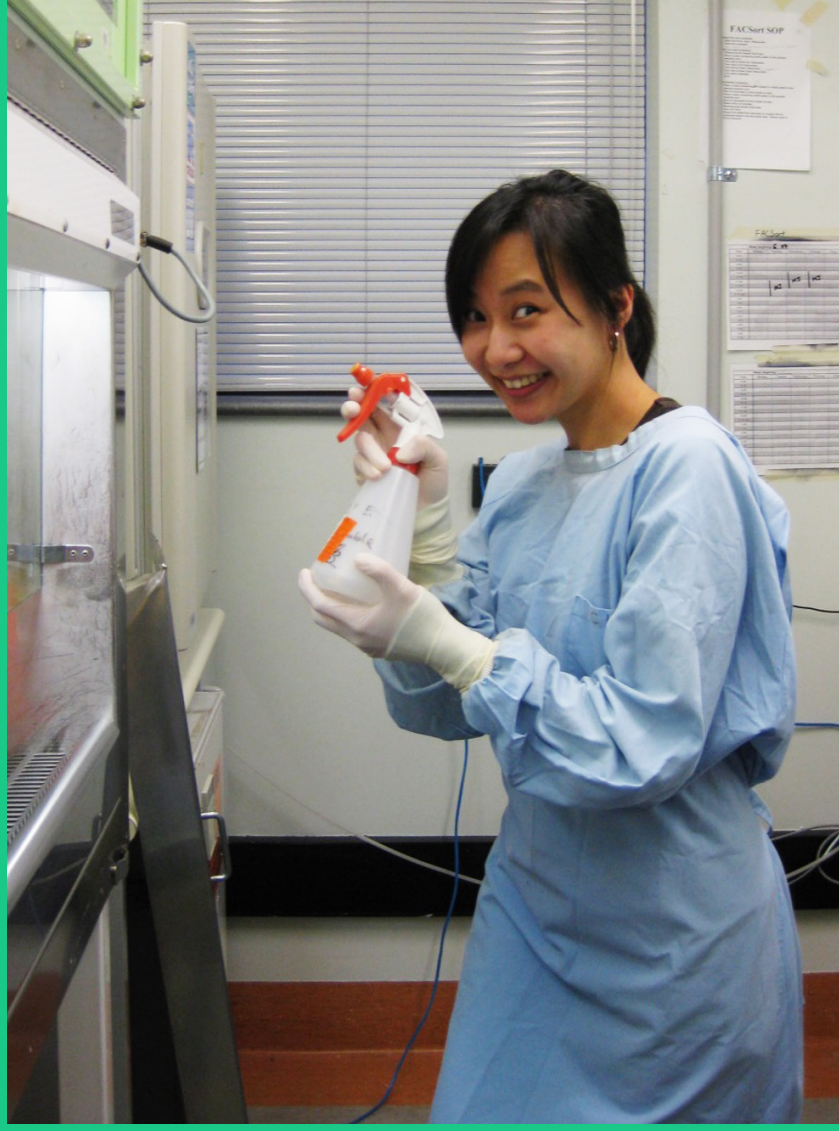


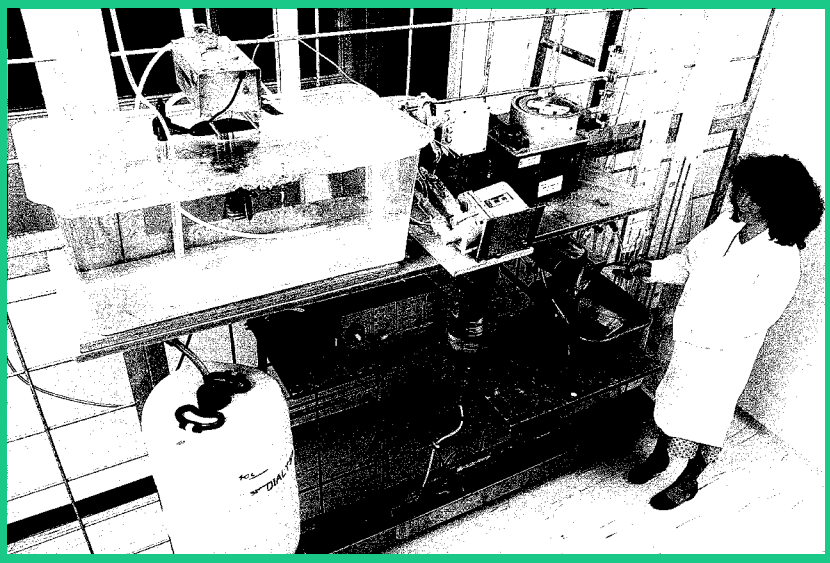












In its earliest days, the School made the most of rudimentary workspaces including, most notably, toilet cubicles. Technical staff maintained impeccable standards, even in the most unlikely settings.







Across five decades, the School community has matched learning with laughter – while pursuing ideas and solutions that improved people's lives in extraordinarily tangible ways.







A collective future: across disciplines, beyond borders



▲ A team led by Scientia Thanh Nho Do has developed a new glove-like device designed to recreate the sense of touch.

OVER 50 YEARS, through ingenuity, collaboration and persistence, the pioneers of biomedical engineering at UNSW built a remarkable foundation – one that helped establish the discipline's global standing, and which now underpins a still unfolding future.

Today, disciplines are converging, opening up possibilities that were once unimaginable. Breakthroughs in areas such as tissue engineering, artificial intelligence and personalised modelling are advancing rapidly in their own right – but their greatest potential lies in how they come together.

Collectively, they point to a future where repair and regeneration are as familiar as treatment, and where health is understood and managed at the level of the individual, often in their own home. Realising that potential will depend, as it always has, on a global community bringing together a rich variety of perspectives and experiences. The School enters its next 50 years ready to play a leading role in building that future.



"I can see this confluence of technology and biology having so much impact in the next few years – beyond health and healthcare. It's going to change society and humanity. It's just such an exciting field – and my only sadness is that I'm not going to be around for it."

– Nigel Lovell

"We still have the challenge of defining the discipline – and I'm really pleased that the School of Biomedical Engineering will have the critical mass to really contribute to that conversation over the next five to ten years."

– Lauren Kark





"I don't know what disease or application we will be talking about in the future, but I know there will always be biomedical engineers at the forefront, saying: 'OK, there's a problem. How can we fix it? What do we need?'"

– Penny Martens

"When I was 21 years old, walking in to start my master's, if you'd told me then what I would be seeing at this end of my career – devices like the Cochlear implants that absolutely blow your mind – I just wouldn't have believed it.

What I've seen in the last 45 years as an engineer has been extraordinary. The next 50 years will be even more extraordinary, there's no question about it."

– Anne Simmons

UNSW School of Biomedical Engineering
Sydney NSW 2052
Australia

E: biomedeng@unsw.edu.au
T: +61 2 93851000
W: unsw.edu.au/engineering/our-schools/biomedical-engineering

Images throughout this publication have been sourced from the UNSW Archives and the UNSW Newsroom, with additional images generously contributed by members of the UNSW School of Biomedical Engineering community.

50 years of thinking differently

UNSW School of Biomedical Engineering, 1976–2026

1976

2026

UNSW SYDNEY