VOL. 9 | NO. 8 | SEPTEMBER 2023

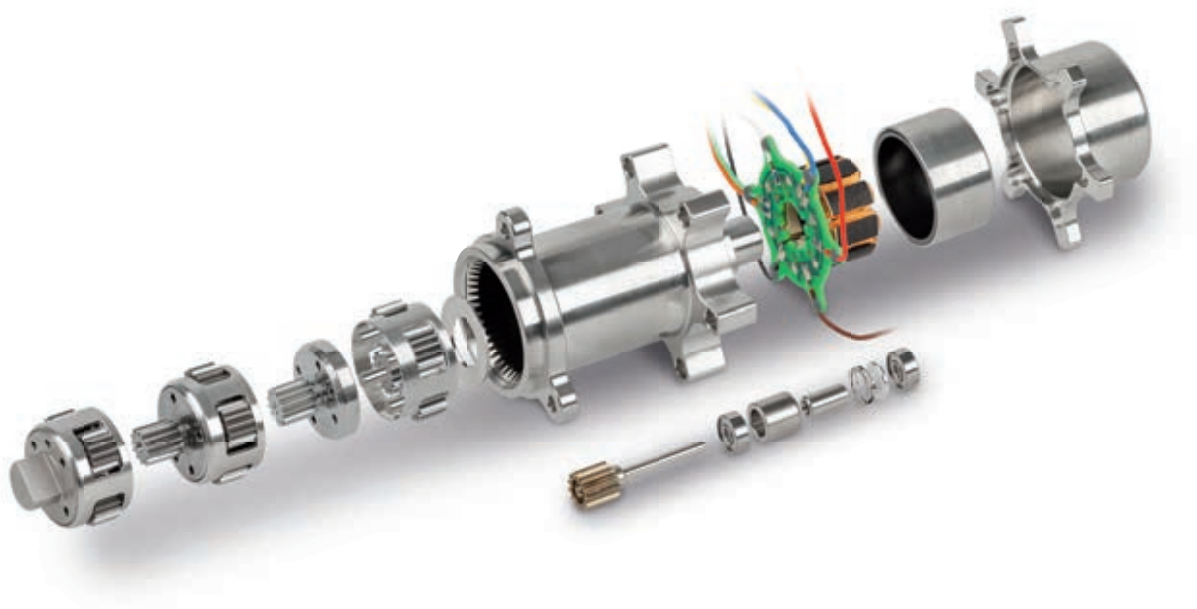
create

ENGINEERING IDEAS INTO REALITY

ENGINEERS
AUSTRALIA

THE BIOTECH BOOM

HOW AUSTRALIA CAN MAKE THE MOST OF A $10 BILLION INDUSTRY



Perfectly tuned to Mars

This high-end drive will handle the soil samples in the Mars rover, and was developed in close collaboration with the customer. It is based on our standard industrial products: a flat, brushless DC motor and a planetary gearhead with a diameter of 22 mm. We don't give up until we make the seemingly perfect even better. Explore our universe now: **www.maxongroup.net.au**

MARS EXPLORATION PROGRAM • SINCE 1997 •

Approved supplier
of mechanism actuators for
space exploration missions

Precision Drive Systems

maxon

CONTENTS

THE JOURNAL FOR ENGINEERS AUSTRALIA

VOL. 9 | NO. 8 | SEPTEMBER 2023

COVER PHOTO: SIEMENS

ENGINEERS AUSTRALIA

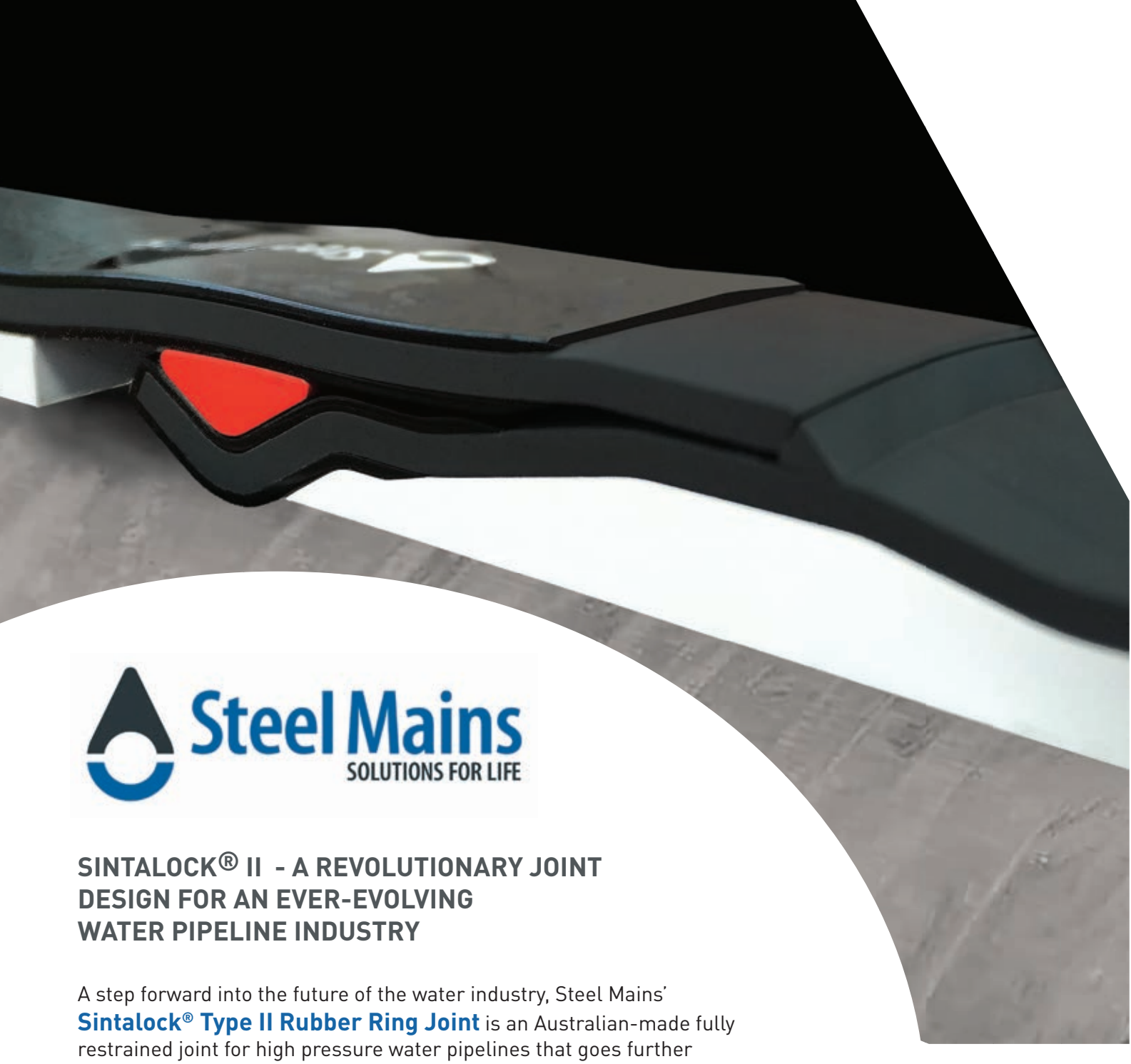
ENGINEERS AUSTRALIA NATIONAL OFFICE

11 National Circuit, Barton, ACT 2600
Phone 02 6270 6555
www.engineersaustralia.org.au
memberservices@*engineersaustralia.org.au*
1300 653 113

National President and Board Chair: Nick Fleming FIEAust CPEng EngExec NER APEC Engineer IntPE(Aus) GAICD
Chief Executive Officer: Romilly Madew AO FTSE HonFIEAust
Board Director: Raj Aseervatham FIEAust CPEng APEC Engineer IntPE(Aus)
Board Director: Lachlan Blackhall FIEAust FTSE
Board Director: Lucia Cade FIEAust FAICD
Board Director: Thomas Goerke FIEAust CPEng EngExec NER GAICD
Board Director: Kourosh Kayvani FIEAust CPEng MAICD
Board Director: Liza Maimone FIEAust CPEng EngExec NER APEC Engineer IntPE(Aus)
Board Director: Lisa Vitaris MAICD
Group Executive, Policy and Public Affairs: Damian Ogden ComplEAust

Publisher: Mahlab
Managing Director: Bobbi Mahlab
Editor: Joe Ennis
joe@mahlab.co
Deputy Editor: Jonathan Bradley
jonathan@mahlab.co
Advertising Manager: Josh Lomas
josh@mahlab.co
Creative Director: Gareth Allsopp
Art Director: Caryn Iseman
Production Manager: Lisa Galvan

369a Darling Street, Balmain, NSW 2041
www.mahlab.co
Printed by: IVE
Mailed by: D&D Mailing
ISSN 2205-5983



Steel Mains
SOLUTIONS FOR LIFE

SINTALOCK® II - A REVOLUTIONARY JOINT DESIGN FOR AN EVER-EVOLVING WATER PIPELINE INDUSTRY

A step forward into the future of the water industry, Steel Mains' **Sintalock® Type II Rubber Ring Joint** is an Australian-made fully restrained joint for high pressure water pipelines that goes further beyond today's standards than any other joint in the market.

With no need to enter the pipe for welding or lining reinstatement, safety is optimised while corrosion protection is fully enhanced and laying rates are maximised.

GET IT ON Google Play

Download on the App Store

www.steelmains.com

EVERY ISSUE

NEWS

CREATE DIGITAL
createdigital.org.au

Check out the *create* website — your best resource for the latest engineering news and information from Australia and the world.

Making life better

ENGINEERS ARE APPLYING FRESH THINKING TO IMPROVE THE HEALTH OF OUR CITIES, OUR ENVIRONMENT AND OURSELVES.

WELCOME TO the September issue of *create*. After a mild winter, spring has arrived with its blue skies, new growth and swooping magpies.

Construction sites across the country, at least those in the southern states, have said goodbye to cold, dark mornings and are basking in the warm, but not yet too hot, days.

At Hanlon Park in Brisbane, the locals and the wildlife are enjoying a free-flowing creek where a concrete stormwater drain once stood, courtesy of a naturalisation project that called on a visionary local government and an innovative team of engineers.

Such green spaces are integral to our cities, providing habitat for urban wildlife, open space for recreation and cooling, and green tracts for cleaner air and water. We take a look at this commendable project, which will be enjoyed for generations to come.

It's with an eye to the future that a dedicated team of scientists and engineers is developing new biodegradable materials to save the oceans from plastic waste.

Read how polymers derived from seaweed aim to prevent plastic pollution from entering the ocean and harming marine life, as well as new uses for waste wool and human hair.

Our cover story this month looks at developments in the bio-medical field. This country has historically been over-represented in inventions and innovations that changed the world — or at least made life better.

The Cochlear implant is a household name, but what about wearable tech that interprets biometric information from newborns or the elderly, or takes heart attack diagnoses down from five hours to 10 minutes?

As with their forebears, Australian engineers are making remarkable gains in the field but, as many a past generation will attest, the local industry has some growing to do before it can support the breadth of talent this country can produce.

A uniform approach to expanding the profession will help the sector develop so local innovations can find a commercial market here and Australian industry can reap the benefits.

Rather than losing our valuable graduates overseas, we could attract international expertise to our shores.

Around the globe, we see momentum gathering on the approach to artificial intelligence (AI).

In this issue, read how Engineers Australia is participating in debates to help Australia establish ethical and viable guidelines on the acceptable use of AI.

This powerful tool has great implications in engineering, to refine and condense design and test phases of projects and minimise disruption during renewal and upgrade works to critical infrastructure.

It's vital that AI can be put to its best use to advance society but that this progress is measured and sustainable.

We are only beginning to understand the vast potential of AI; so too the risks.

It's important that our policymakers and agenda-setters keep in touch with the STEM community to move forward at a pace that doesn't disadvantage Australia in the race to capitalise on AI without barrelling headlong into a situation history may judge harshly.

"This country has historically been over-represented in inventions and innovations that changed the world."

Dr Nick Fleming
FIEAust CPEng EngExec NER
APEC Engineer IntPE(Aus) GAICD,
National President
nationalpresident@
engineersaustralia.org.au

Romilly Madew AO
FTSE HonFIEAust,
Chief Executive Officer
rmadew@
engineersaustralia.org.au

Gala dinner | 29 November

Celebrating engineering shaping the nation

ENGINEERS AUSTRALIA

Excellence Awards

Celebrate excellence in engineering at this year's prestigious awards

Join us Wednesday 29 November at Crown Towers, Melbourne as we celebrate the national winners of the Engineers Australia Excellence Awards 2023. The awards recognise the outstanding achievements of the country's engineers across the diverse categories of people and projects.

Book tickets →

DEBATE AND DISCUSSION BY *CREATE* READERS

Getting energy right

There is an obvious solution to the sustainable energy problem ("Negative emissions," *create* July 2023) which we choose to continuously ignore: nuclear power. It is safe, stable, reliable, controllable and emissions free.

It is also the cheapest way to generate baseload electric power essential for the grid to be able to operate.

Solar, wind and batteries are not the answer as they are intermittent, unstable, unreliable, uncontrollable and unaffordable, and thus cannot generate baseload power. Also, a "black" start would be impossible.

You cannot run a power grid from uncontrollable generators.

NATHANIEL BULL

Questions to consider

Having watched, with some bemusement, the slow-motion train wreck of our energy transition in Australia I'd like to put the following questions to my colleagues:

"There is an obvious solution to the sustainable energy problem which we choose to continuously ignore: nuclear power."

- The only technologies that we actually know have been successful in deep decarbonising electricity grids are geothermal, nuclear and hydro. It is entirely speculative that wind and solar will work. Why have we opted for the highest risk option?

- When we consider integration costs, wind and solar are the most expensive. This cost scales up with the proportion of renewables we are trying to integrate. Again, why have we done this?

- We still have no clear idea of what the final cost of this will be, but for integration costs alone it will be in the range of hundreds of billions of dollars, and probably much, much more. Shouldn't this uncertainty, and risk, concern us as engineers?

- We will lock in fossil fuels because 100 per cent renewable energy is even now recognised as incredibly expensive. Multi-week wind lulls dictate dispatchables, as battery storage will not scale cost-effectively. We are thus still locking in fossil fuels to the energy mix. Is failure acceptable then?

- The cost of power will go up as renewables increase, just as it has wherever renewables achieve a significant share of the energy market. Do we really expect industry and consumers will appreciate power that is both less reliable and more costly?

Perhaps it's time for us as a profession to speak up, loudly, and shape a new course for the nation.

MATTHEW SQUAIR CPEng

The engineer's toolkit

I am so pleased to see artificial intelligence and machine learning being referred to as *tools* ("Mind at work," *create* June 2023), which will enable humans to excel. Way to go! But we need to make many commentators in industry aware of this instead of them assuming "expert status" and derailing the much-needed training to use these tools.

OLLENCIO D'SOUZA

create

welcomes feedback from the community

Do you know of an exciting project we should write about? Is there an outstanding engineer in your midst? Are you working on an innovative technology that you'd like to share with your fellow members? Are there engineers out there doing their bit to help the community? Do you want to comment on an article you've read in *create*?

Email *letters@engineersaustralia.org.au* and we'll be pleased to consider your suggestions.

Introducing our new range of Structural Assemblies:

AVAILABLE NOW

Weathering Steel

For enhanced weather resistance

NEW

KBH83W

Traceability from the bolt head

ASTM A325M

Type 3 / CLASS 8.8

Weathering Steel structural applications

Bridges, facades, stadiums, high rise, road and rail Infrastructure

Suitable for use with Redcor® composition A and B

Features

- Property class 8.8
- Metric threads for use with AS/NZS design standards
- Phosphate and oil coating for improved installation outcomes
- Extended shank for higher shear capacity when shear planes do not cross threads
- Full traceable 3-character code

Patina Colour Over Time

Patina forms and matures on the top layer when subjected to alternating wet and dry conditions.

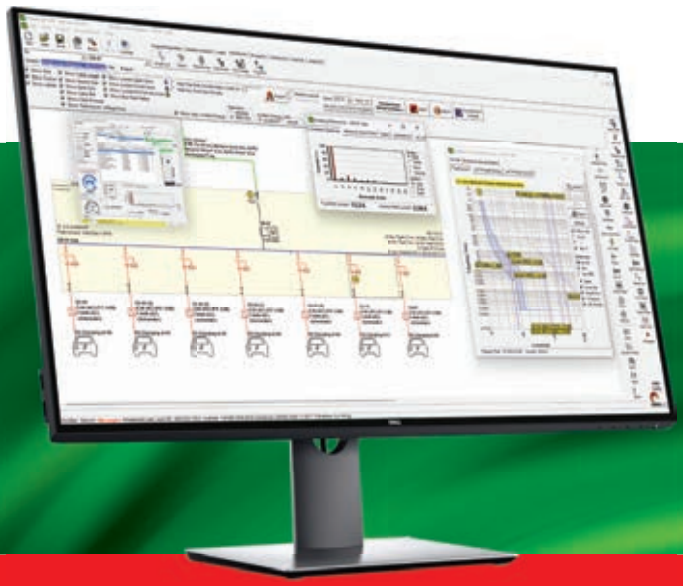
Member of AUSTRALIAN STEEL INSTITUTE

Bolt Tension | Anti-Vibration | Corrosion Resistance | Product Reliability | Traceability

hobson.com.au **QUALITY FASTENERS** SINCE 1935

HOBSON ENGINEERING

2302091



POWERCAD-5

leaders in innovative electrical engineering design software

- ✓ AS/NZS 3000:2018 Amdt 3:2023 Compliance Checking
- ✓ Supports AS/NZS3008.1.1: 2017
- ✓ Arc Flash Analysis to IEEE1584 – 2018
- ✓ Now includes support for 690Volt and 1000Volt Systems
- ✓ Now with support for Revit® 2024, AutoCAD® 2024
- ✓ Support for Revit App PowerCad-M
- ✓ Quality Services and Support

EV Charging Stations

PowerCad-5™ Features

- Cable Voltage Drop Calculations
- Circuit Breaker Selection
- Time/Current Co-ordination Curves
- Co-ordination Curve On Screen CB OCR Adjustment (dynamic)
- User Defined Time/Current Co-ordination Curves
- Selectivity/Cascading
- Maximum Demand
- Cable Thermal Stress
- Let Through Energy
- Cable Sizing
- Conduit Sizing
- Fault-loop Impedance
- Fault Level Calculations
- ARC Fault Check
- ARC Flash calculations
- Harmonic Analysis
- Network Resonance Check
- Harmonic Mitigation
- Power Factor Correction
- Active Harmonic Filter Sizing
- Passive Harmonic Filter Sizing
- Substation Sizing
- Standby Generator Sizing
- Single Line Diagram Display
- Single Line Diagram Export to AutoCAD®
- L.V.Distribution Network Modelling
- Bus-Tie modelling
- Check metering modelling
- Automatic Mains and Submains Cable Selections
- Automatic Final Subcircuit Cable Sizing
- Variable Speed Drives
- Display Load Starting Current Profile
- AutoCAD® Interface for Loads Input
- Light Fitting and Motor Libraries
- Reports with Print Preview
- Direct Online Support
- Standards AS/NZS, IEE, BS, CP5, SAS and IS (India)

Compliance Checking

- ☑ **clause 2.5.5.3 arcing fault clearing capacity of protective devices for feeds of 800amps and above**
- ☑ **clause 2.5.7.2.3 supply circuit discrimination with option for checking protective devices less than 250amps**
- ☑ **clause 5.3.3.1.1 protective earth conductor thermal stress check**
- ☑ **clause 5.7.4 earth system impedance check at 0.4s and 0.5s disconnect times**

Connect an Electric Vehicle

PowerCad Software Pty Ltd
1/16 Sigma Drive
Croydon South, Victoria 3136, Australia
Telephone: +61 3 9819 3853

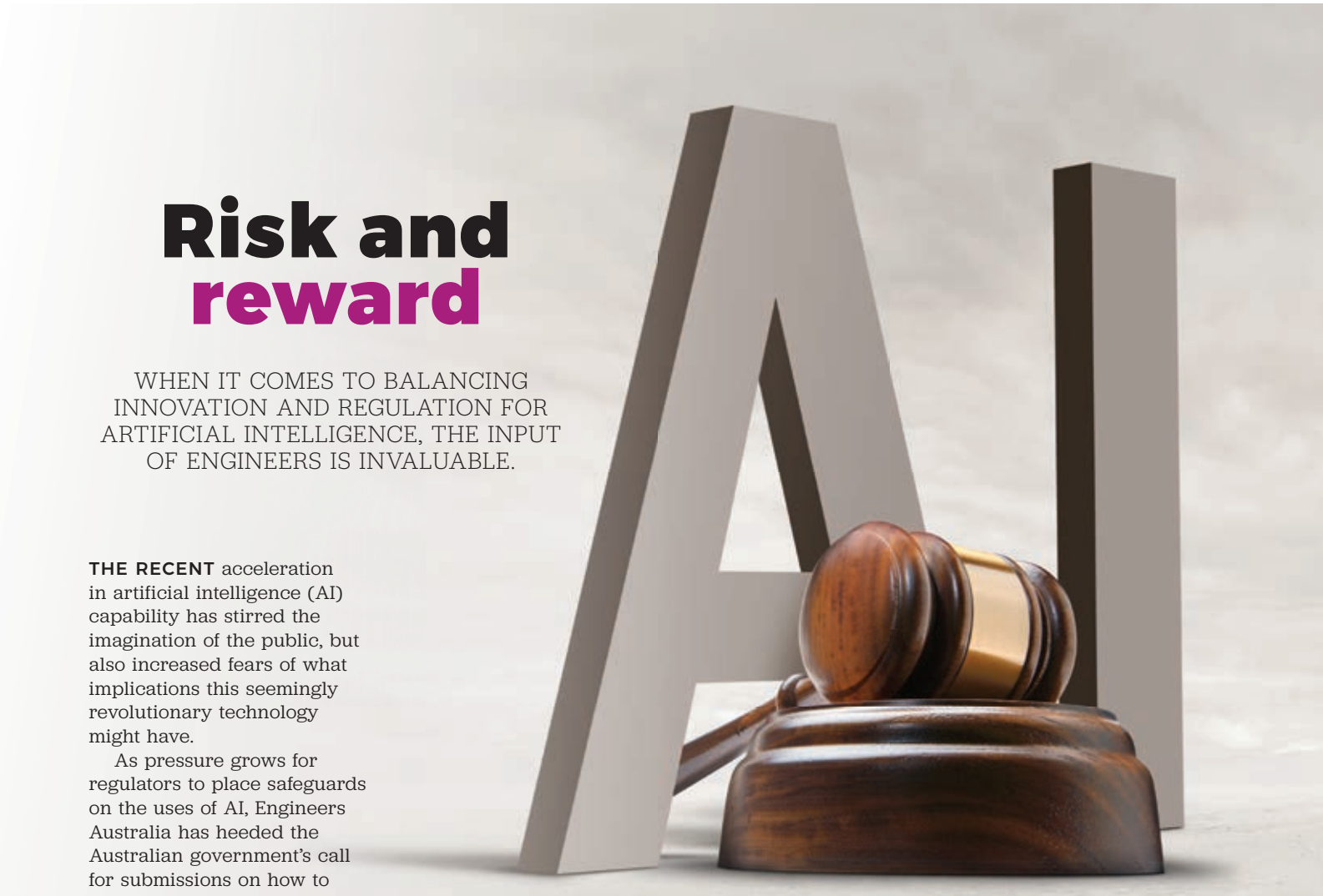
Autodesk
Authorised Developer

www.powercad.com.au
info@powercad.com.au

POWERCAD®
established February 1991

Risk and reward

WHEN IT COMES TO BALANCING INNOVATION AND REGULATION FOR ARTIFICIAL INTELLIGENCE, THE INPUT OF ENGINEERS IS INVALUABLE.



THE RECENT acceleration in artificial intelligence (AI) capability has stirred the imagination of the public, but also increased fears of what implications this seemingly revolutionary technology might have.

As pressure grows for regulators to place safeguards on the uses of AI, Engineers Australia has heeded the Australian government's call for submissions on how to support responsible uses of these systems.

The government has also sought advice on how generative AI – programs such as the large language model ChatGPT – might shape the future of education.

"AI has the potential for significant transformation in the future of engineering in ways we are just starting to understand," said Damian Ogden, Engineers Australia's Group Executive for Policy and Public Affairs.

"It will alter how engineering is taught and assessed. In the workplace, it can optimise design processes, improve modelling and help extract more meaningful insights from data. This will lead to greater productivity, freeing up engineers to be more innovative."

Engineers Australia's Information, Telecommunications and Electronics Engineering (ITEE) College, contributed to the Engineers Australia submissions.

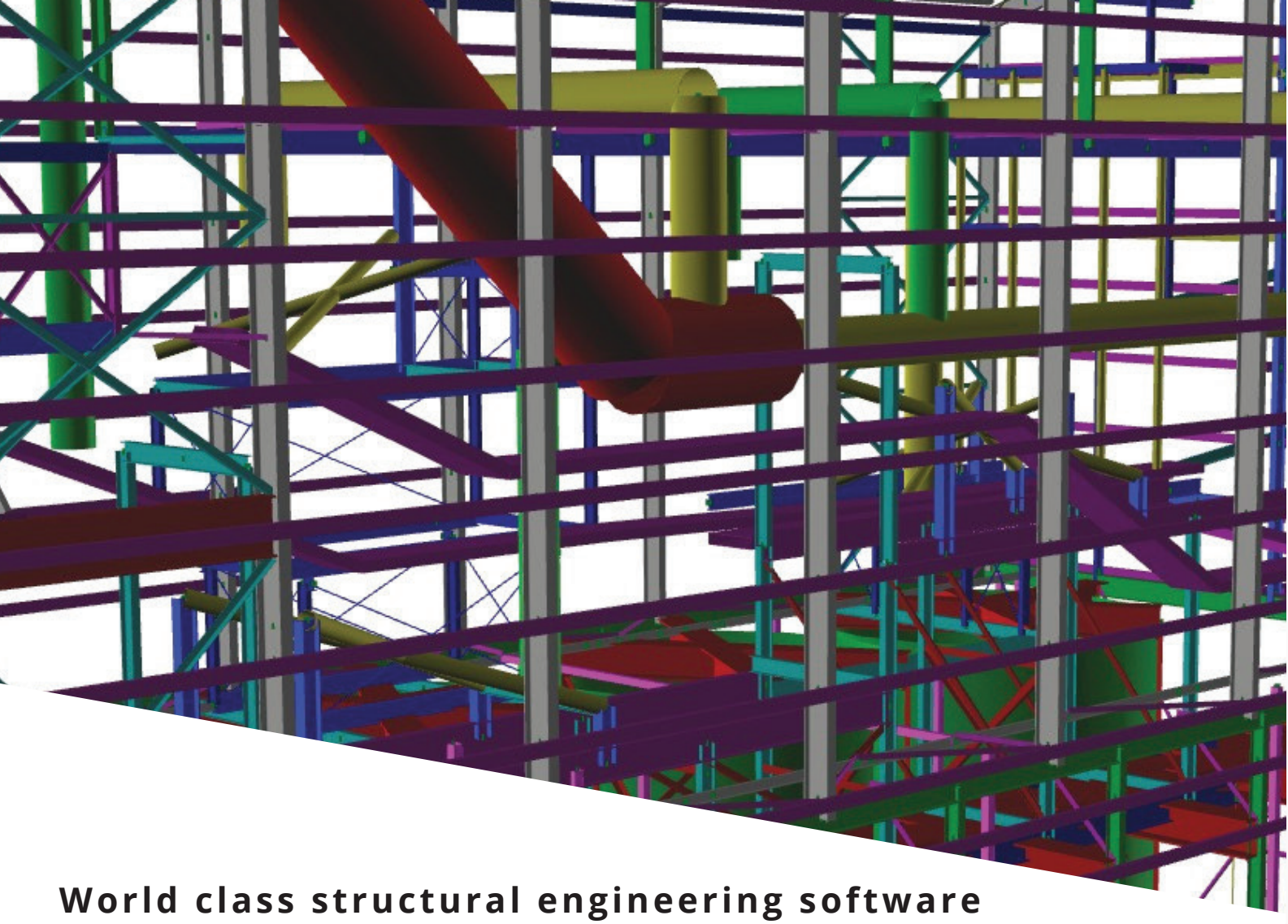
ITEE Chair Peter Stepien told *create* that while AI has been around for a long time, it has evolved.

"It has reached a stage where it is a lot more versatile than it used to be," he said.

"We are using a technology that is just another tool in our toolbox that we can use to design and build. So in that respect, we have to manage the risks that are associated with it."

Stepien said it was important to embrace the benefits that AI can deliver. ▸

"AI HAS THE POTENTIAL FOR SIGNIFICANT TRANSFORMATION IN THE FUTURE OF ENGINEERING IN WAYS WE ARE JUST STARTING TO UNDERSTAND."



World class structural engineering software

Try SPACE GASS free for 30 days and experience its amazing analysis speed, powerful 3D graphics, modelling features, ease of use and top-notch support.

Our concrete design modules allow you to design slabs, beams and columns, all from within SPACE GASS. Add them to your license with our flexible packages.

Cloud-based licensing and Subscription packages are now available.

CHECKWIND
is now available for automated site wind analysis within SPACE GASS

SPACE GASS

Beautiful Design, Amazing Features

www.spacegass.com

"But, of course, in everything that engineers do, we always complete a risk analysis – and this is a technical and safety risk analysis, to ensure that whatever we were designing is going to be safe," he said.

"We must not build something that's unsafe, and AI would still fit into that framework.

"However, I think the government wants to make a special case of AI, given that it's so different to what we would normally consider as being a traditional engineered approach to a problem, which is more deterministic.

"While AI is, in principle, deterministic, it still lends itself to providing a wide variety of responses for a given input. That makes it a little bit different."

That, Stepien said, explains why governments are approaching the technology cautiously.

"And I think rightly so," he added.

"They want to ensure that the risks they can mitigate by legislation [are addressed]. But at the same time, I don't think they want to hinder creativity in this space."

And this is playing out on an international scale too: governments want to ensure that they are not hindering their own AI development and allowing competing nations to get ahead of them.

That means, Ogden said, properly deploying regulation to reduce the risk of bias and misinformation. In that regard, he has found that Engineers Australia's members' views align well with what the government has been saying.

"We have been speaking to many members with strong experience in this field, and our perspective on AI aligns quite well with what we are hearing from government," he said.

"We are advocating for a balanced approach – regulatory and non-regulatory measures – to harness AI's benefits while safeguarding professionals, educators, students and the community."

ABOVE (from top): Damian Ogden, Engineers Australia, Peter Stepien, ITEE.

"The approach must prioritise regulation for AI systems with high-risk implications, ensuring public protection while maximising the benefits of these systems and ensuring Australia can develop an internationally competitive AI industry."

Stepien said an important place on which to focus AI regulation was in its use in critical systems, where failure would have a significantly detrimental effect.

"We don't want to have the government regulate and hinder the use of AI in places where it can be used safely," he said.

"But we want to make sure that in places where it can cause a hazard, the government does have some regulation.

"And this comes down to mainly critical systems. We need to have some verification that a particular design is working correctly.

"So some governments around the world, that's what they're doing. They're saying, here is the risk associated with the use of AI, and depending upon where it sits, they either regulate that area or they don't regulate."

Ogden described input from engineers as "critical" to the AI debate.

"AI will not only impact the profession, but it is engineers who are developing these technologies and it will be engineers who integrate them into current and future systems," he said.

"The more diverse perspectives we hear from, the greater chance we have at shaping policy which is fit-for-purpose and supports AI in the future." ●

JONATHAN BRADLEY

"WE DON'T WANT TO HAVE THE GOVERNMENT REGULATE AND HINDER THE USE OF AI IN PLACES WHERE IT CAN BE USED. BUT WE WANT TO MAKE SURE THAT IN PLACES WHERE IT CAN CAUSE A HAZARD, THE GOVERNMENT DOES HAVE SOME REGULATION."

WORDS BY **MICHELLE WHEELER**

SEA CHANGE

THE WORLD'S OCEANS ARE ESTIMATED TO CONTAIN MORE THAN 170 TRILLION PIECES OF PLASTIC. MEET THE AUSTRALIAN COMPANIES MAKING WAVES IN OCEAN CLEAN-UP.

IN WATERMANS Bay, a quiet Perth suburb best known for its million-dollar houses and ocean views, something is brewing. A team of scientists, engineers and entrepreneurs has assembled a beachside laboratory with a walk-in freezer of seaweed from around the world.

There are cultures of sensitive saltwater microbes, and a basement full of pressure vessels tended by the team's resident "seaweed cooker".

The team is trying to develop an alternative to plastic that's good for the world.

In charge of the laboratory is Uluu co-founder and co-chief executive Dr Julia Reisser. She started Uluu to create new materials from farmed seaweed.

"We're still missing a truly compelling alternative [to] fossil plastic," Reisser said. "And the reason for that is twofold. One is on the feedstock [raw material] side … we currently [produce] more than 400 million tonnes of plastic a year. Then on the material side, we can't live without plastic as a modern society."

Uluu uses seaweed to produce polyhydroxyalkanoates, or PHAs, a material with the potential to replace many if not all plastics.

"PHAs is a natural material, just like cotton and silk and paper, that nature knows and can get rid of," Reisser said. "But it has this superpower of mimicking those properties that we love about plastic and that we need. It's lightweight, durable, it melts and re-melts, it has good oxygen and moisture barriers … with the big difference of being biocompatible and truly biodegradable."

Reisser points to timber as an example of a material that's strong and durable, yet biodegradable.

"A wooden table is not going to last forever like a plastic one will," she said. "But because it's so thick and used in an environment where the moisture is low [and] there is

not so many microorganisms, it can last a long time. If you dump a whole table in the ocean, it's going to take months to degrade. But it will eventually – and it's the same with PHAs."

Reisser, a marine scientist, began studying plastic pollution after discovering turtles eating plastic in her native Brazil.

She was one of the earliest members of The Ocean Cleanup, a Dutch not-for-profit developing technology to remove plastic from the seas.

But as time went on, Ressier realised she was tackling the symptoms rather than the problem.

"I wanted to be more upstream," she said. "It's such a massive problem that it's hard to just clean it up."

A BEAUTIFUL IDEA

Dr Jesús Rodríguez, an agro-industrial engineer from Venezuela, moved to Australia to join the Uluu team.

Rodríguez had been researching PHAs in Italy but wanted to use his expertise to start PHA production rather than write reports.

"The idea of Uluu, for me, was beautiful," he said.

Rodríguez was attracted to the idea of using farmed seaweed. Companies in other parts of the world are producing PHAs, but they're made with glucose from corn or sugarcane.

"The cost of the PHAs is too high, and you interfere with the food of the people," Rodríguez said.

PHAs are natural polymers and are very versatile. Through bioprospecting, many different kinds have been discovered in nature.

According to Rodríguez, different microbes produce different types of PHA, and what the microbes are fed also changes the material they produce.

Most of what is currently being commercialised is a PHA named polyhydroxybutyrate (PHB). It's strong but too brittle for most applications.

Instead, Uluu's seaweed-eating microbes produce poly(3-hydroxybutyrate-co-3-hydroxyvalerate) – PHBV – a co-polymer that's more flexible than PHB.

One research and development area on which Rodríguez is focused is fine-tuning the properties of Uluu's PHAs for different applications by adding tiny amounts of secret ingredients to the Uluu fermenters.

That includes producing PHAs that could replace polyester in the fashion industry.

BELOW: Uluu engineer Jesús Rodríguez (right) at the company's pilot production facility with plant operator Chris Phillips.
BELOW RIGHT: Samples of (from left) Uluu's seaweed, PHAs and pellets.

"WE HAVE A FEW MILLION TONNES PER YEAR OF SEAWEED THAT'S PRODUCED, BUT IF WE WANT TO FULFIL OUR AMBITION, WE REALLY NEED TO BE FINDING WAYS TO SCALE THAT."

Ambitions the size of Uluu's don't come without risks. Global production of farmed seaweed would have to increase dramatically to replace the plastics produced each year. It takes about 10 kg of seaweed to produce one kilogram of PHAs.

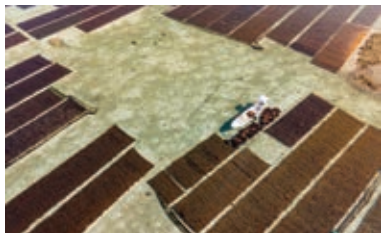
"We have a few million tonnes per year of seaweed that's produced," Reisser said. "But if we want to fulfil our ambition, we really need to be working on ›

IN THE WEEDS

How Uluu's PHAs are made

1. FARM SEAWEED

Uluu buys seaweed from Indonesia, the world's second largest producer of farmed seaweed (pictured below).



2. HYDROLYSIS

The team breaks down the carbohydrates in the seaweed into fermentable sugars in a process called hydrolysis — cooking the seaweed. The result is a liquid full of seaweed sugars and a solid by-product.

3. FERMENTATION

The sugar-rich liquid goes into a fermenter containing saltwater microbes that can digest the seaweed sugar and make PHAs. These PHAs are the carbon storage system of the microbes, serving a function similar to human fat.

4. EXTRACT PHAs

The cells are exploded using a unique water-based method that removes the PHAs, a white powder, from inside the microbial cells.

5. MAKE PELLETS

The powder is melted into pellets that can be extruded into any plastic form, including films, rigids, coatings and fibres. These pellets can be sold to manufacturers and used to produce everyday items like packaging, furniture, car parts and clothing.

the ground with the farmers and finding ways to scale that."

The technology also has challenges. Uluu is currently piloting its technology with premium fermenters used in the pharmaceutical industry to produce vaccines. But, to scale the technology, Uluu will have to employ giant fermentation facilities more akin to the ethanol and brewing industries.

"It's a journey," Reisser said.

"But I'm a true believer that fermentation, or synthetic biology … is going to be the future for a few commodities. Not only biopolymers, like us, but also lab-grown protein."

Reisser believes Uluu can one day compete with the cost of plastics produced from fossil fuels. That path includes selling the protein-rich, vegan by-products of the production process as aquaculture feed or protein powders.

"It's very risky, the kind of thing that we're doing, and we need the best engineers, the best scientists," Reisser said. "But I think the great thing is: if you do nail that, you can turn a problem into something that's actually good."

GIVING PLASTICS VALUE

Like Reisser, Plastic Collective founder and chief executive Louise Hardman was inspired to tackle ocean plastics after working with turtles.

The zoologist was leading a turtle research project more than 25 years ago when she discovered a dying green turtle that had eaten plastic hidden in seagrass.

Hardman went on to work in environmental education before founding her business in 2016.

"At the time, there was a lot of media around sperm whales eating plastic bags, turtles with straws in their nose," she said.

"And I just felt really disempowered. I needed to work out a solution to empower myself to empower others."

Hardman started looking at communities in the Asia-Pacific, where much of the world's plastic waste enters the ocean.

"IT'S VERY RISKY, THE KIND OF THING THAT WE'RE DOING, AND WE NEED THE BEST ENGINEERS, THE BEST SCIENTISTS."

ABOVE: Uluu co-founders Dr Julia Reisser (left) and Michael Kingsbury in front of a PHA-producing fermenter. RIGHT: Louise Hardman, Plastic Collective.

"A lot of them will be either burning, dumping or throwing the rubbish into the rivers or the environment, simply because of high transport costs, low incomes … and poor infrastructure," she said.

Hardman developed mobile recycling stations, usually housed in shipping containers, that could be sent to islands and other remote communities with limited waste infrastructure.

"I thought if every small community could have small mobile recycling equipment, then that would start to get the value of the materials," she said. "They could basically make products that they needed, like benches or fence posts or whatever's useful in the community."

A typical Plastic Collective set-up has equipment to break down plastics, such as shredders, granulators, small balers and digital scales.

Some communities choose to simply sell the shredded plastic, while others create new products with manufacturing equipment like extruders, injection moulders and compression moulders.

The company's early designs for recycling machines were based on those from Dutch open hardware project Precious Plastic.

Hardman later worked with engineers to increase the capacity of the equipment and ▸

BricsCAD®. The harder-working CAD alternative.

Building the future is hard work. And you need a hard-working CAD design platform to take you there. Introducing BricsCAD® - the powerful yet affordable DWG-based CAD platform for 2D, 3D, BIM and mechanical design.

Faster and more affordable than the market leading software, BricsCAD's Smart AI-driven features let you design CAD faster, with less repetition. BricsCAD is also based on native DWG file format, for the highest compatibility with the leading CAD program.

Choose from BricsCAD Lite (for 2D designing including AutoLisp), BricsCAD Pro (for 3D modelling and third party software usage) BricsCAD BIM for building design, BricsCAD Mechanical including sheet metal and BricsCAD Ultimate, for all versions.

Available in Standalone and Network versions, BricsCAD's flexible licensing options including Perpetual or Subscription licenses put you back in control. Combine with Bricsys® Maintenance to keep your perpetual licences up to date with new BricsCAD updates and technical support, at a fraction of the cost of other CAD subscription software.

Let CAD*Apps* Australia show you BricsCAD, the modern CAD alternative for Australian businesses. You'll be surprised at how easy it is to change over and reduce your CAD budget.

For more information:

- Contact CAD*Apps* Australia, Bricsys Premium Partner, **cadapps.com.au**
- Email **sales@cadapps.com.au** or call Leigh on **0436 336 300** for more information.
- **Scan the QR code to download your free 30 day BricsCAD trial**.

CADApps Australia

Bricsys® Premium Partner
part of **Hexagon**

capps 0122

Become a leader in your field

Further your career with advanced qualifications and deeper technical expertise.

With a postgraduate Engineering degree from RMIT, you'll develop internationally-recognised skills in the areas that interest you most. With 14 different specialisations to choose from and accreditation by Engineers Australia, RMIT's suite of Masters degrees are globally recognised and highly regarded by industry, both locally and internationally.

From manufacturing to management, you could find yourself designing and creating products, systems, structures and services that transform our world and improve lives.

The RMIT 4+1 Model

If you've completed your Bachelor of Engineering (Honours) at RMIT you may be eligible to complete a Master by Coursework degree in your related area in only 12 months — half the time it normally takes to complete a Masters degree!

RMIT UNIVERSITY

Find out more at
rmit.edu.au/engineering

CRICOS: 00122A | RTO Code: 3046

"THEY NEEDED TO BE PRETTY MUCH BOMBPROOF AND RUSTPROOF, BECAUSE YOU'RE WORKING IN A SALTY ENVIRONMENT. YOU'VE GOT INSECTS, YOU'VE GOT HUMIDITY."

make it more reliable in remote, tropical locations.

"They needed to be pretty much bombproof [and] rustproof, because you're working in a salty environment," she said. "You've got insects, you've got humidity. All of those factors had to be taken into account when [designing] these containers."

Plastic Collective's recycling infrastructure is up and running in communities in Indonesia, Malaysia and Australia, with plans for more sites in Indigenous communities in northern Australia, Papua New Guinea and island communities in the Pacific.

As well as equipment, the company provides training and links to buyers.

Hardman said recovered ocean plastic is highly sought after by manufacturers, and communities can command premium prices for plastic recovered from places like coral reef restoration areas or turtle nesting grounds.

"That also provides a bit of a negotiation point for the sale of materials," she said.

Ultimately, Hardman said plastic only becomes waste when it's not worth anything.

"Plastic is a material," she said. "If we give it value, we recover the value and we don't throw it away, which means it doesn't become pollution."

TOP LEFT: A Plastic Collective recycling facility. ABOVE: A typical Plastic Collective set-up.

STOP IT AT THE SOURCE

In 2004, Heidi Tait was working as a diving instructor near Margaret River in Western Australia.

She was amazed by the amount of plastics and other rubbish washing up on the region's otherwise pristine beaches.

Tait decided to hold a community clean-up to understand where it was coming from.

"I think we did 30 beaches between capes Naturaliste and Leeuwin over a weekend, and then we held a workshop a couple of weeks later to look at the data," she said. "The idea was to identify sources and see if we could do something about it."

The group recognised that the packing tape washing up onshore was from bait boxes used by the local rock lobster industry.

They looked for alternatives and found a self-locking cardboard box in South Australia, then decided to work with the industry and the state government on a solution.

"It took a while," Tait said. "But six years later, in 2011, they actually changed the legislation and it became illegal to have packing tape on commercial and recreational fishing vessels in the state of WA.

"For us, that was really proof-of-concept that you could take citizen science data, as long as you collected it in a robust manner, you engaged the right stakeholders, you came up with a solution and you had a way to measure the impact."

Today, Tait is the founder and chief executive of the Tangaroa Blue Foundation, a not-for-profit dedicated to the removal and prevention of marine debris.

She also created the Australian Marine Debris Initiative, a network of volunteers and partners that collects and categorises rubbish.

The initiative boasts more than 30,000 clean-ups, with volunteers meticulously logging the rubbish they find and trying to stop it through "source reduction plans".

Projects range from reducing cigarette butts from rugby league patrons in Townsville to working with the plastics industry to stop the loss of resin pellets during manufacturing and transport. ▸

ALLFASTENERS .COM.AU

Anchors for Infrastructure

Allfasteners continues to innovate as an emerging major supplier of concrete anchors for the largest infrastructure projects across Australia.

We have supplied anchors for bridges, and major road and rail tunnels, including Victoria's Big Build and major infrastructure projects across Sydney and Brisbane.

Some application examples include road stitching, overhead services, and various structural applications. These anchors had to meet the most stringent compliance requirements, including 100-year design life.

Choose Allfasteners for high-performance anchors, a proven track record and top engineering support.

engineering@allfasteners.com.au | 03 9330 0555

allfasteners.com.au/afos

100 YEAR

ETA

NCC COMPLIANT

AFOS® Anchor Design Software

21MB Download

LEFT: Heidi Tait, Tangaroa Blue Foundation.

With more than 23 million data points, the Australian Marine Debris Initiative is the biggest database of its kind in the Southern Hemisphere, and one of the largest in the world.

"It tells you really clearly that what's washing up on a beach in Cape York is completely different to what is washing up on a beach in Melbourne's Port Phillip Bay," Tait said.

"You can't just say we're going to do 'this' and it'll fix the problem; you need to look at a very regional setting. And the data helps you to understand where to start."

Tait sees opportunities for engineers in retrofitting existing storm infrastructure to stop waste from washing into the ocean, and producing products that last or can be repaired.

"If all you do is clean up, that's all you'll ever do," she said. "We need to find ways of stopping the source, otherwise, we'll just be cleaning up forever." ●

"IF ALL YOU DO IS CLEAN UP, THAT'S ALL YOU'LL EVER DO. WE NEED TO FIND WAYS OF STOPPING THE SOURCE."

THE OCEAN CLEANUP

One of the world's best known marine plastic organisations is The Ocean Cleanup, a Dutch not-for-profit developing and scaling technologies to remove vast quantities of plastic from the seas.

Founded in 2013 by 18-year-old entrepreneur Boyan Slat, The Ocean Cleanup now boasts more than 120 engineers, scientists, computer modellers and support staff working to rid the world's oceans of plastic.

The organisation has ambitious aims, including the removal of 90 per cent of floating ocean plastic by 2040.

The Ocean Cleanup has designed several systems to collect rubbish from the Great Pacific Garbage Patch, a concentration of floating debris in the Pacific Ocean.

The technology consists of a long U-shaped barrier — up to 2.5 km in length — that's slowly pulled through the water, guiding the plastic into a retention zone at its far end.

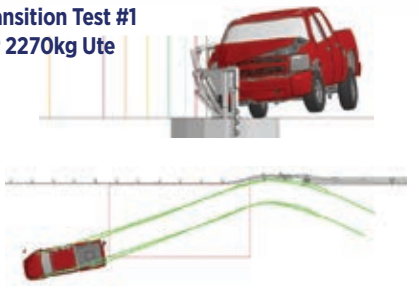
But the organisation's early designs recovered relatively small amounts of debris and attracted criticism from the scientific community for being expensive and a potential risk to marine life.

The Ocean Cleanup is also developing "Interceptor" solutions for rivers, which aim to stop new plastic entering the ocean.

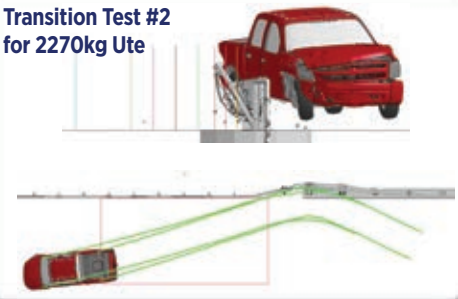
RIGHT: An Ocean Cleanup Interceptor deployed in Guatemala.

IMAGE: JAMESMCPHERSONPHOTOGRAPHY.COM; THE OCEAN CLEANUP

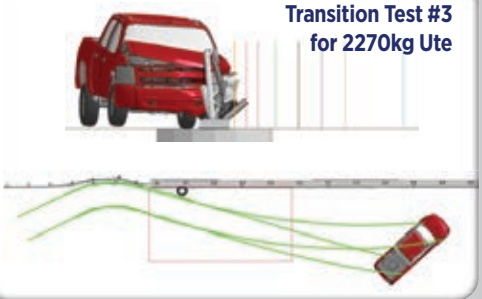
Transition Test #1
for 2270kg Ute



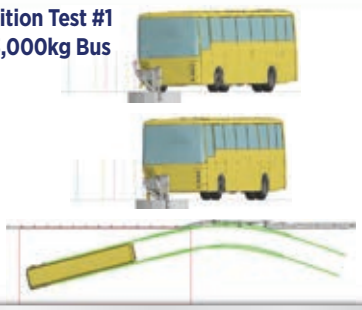
Transition Test #2
for 2270kg Ute



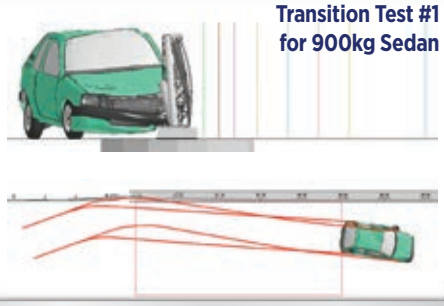
Transition Test #3
for 2270kg Ute



Transition Test #1
for 13,000kg Bus



Transition Test #1
for 900kg Sedan



The DOLRE bridge traffic barrier development demonstrates how the incorporation of FEA into the design process can optimise a solution that is vastly different from the solutions that traditional Engineering methodologies would produce.

A problem was identified and through the iterative use of FEM combined with Eurocodes for structural analysis a solution was found and optimised that was vastly different to the direction that traditional engineering was leading.

Once the bridge barrier design was optimised, the same process was used to assess **transition designs** to various European roadside barriers in accordance with EN1317 and TR16303-2011 requirements.

Australian authorities required product assessment to Australian bridge standards. Future finite element modelling in accordance with MASH standards and NCHRP179 validation requirements satisfied ASBAP's analysis for both traffic barrier and transition designs.

LB AUSTRALIA

Ideal for Bridge Refurbishment Projects.

ASBAP Approved for use in Australia

DOLRE
LOW STRESS PARAPET SYSTEM

TOWARDS ZERO BRIDGE FATALITIES

DISCOVER MORE

SCAN ME

- Fully crash tested to European Standards and simulated to US MASH TL4 requirements
- Unique design imparting low stress to bridge deck - protecting water proofing membranes and coatings on the deck
- Easy to install
- Easy to dismantle in times of flood
- Cost-effective bridge rehabilitation solution

INNOVATION TOWARDS ZERO

www.lbaustralia.com.au Ph 1300 522 878

WORDS BY **ELLE HARDY**

PICTURE OF HEALTH

CUTTING-EDGE RESEARCH, GROUNDBREAKING TECHNOLOGIES AND PROMISING DEVELOPMENTS ARE REVOLUTIONISING HEALTHCARE AND IMPROVING PATIENT OUTCOMES.

WHEN BIOMEDICAL signals and systems engineer Dr Arman Ahnood wanted to create a tool to identify bilirubin concentration in the blood of newborns, he turned to consumer electronics.

Specifically, a $20 pulse oximeter sensor developed for activity trackers such as Fitbit.

As Ahnood prepared to start pilot clinical trials, he told *create* the technology "will allow us to determine whether they're at risk of developing later stage disease".

Ahnood believes that, if successful, it will be useful for regional areas where people don't have immediate access to hospital facilities.

"If we can detect elevated bilirubin concentration in the first 24 hours, we can administer very simple treatments," he said.

"If we lose that window of opportunity, there are long-term consequences that could result in disability – or even death."

The three cutting-edge fields of biotech, med tech and health tech are interdisciplinary fields that combine principles of engineering, medicine and biology to develop innovative solutions, medical devices and technologies to enhance diagnosis, treatment and patient care.

Many see this form of personalised medicine, which uses wearables, real-time monitoring and advanced analytics, as the next frontier of healthcare.

While everyone knows Cochlear, the bionic ear that is heralded as one of Australia's greatest innovations, local biomed continues to face a number of challenges.

Lack of access to capital, limited support for commercialisation and a lack of coordination between funding bodies and industry are chief among them.

Yet, in spite of this, biomed is still a thriving, $10 billion industry.

RIGHT: Siemens's Melbourne laboratory, where the company is producing influenza vaccines.

"IF WE CAN DETECT ELEVATED BILIRUBIN CONCENTRATION IN THE FIRST 24 HOURS, WE CAN ADMINISTER VERY SIMPLE TREATMENTS."

If Australia can up its game, engineers hope that, one day, consumer products will be the ones learning from biomed.

"We produce a high number of biomedical engineering graduates in Australia," said Kelly Coverdale, chair of Engineers Australia's Biomedical College.

"But we don't have a well established industry base to support their employment."

While Australia is conducting a great deal of exciting biomedical and medtech research, Coverdale said, there is generally more opportunities in research than in product development, as that area continues to be prioritised for funding.

ON TREND

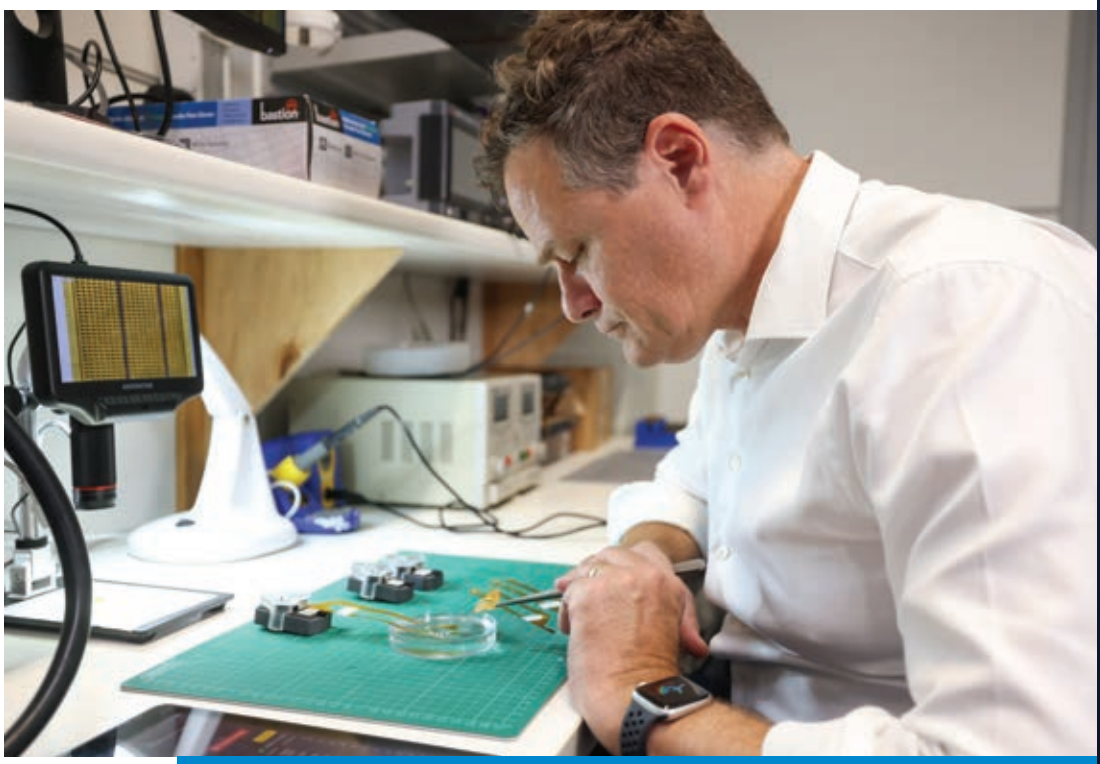
Whether it's in regenerative medicine, bioinformatics, medical imaging, biomaterials, prosthetics, telemedicine or artificial intelligence in healthcare, some Australian pioneers are trying to ensure the nation sees a "brain gain".

"One of the challenges in Australia is that about two thirds of engineering innovation gets done in universities. In the US, it's the other way around," said Professor Mark Kendall, the biomedical engineer and inventor behind skin sensor technology WearOptimo.

"There's a different attitude towards risk appetite in Australia – in terms of how capital gets deployed – than those larger funds that are based, for instance, in the US. So there's more work to be done on that front."

Kendall made the decision to launch WearOptimo in Australia to help the local innovation ecosystem and try to spur a bigger industry.

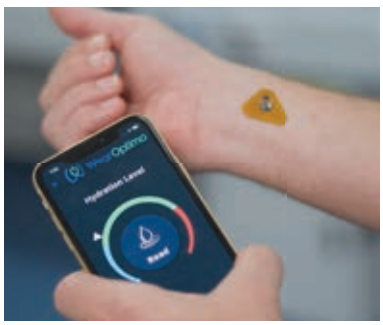
Former Formula One driver Mark Webber is an investor and strategic partner in WearOptimo's first product, a dehydration sensor that will help elite athletes, military personnel, mining workers and, eventually, the elderly monitor their hydration levels.



"WE PRODUCE A HIGH NUMBER OF BIOMEDICAL ENGINEERING GRADUATES IN AUSTRALIA. BUT WE DON'T HAVE A WELL ESTABLISHED INDUSTRY BASE TO SUPPORT THEIR EMPLOYMENT."

TOP: Professor Mark Kendall, WearOptimo. RIGHT and BELOW RIGHT: Using the WearOptimo skin sensor technology.

ABOVE: Kelly Coverdale, chair of Engineers Australia's Biomedical College.



In a similar vein is Nutromics, co-founded by chemical engineer and entrepreneur Peter Vranes.

The firm is creating a patch that can be worn on the back of the arm and uses needles only two millimetres long to access the interstitial fluid under the skin.

Vranes told *create* that one application for the technology, which includes the first commercial use of electrodes coated with DNA sensors, is to treat heart attacks.

"Chest pain protocol sees blood drawn to measure troponin, and it takes five to six hours to diagnose," he said.

"A troponin sensor on our patch can begin streaming data ▸

ENGINEERS AUSTRALIA | cse

Climate Smart Engineering Conference

29-30 November 2023 | Melbourne

ARE WE ON TRACK TO REACH NET ZERO?

Connect with the profession's brightest and boldest minds, government and industry leaders to help shape a sustainable future at the Climate Smart Engineering Conference this November.

Register now

engineersaustralia.org.au/cse

Conference partners

radlink COMMUNICATIONS | RSK AUSTRALIA | SIEMENS | WSP | MELBOURNE | MELBOURNE Convention Bureau

immediately and reduce that time to 10 minutes."

Rounding out the impressive collection of wearables pioneers is Goldilocks, a baby-monitoring system woven into a cotton jumpsuit that helps stressed new parents address their babies' needs.

"We have two thermistors: one for core temperature and one for skin temperature, as well as an accelerometer gyro, which sits on the diaphragm and detects things like breathing waveforms and gross motor movements," said Shem Richards, medical device engineer and Goldilocks co-founder.

Hooking up to a proprietary artificial intelligence, the system tells parents some steps that their clinician consultants recommend to help resolve the identified issue – and, if necessary, connects them to telehealth help.

In the next year, Richards said Goldilocks will be launching a product for dementia patients, woven into a shirt with silver fabric technology.

"It will monitor things such as falls through gait analysis [and]

RIGHT: Nutromics CEO Peter Vranes (right) with Senior R&D Scientist Mars Harrison (left) and CFO Rowan Wilkie. BELOW: The wearable Nutromics device.

"THE CHALLENGE WAS CREATING A DEVICE WHICH WOULD ACHIEVE WHAT A PLATE CAN ACHIEVE. WE HAD TO ENSURE THAT WHAT WE CREATED WOULD GET PURCHASE PROXIMATELY AND DISTALLY."

TIMELINE: AUSTRALIAN INNOVATIONS

1970s

1979 — Professor Graeme Clark's bionic ear changes the lives of millions and puts Australia on the map as a biotech innovator.

1980s

1981 — The CPAP system for treatment of sleep apnoea is developed by Professor Colin Sullivan of Sydney University and later commercialised by firm ResMed.

1985 — Technegas, a carbon-based nanoparticle invented by Dr Richard Fawdry and Dr Bill Burch, is used to help lung ventilation scanning for pulmonary embolism.

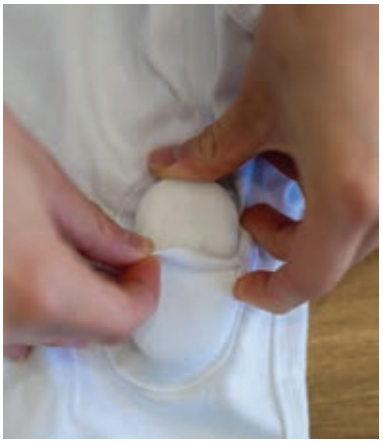
1987 — Oral bronchitis vaccine Broncostat is developed by Professor Dr Robert Clancy at the University of Newcastle, reducing acute bronchitis attacks by up to 90 per cent.

1987 — CSIRO scientists design "gene shears" — RNA molecules that cut messenger RNA, removing its ability to convey disease-causing genetic information.

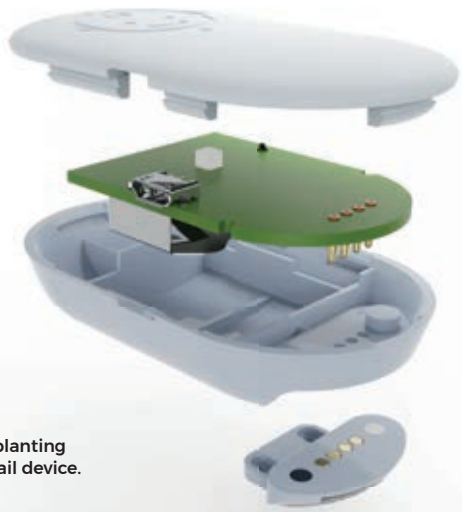
1990s

1991 — A technique using plastic rods in place of metal pins and screws is developed by Dr Michael Ryan and Dr Stephen Ruff at Sydney's North Shore Hospital.

1991 — Pioneering heart transplant surgeon Dr Victor Chang creates an artificial heart valve at Sydney's St Vincent's Hospital.



ABOVE: Shem Richards, Goldilocks. LEFT: Slipping the Goldilocks module into clothing. BELOW: Inside the module.



LEFT: Implanting the NX Nail device.

whether they've remembered to turn on the air conditioner through body temperature, as well as sleep and sleep apnoea," he said.

RESEARCH INNOVATIONS

Hand surgeon Dr Greg Couzens has developed a device called NX Nail in conjunction with biomedical engineering firm Field Orthopaedics, which he uses to help AFL players and other patients get back to work quickly.

The device is the difference, he told *create*, between major surgery separating soft tissues and disturbing the fracture, and a small incision that uses a cannulated drill and screws the NX Nail into the bone, requiring only one stitch.

"The challenge was creating a device which would achieve what a plate can achieve," he said.

"A plate reduces the fracture and sits on the bone, ensuring it has the correct rotation. We had to ensure that what we created would get purchase proximately and distally, [and] be small enough and strong enough to fit inside the bone."

His collaborator on the design, Michael Maurer, the vice president of technology at Field Orthopaedics, said that the device was specifically designed from computerised tomography data and has a compaction taper to achieve implant stability.

"We're also promoting healing through our material selection," he said.

"We're utilising a specialty titanium alloy that has extremely good biocompatibility and also ➤

1992

The world's first multifocal contact lens is developed by research scientist Stephen Newman in Queensland.

Perth surgeon Dr Fiona Wood's spray-on skin reduces skin culturing for burns victims from 21 days to five days.

1995

A CSIRO team led by Dr Peter Waterhouse discovers that double-stranded RNA triggers RNA interference, known as RNAi or gene silencing.

1996

Victorian scientists in collaboration with the CSIRO develop anti-flu vaccine Relenza, a neuraminidase inhibitor developed by the Australian biotech firm Biota Holdings.

2006

Professor Ian Frazer from the University of Queensland, in conjunction with researchers in the United States, creates a preventative for cervical cancer.

2011

Researchers at the University of Wollongong develop the Biopen, a device which acts like a 3D printer to deposit regenerative stem cells on damaged bone and cartilage.

2013

Melbourne medical researchers identify a way of analysing RNA fragments in a mother's blood that indicates oxygen and nutrient deprivation in a foetus, which can help prevent stillbirths.

2018

The first modular self-fit hearing aid is released, allowing users with dexterity problems to self-manage their own hearing aids.

Civil Site Design

Supercharge Your Civil 3D

Design & Deliver with Civil Site Design's integrated toolset for Civil 3D

- Fast road networks & kerb returns creation with Civil 3D corridor model exchange
- Integrated drainage design with exchange to Watercom DRAINS for detailed analysis

"I have been using Civil Site Design since 2004 for road, dam and pipes design. Civil Site Design increases productivity and speeds up project delivery, and is fully compatible with Civil 3D. With its quick and easy user interface and functionality, Civil Site Design is my design program of choice."

Bede Mulholland
Senior Designer Civil Infrastructure (WSP)

"The advances in the user interface, the YouTube Channel, the simplicity of Model Viewer and kerb returns all allow me to achieve great results very efficiently. We can export any Civil Site Design road model to a corridor model and update both ways, so we get the best of both worlds!"

Peter Thomson
Senior Civil Designer (MWH)

Want to know more? Visit www.civilsitedesign.com.au

AUTODESK Gold Partner

Civil Survey Solutions

Civil Site Design
Stringer Survey Suite

Civil Site Design is developed by Civil Survey Solutions | www.civilsurveysolutions.com.au

has stiffness that more closely resembles that of bone compared to other implant material that's used."

Sydney-based startup ARIA Research has embarked on a fundraising campaign for its innovation, which provides blind people with a visual perspective through hearing – a much simpler, cheaper to access and less invasive approach to a solution compared to a bionic eye.

CEO and co-founder Robert Yearsley told *create* that ARIA is the world's first non-invasive bionic vision system – "an analogue for how dolphins echolocate, but for humans", he said.

Yearsley said that the firm is "pioneering a new type of relationship with the [National Disability Insurance Scheme], because one of their biggest problems is getting good data on the effectiveness of assistive technology on the ground."

To this end, he said that working with the world's largest single disability marketplace is a great way to connect the innovator to the end user, and "answers many of the key questions around commercialising biomed tech in Australia".

TOP: The NX Nail implant. ABOVE: Hand surgeon Dr Greg Couzens (top) and Field Orthopaedics collaborator Michael Maurer.

COLLABORATIVE SUCCESS

If a picture is emerging of the industry, it is one of a small space where collaboration is critical to success.

Siemens, one of the world's largest technology firms, knows this better than most.

It is working with CSL Seqirus, the world's second largest influenza vaccine provider, in its project making flu vaccines at a facility in Melbourne.

The state-of-the-art facility will supply influenza vaccines to Australia and the rest of the world, plus Australian antivenenes and Q-fever vaccine.

"Where we come in is the plant-wide automation," explained Howard Sachs, a digital architect advisor at Siemens.

"This includes the manufacturing execution system – the technology stack that sits below the enterprise resource planning software, down to the controller level as well as the building management solution."

Until recently, much of pharmaceutical manufacturing control involved using paper and pens.

"A multivitamin you buy at the supermarket traditionally had 50 to 150 physical pages of handwritten notes," he said.

"What we provide the pharmaceutical biotech sector is the digitalisation of their processes and products both through hardware and software.

"These are often complete digital twins of processes and paperwork all the way down to widgets – for example, a sensor for how many people are in the room, or others to measure temperature and pressure levels."

AI DIAGNOSIS

Far beyond paper and pen, artificial intelligence (AI) is being increasingly integrated into healthcare systems – and Australian researchers are at the forefront of developing AI-based solutions.

One notable innovation is the development of AI algorithms that analyse medical imaging data, such as X-rays and magnetic resonance imagery, to detect ›

"WHAT WE PROVIDE THE PHARMACEUTICAL BIOTECH SECTOR IS THE DIGITALISATION OF THEIR PROCESSES AND PRODUCTS BOTH THROUGH HARDWARE AND SOFTWARE."

LEFT: Siemens is introducing digitalised processes into the pharmaceutical industry.

"THE CAPACITY OF STATE-OF-THE-ART AI TO RECOGNISE OBSCURE AND MINUSCULE PATTERNS WITHIN MULTIMODAL, MULTIDIMENSIONAL MEDICAL IMAGES IS ON PAR WITH, AND SOMETIMES SURPASSES, THE ABILITY OF HUMAN EXPERTS."

diseases and abnormalities with high accuracy.

Dr Antonios Perperidis, research engineer and fellow at the Australian Institute for Machine Learning and Artificial Intelligence Lead for the Women's and Children's Hospital, said that there's a wide range of methodologies for producing algorithms that can analyse medical imaging data.

"The advent of deep neural networks over the last decade has effectuated a gearshift in algorithm performance," he explained.

"In a controlled environment, the capacity of state-of-the-art AI to recognise obscure and minuscule patterns, sometimes imperceivable by the human eye, within multimodal, multidimensional medical images is on par with – and sometimes surpasses – the ability of human experts."

Perperidis adds that AI algorithms can be used to perform a number of clinically relevant tasks, aiding radiologists and improving on existing manual and labour-intensive workflows.

"A key benefit of integrating reliable AI algorithms in radiology practice is AI's capacity to analyse vast, multidimensional data and monitor miniscule patterns consistently while overcoming issues like operator fatigue, incomplete data search, satisfaction syndrome and inter or intra-observer variability," he said.

MOVING FORWARD

While there is a decidedly optimistic mood when it comes to Australian biotech, bio med and health tech practitioners, Coverdale said that the challenge is how to translate emerging research into viable products.

"The priorities of research do not align with the priorities of industry, so often outputs of research are often not commercially translatable without further significant investment," she said.

"Many industry partners report they need to reassess innovations emerging from research for feasibility in the context of relevant standards, manufacturing and regulatory relevant design principles."

Furthermore, she added, Australia lacks a single entity that supports the identification and growth of a globally competitive industry.

"We need to develop a national ecosystem," she said.

"All of the states are competing against each other rather than combining efforts to understand exactly what the needs are for Australia, and prioritising funding to fill the gaps where it's actually needed." ●

ABOVE: Dr Antonios Perperidis, Australian Institute for Machine Learning.

Know your biotech

Biotech tends to be a catch-all word for the confluence of medicine and technology, but practitioners divide the field into three distinct, if overlapping, areas.

BIOTECHNOLOGY is technology based on knowledge of living organisms and uses biomolecular and cellular processes to develop things such as new medicines and diagnostic tools. Biotech firms conduct groundbreaking research and development to find new ways to do everything from treating rare diseases to improving manufacturing processes.

MED TECH, sometimes called bio med, means using technology for products, services and solutions that improve people's lives. Most people experience med tech in devices, from pregnancy tests to prosthetic limbs, while in hospitals it is the systems that can save lives through monitoring and complex surgical tools.

HEALTH TECH, often called the fastest growing vertical within the healthcare sector, is the technology applications that enhance the delivery of healthcare services. Think wearables, AI diagnostics, electronic healthcare records and telemedicine platforms.

Living with extremes

Hydrology & Water Resources Symposium

12-15 November | Sydney

ENGINEERS AUSTRALIA

National Committee on Water Engineering

Collaborate, innovate and engineer excellence to navigate water resource challenges, ensuring human safety and protecting our ecosystems within a rapidly changing climate.

engineersaustralia.org.au/hwrs2023

Register now

Book early and save up to $200

WORDS BY **JEN WALKER**

READY TO ROLL

THE CIRCULAR ECONOMY HAS BECOME MORE THAN A CONCEPT. A NUMBER OF INNOVATIVE AUSTRALIAN COMPANIES ARE SHOWING HOW THE PRINCIPLE WILL PLAY OUT IN REAL LIFE.

THE TERM "circular economy" is often thought to mean better management of waste streams, but that's only one part of true circularity.

A central tenet of circularity is designing out waste. Products and materials are created so they can be repurposed either through reuse or recycling – including composting – to minimise the need to extract virgin resources to make new items or add to landfill.

There are also economic benefits. Circular Australia Hub estimates there is more than $200 billion in economic opportunity in circular solutions and the potential for 17,000 new jobs.

And with about 35 per cent of Australian waste currently going to landfill, disposal costs could be reduced.

The opportunity with the most potential from an engineering perspective is in process engineering – manufacturing – as this contributes about $100 billion to Australian GDP annually, according to Lucy Baker, Chair of Engineers Australia's Environmental College.

ABOVE: Engineers Australia Environmental College Chair Lucy Baker.

"There is also potential for increased recycling using waste [or] demolition products from the construction sector," she said.

"The biggest challenge is in the implementation, to ensure that the products meet all the respective standards, so that they are functional and fit for purpose.

"If recycled products do not meet the same standards of new products, implementation in construction can be more difficult."

But as the circular economy becomes more established, a range of innovative recycling companies are finding success in viewing waste as a resource.

GREAT WRAP

Australian households throw out more than 300 kg of food waste each year. Great Wrap has found a way to convert this waste into a plastic-film alternative.

"Currently, we are using an imported potato waste-derived bioplastic, compounding it with other biomaterials to produce our compostable home wrap and our compostable pallet wrap," said Martin Markotsis, Great Wrap's Materials Innovation Manager.

"We have in-house extrusion compounding capabilities to compound our film material, which we then process into cast stretch film in our factory in Tullamarine in Victoria.

"Our vision for further food waste valorisation over the coming two years includes using Australian potato waste to produce polyhydroxyalkanoates (PHAs) in biorefineries built here in Australia. We would then compound the locally produced PHA material in-house and then produce film on our cast film lines."

Markotsis said the company is looking to optimise processes to produce bioplastics such as PHA in a sustainable and economical way, so final products can compete on performance and pricing with petrochemical plastic wrap, which ends up in landfill.

LOGAN WATER BIOSOLIDS GASIFICATION FACILITY

The population of the Queensland city of Logan, south of Brisbane, is growing fast, with 150,000 more people predicted to move to the area by 2030. That's a lot of sewerage to process.

The solution developed by Logan City Council and Logan Water was a $28 million gasification facility, which was completed last year.

The facility sees waste-activated sludge pumped to centrifuges, where biosolids are dewatered to 22 per cent dry solids, then transferred to 34 t, 18 m industrial-grade belt dryers that dry the biosolids to 90 per cent dry solids.

The dried biosolids move to the gasification phase where they are processed in a hearth at 650 degrees Celsius for about 100 seconds to create a charcoal-like product called biochar.

"Biochar contains nutrients like those found in commercial slow-release fertilisers and can also be added to soil, asphalt, concrete and bricks to sequester carbon for thousands of years. It also has potential to be used in industrial combustors as fuel

ABOVE: Logan Water's biosolids gasification facility. RIGHT: Martin Markotsis, Great Wrap.

"THE BIGGEST CHALLENGE IS IN THE IMPLEMENTATION, TO ENSURE THAT THE PRODUCTS MEET ALL THE RESPECTIVE STANDARDS, SO THAT THEY ARE FUNCTIONAL AND FIT FOR PURPOSE."

and feedstock, and as activated carbon," said Mike Basterfield, Group Manager of Logan Water.

"The hearth also produces a syngas that combusts in an oxidiser that is set to around 850 degrees Celsius for a two second retention time, which destroys persistent organic pollutants, such as PFAS.

"The heat produced is recovered from heat exchangers and the air is treated through a wet scrubber and electrostatic precipitator to ensure emissions meet environmental requirements. The facility reuses the heat energy to dry the biosolids in the belt dryers."

Basterfield said that prior to the gasification facility, gravity drainage decks and belt filter presses were used to dewater the biosolids to around 14 per cent dry solids.

Every day, four truckloads of biosolids would be transported 300 km to the Darling Downs region to be applied to land – a process that accounted for 30 per cent of the total wastewater treatment plant operating costs.

"Now, the gasification process reduces carbon emissions by about 6000 t a year, operational cost savings and carbon credits will return almost one million dollars a year, and a new revenue stream is being created from biochar sales," Basterfield said.

But it's not only the council's budget that benefits. The innovation has identified a role for biosolids in the circular economy: a community-created "resource" can return nutrients to the earth and sequester carbon for thousands of years.

PLANET PROTECTOR WOOLPACK

Until 2016, the underbelly wool of sheep generally ended up in landfill. Meanwhile, approximately 30 per cent of global landfill is polystyrene.

One solution exists for both waste problems.

"We've used waste wool unsuitable for the textile industry and given it a second life and commercialised it into a product that is insulated packaging to replace polystyrene in cold supply chains," said Planet Protector founder Joanne Howarth.

The wool used in Planet Protector "goes through a very rigorous washing process – which involves six baths of boiling hot water – and then it's felted to our specifications".

"ENGINEERS NEED TO WORK CLOSELY WITH INVESTORS AND GOVERNMENT TO RESOLVE A SOLUTION THAT WORKS FOR US."

It is then sealed with recyclable or compostable food-grade wrap.

"We have multiple clients who have set up a closed-loop recycling program and they are able to use the product multiple times," Howarth said.

The wool can be composted when it can no longer be reused.

In addition to providing a new revenue stream to sheep farmers, the company said it has so far prevented approximately 40 Olympic-sized swimming pools of polystyrene from going to landfill.

SUSTAINABLE SALONS

Human hair has a remarkable composition: it is one of the highest organic sources of nitrogen and contains 20 other elements such as sulfur and carbon.

"We're the world's biggest collector of human hair but we don't just collect it, we study it and turn it into products such as hair booms that clean up oil spills," said founder of Sustainable Salons Paul Frasca.

The organisation has collected 80 t of hair from Australian and New Zealand hairdressers and pet groomers since its inception in 2015, and one kilogram of hair can remove 840 g of spilled oil from seawater

"We have another product coming out later this year: hair fertiliser," Frasca said, adding that

BELOW (from left): Logan's biochar product; Planet Protector produces insulated packaging from wool; a sheep's underbelly wool usually ends up in landfill; Sustainable Salons collects hair and transforms it into new products.

the company also produces Refoil, made from aluminium collected from salons.

It is also investigating how human hair can replace heavy metals in flexible organic light-emitting diode, or OLED, displays and solar panels.

Hair is 45 per cent carbon and experiments have shown that exposing hair to extreme temperatures can extract carbon dots, which can then be blended with other agents to make them luminescent.

THE ROAD AHEAD

Baker said the engineering profession is developing good processes for plastics, tyres, glass and paper.

However, Australia has set itself an ambitious target of recycling or reusing 80 per cent of its waste by 2030. That figure currently stands at about 63 per cent.

"Engineers need to work closely with investors and government to resolve a solution that works for us. We are missing a national recycling framework that is integrated across Australia," Baker said.

Across the profession, she said, engineers should emphasise the potential and importance of the circular economy in Australia's sustainable future and encourage further exploration and adoption of circular economy practices. ●

FOGO TO GO

According to the Australian Government's *National Waste Report 2020*, about half the waste organics in Australia ends up in landfill, where it creates approximately 13 million tonnes of greenhouse gases — about three per cent of the nation's total emissions.

But the negative isn't just what this food organics and garden organics (FOGO) waste creates; it's what we're missing out on that worries Chair of the Australian Organics Recycling Association (AORA), Peter Wadewitz.

"If we keep wasting all this material by putting it in landfill, we're missing the opportunity to get it back to agriculture and horticulture to build good, sustainable healthy soils," he said.

"That soil is being depleted every day."

The benefits of compost include reducing water loss in soils, adding nutrients, protection against erosion, and reducing the need for synthetic fertilisers and pesticides.

AORA's 2031 vision says that the organics recycling industry currently has the capacity to process 51 per cent more organic materials, but there are several obstacles.

"There are major contamination issues in FOGO — households might put plastic or glass in it — so a lot of composters won't process it," Wadewitz said, adding that the government permits, as well as regulatory policy uncertainty, also hinder industry growth.

Beyond government concerns, he believes that terminology and education are key to maximising the potential of FOGO.

"If it's not reusable or recyclable, then it's got to be compostable — we need to promote this a lot harder," he said.

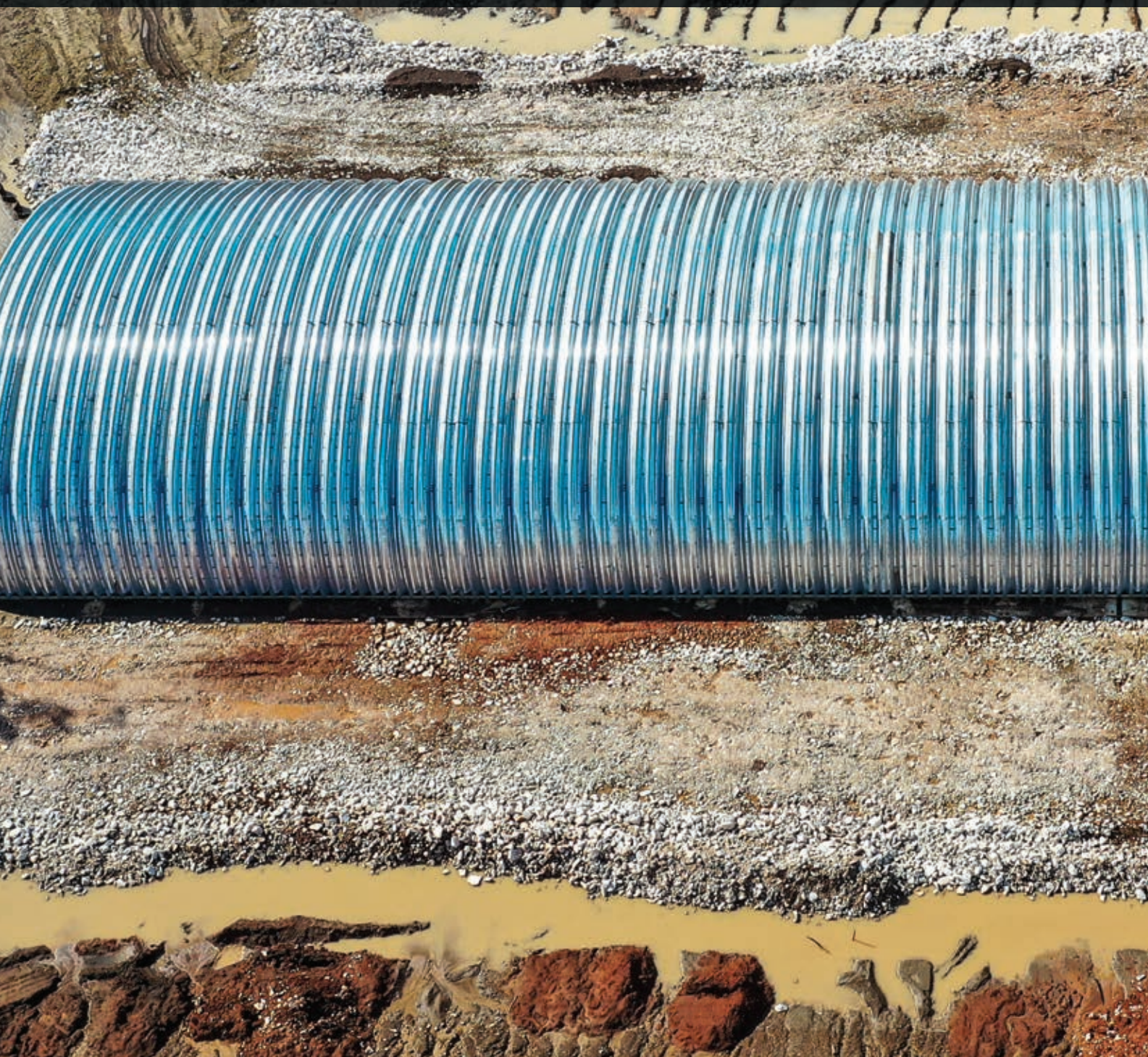
Wadewitz believes greater education to avoid contamination in recycling streams and highlighting associated cost savings — FOGO disposal levies are about half that of landfill — will also help boost the industry.

RIGHT: Peter Wadewitz, Australian Organics Recycling Association.

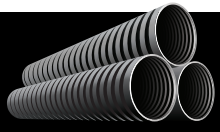
roundel

CIVIL PRODUCTS PTY LTD

Bolted, corrugated steel …. a cost-effective, and durable, alternative to concrete.



Roundel designs and manufactures / supplies a wide range of bolted, corrugated steel structures for use as underpasses, conveyor / personnel tunnels, mine portals and decline tunnels. All design and manufacture to AS/NZS2041 standards, with a 100-year lifespan achievable through design in all but the most aggressive conditions. Considerable time and cost savings can be achieved over traditional concrete designs. We welcome your inquiries.



INQUIRIES WA **08 9404 5391** QLD **07 4789 6700**
General **1800 194 746** **roundel.com.au**

WORDS BY **CHRIS SHEEDY**

RETURN TO NATURE

A CONCRETE STORMWATER CHANNEL IN BRISBANE HAS BEEN TRANSFORMED INTO A MEANDERING STREAM THROUGH LUSH PARKLAND, REPRESENTING A NEW, SUSTAINABLE SIDE OF ENGINEERING.

LEFT: Hanlon Park has become a place popular with children and adults alike. BELOW: Alan Hoban, Bligh Tanner.

IT TOOK several years of design and consultation to transform a functional but unsightly stormwater channel into a 600 m creek through parkland that is now popular with children and adults alike.

Most importantly, the reinvention of Brisbane's Hanlon Park required excellent engineering work.

"We think it might be the most significant creek naturalisation project in Australia," said Alan Hoban, Director of Stormwater Australia and Director and Principal Engineer at Bligh Tanner, the design lead on the Brisbane City Council project.

"WE THINK IT MIGHT BE THE MOST SIGNIFICANT CREEK NATURALISATION PROJECT IN AUSTRALIA."

"The engineers 100 years ago had one focus, which was flooding and drainage and getting water away as quickly as possible. The local catchment group realised something better could be done."

People power and a forward-thinking team at Brisbane City Council helped make the vision a reality. But along the way from concrete drain to creek re-naturalisation were numerous challenges, Hoban said.

First and foremost was the ever-constant threat of flooding.

"The area has a 30 km^2 urbanised catchment upstream of it," he said. "You don't need much rain in that catchment to cause flash flooding through the site.

"So we were transitioning from something that was the ultimate engineering of last century. Back then, they turned waterways into geometric drains that were optimised to convey water really quickly. And they did that job very well; the engineers were highly competent.

"When you want to change that and start naturalising it, adding plants, bends in the water course and other features, you invariably slow water down. To compensate for that we needed to do significant bulk earthworks.

"So it's a very complex engineering task in terms of optimising that design to make sure we weren't making flooding any worse for anybody."

FLOOD RESILIENCE

Recent flooding in Queensland has proven conclusively that no stormwater drainage system can cope with the worst of what nature offers.

The infrastructure must simply continue to perform. It must survive the event. The Hanlon Park re-naturalisation project, a far softer landscape, was tested and proven several times during and after its completion.

"We had four decent-sized floods during construction, and one since," Hoban said.

"So we didn't even get to completion before we had it tested thoroughly. An open construction site with quite a number of flood events was a challenge and a frustration.

"But it all worked because we had done a lot of engineering analysis to understand the velocities and erosive forces of the creek. That's why it didn't just get ripped apart."

The iterative design process began with sketches: quick designs that allowed the team to consider potential water movement options.

The team spent a great deal of time analysing maps of current waterways to begin locking down possible shapes and forms of the new creek.

Fixed constraints were then introduced. A major sewer line ran through the site – one of Brisbane's biggest – which had a number of manholes and smaller feeder lines running across to the main pipe. ▸

Dulux
PROTECTIVE COATINGS

The West Gate Bridge Project

Dulux® Protective Coatings is proud to have partnered with McElligotts on one of Australia's largest steel maintenance projects – the West Gate Bridge.

Built in the 1970's, this Melbourne icon was coated with Dulux Protective Coatings and now 40 years on it was time for a remediation project.

Exposed to pollution from traffic and sea water the West Gate Bridge required superior protection. For the 800m-long steel deck, Dulux Protective Coatings along with Mark Dromgool of KTA-Tator Australia specified a four-part coatings system, plus a special stripe coat for more than 120,000 bolts!

After extensive product trials by the McElligotts team, Dulux's durable system was chosen as the fastest drying solution with the best finish. Here are the steps in our specification:

BLAST: The 800m long steel deck had a total of 60,000 square meters to repaint. The underside of the steel deck was abrasive blast cleaned.

PRIME & FIRST COAT: Zincanode® 402 was applied with a Cold Cure Hardener. The two-pack epoxy zinc rich primer is ideal for use over abrasive blast cleaned steel.

SECOND COAT: The second coat of surface tolerant epoxy Durebild® STE was then applied.

THIRD COAT: Durebild® STE MIO added a layer of surface tolerant micaceous iron oxide, working as a barrier coat for protection against water ingress.

FINISH: A final topcoat of Weathermax® HBR MIO ensured a high build finish.

people and to attract wildlife to the park, but safe for bicycles and pedestrians.

"Green infrastructure evolves over time," Hoban said.

"When you're doing reinforced concrete, you know once it's set pretty much how much strength you've got. But when you're using vegetation, it might be 12 months to two years before that's in place.

"So you need a really good approach to working with risk."

"IT ALL WORKED BECAUSE WE HAD DONE A LOT OF ENGINEERING ANALYSIS TO UNDERSTAND THE VELOCITIES AND EROSIVE FORCES OF THE CREEK. THAT'S WHY IT DIDN'T JUST GET RIPPED APART."

There was also a focus on active transport, including walking and bike routes and bridges.

Where these features sat in the park and how they interacted with the creek had to be carefully planned.

"There was a reasonable amount of civil engineering, just thinking about the grades and levels of those paths and the bridge designs, and how they all work together," Hoban said. "Initial sketches were on paper, but software is now quite sophisticated, both in terms of earthworks terrain modelling software and the ability to create quite organic forms. You imagine that software is really good at drawing quite geometric forms, but we can now also use it to create quite organic ones."

Flood modelling software enabled further iteration; Bligh Tanner used a package called Tuflow.

The software helped the design engineers produce maps showing exactly how deep the water might get across the site, how fast it could flow, and the effect of any change in the extent of flooding compared to the existing situation.

"Once we had those site results, we could see where we needed levels to be a bit lower or higher, so we might need more excavation," Hoban said. "We probably ran through around 20 iterations of the design."

Surface materials were also a focus for flood resilience. They had to be designed so they would not erode under flooding, but they also had to slow water down to create a meandering creek.

Surfaces required a certain level of softness and greenery, appealing enough to engage

ABOVE: Bligh Tanner's work replaced a concrete stormwater drain with a natural watercourse.

SUSTAINABILITY FOCUS

There was a lot of that concrete to dig up and drag away.

On such a high-profile – "gutsy and provocative", as Hoban describes it – project that was sure to attract a lot of scrutiny, it was important to do the work in the most sustainable manner.

Bligh Tanner and construction firm Epoca Constructions agreed to re-use as much concrete as possible.

Much of it was used in the new site for landscape walls that ➤

double as places to sit and rest; for armouring the creek bed in high-velocity areas; and as stepping stones across the creek.

"Public parks are important places to showcase sustainability principles," Hoban said. "People talk a lot about sustainability and resource conservation, but when people see it in action, that's when it starts to resonate for them."

The biodiversity benefits from such a project are also significant, Hoban said.

There are now fish in the creek and their numbers are increasing. With the numerous varieties and levels of vegetation, bird life has also boomed.

As urban areas increase in size, the heat island effect means such green spaces help to make those cities more liveable.

"These green-blue places in our cities become cooling places, and there's a huge benefit to people in just being able to get close to – or into – water," Hoban said. "We really start to see some of that cooling benefit when we look at thermal imaging.

"It's a pretty significant sustainability benefit provided to the local community."

Since the project was completed last year, word has spread about its success. Delegations from local governments in New South Wales and Queensland have already visited or been in touch to make enquiries. It has also been the focus of an international waterways conference.

Coverage in the media, even including a report from ABC TV's *Gardening Australia*, has influenced other communities to connect with their local members to suggest similar solutions for their unsightly drains.

Where such projects can proceed, a broad range of talent is required to realise the re-naturalisation journey.

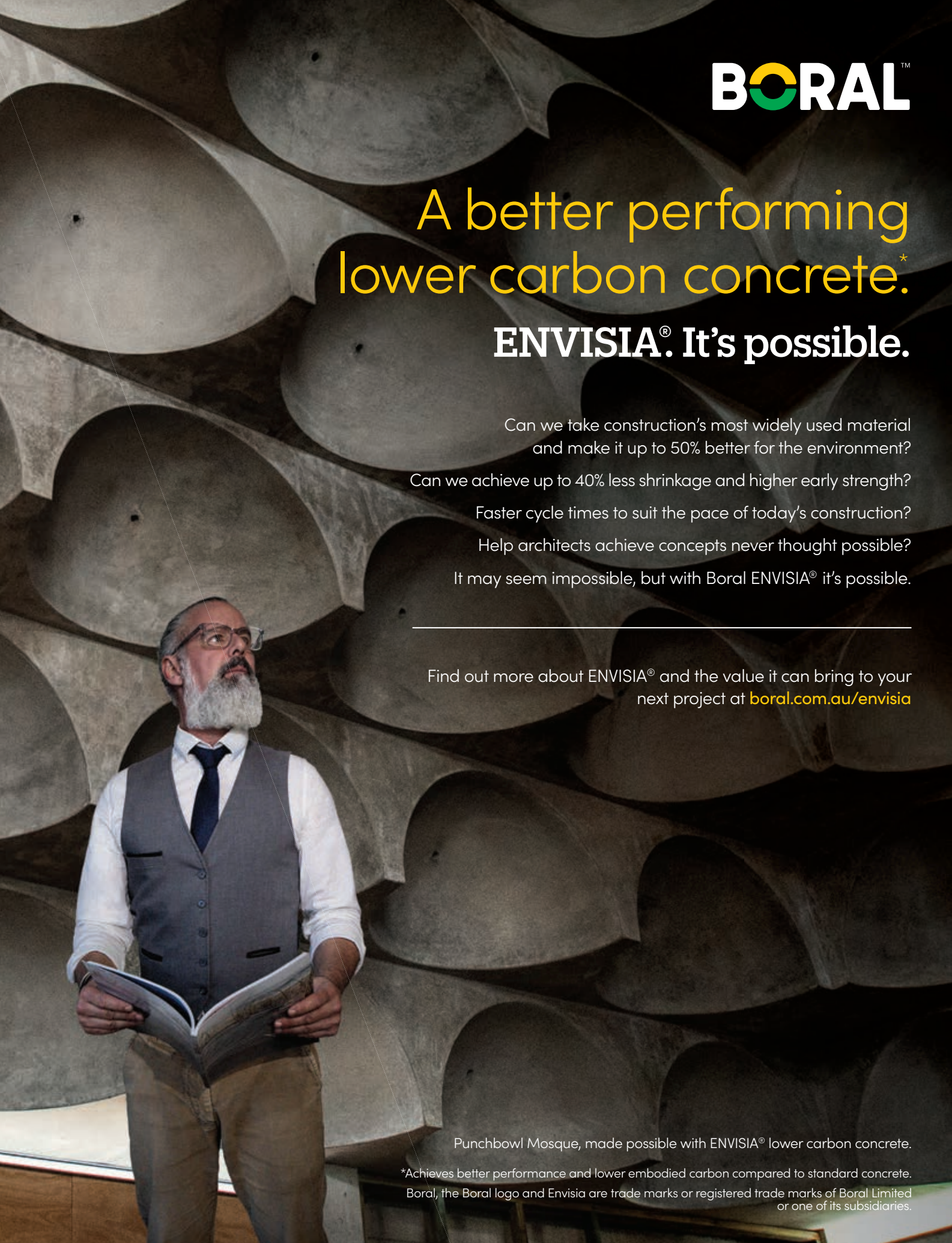
"We had civil engineers, structural engineers, electrical engineers, geotechnical engineers and flooding engineers, as well as landscape architects, ecologists, and a range of other people," Hoban said. ●

"THESE GREEN-BLUE PLACES IN OUR CITIES BECOME COOLING PLACES, AND THERE'S A HUGE BENEFIT TO PEOPLE IN JUST BEING ABLE TO GET CLOSE TO – OR INTO – WATER."

ABOVE: Green space like Hanlon Park reduces the urban heat island effect.

BY THE NUMBERS

- Idea proposed: **2010**
- Design begins: **2019**
- Construction time: **2 years**
- Project area: **5.2 ha**
- Channel removed: **500 m**
- New creek length: **600 m**
- Earthworks removed: **20,000 m²**
- Plants: **43,000**
- Trees: **462**



BORAL™

A better performing lower carbon concrete.*

ENVISIA®. It's possible.

Can we take construction's most widely used material and make it up to 50% better for the environment?

Can we achieve up to 40% less shrinkage and higher early strength?

Faster cycle times to suit the pace of today's construction?

Help architects achieve concepts never thought possible?

It may seem impossible, but with Boral ENVISIA® it's possible.

Find out more about ENVISIA® and the value it can bring to your next project at boral.com.au/envisia

Punchbowl Mosque, made possible with ENVISIA® lower carbon concrete.

*Achieves better performance and lower embodied carbon compared to standard concrete.

WORDS BY **CHLOE HAVA**

WITH TIME AND BUDGET CONSTRAINTS ALONG WITH SIGNIFICANT SITE ISSUES, A ONE-OF-A-KIND "JUMPSTART" TECHNIQUE WAS USED TO DELIVER A STELLAR URBAN REGENERATION PROJECT.

SYDNEY IS Australia's economic epicentre, but most of its inhabitants don't live anywhere near the city's harbourside central business district.

With a burgeoning workforce of 23,000 employees, there has been an ever-growing need to develop a new CBD in Parramatta, the heart of greater Sydney.

The centrepiece of this new precinct is the new $3.5 billion Parramatta Square precinct, a civic hub and public domain that includes four commercial towers (4, 3, and 6 and 8 Parramatta Square).

Construction group Built, in joint venture with Obayashi (BOJV), was selected by Walker Corporation and Parramatta Council to deliver the project.

The new precinct, among Australia's largest ever urban transformations, has ensured Parramatta is recognised as one of the most connected cities in the world, accommodating several top-tier private sector and government institutions, said Patrick Polomka, Senior Project Manager, Walker Corporation.

These include Property and Development NSW, the Australian Taxation Office, Australian Broadcasting Corporation, Link Market Services, Westpac, Deloitte, Endeavour Energy, NAB and LG.

"Combining state-of-the-art workspaces with the highest achievable sustainability credentials and premium

IMAGE: MATTHEW VASILESCU

LEFT: The façade of the 4 Parramatta Square building. RIGHT: The project expedited construction with a "jumpstart" methodology.

amenities, it will improve social and economic outcomes for generations to come," Polomka said.

However, there were several hurdles to navigate in the design and construction of the precinct, including site and regulatory issues.

Here's how BOJV and Walker managed to overcome them – and receive a finalist nod in the 2023 Australian Construction Achievement Awards along the way.

PROJECT CHALLENGES

Several challenges were unearthed throughout the design and construction of 4 Parramatta Square, beginning with a complex regulatory process that needed approvals from all levels of state and local government, said Polomka.

"The site's proximity to the existing floodplain and adjoining sites with multiple levels required extensive consultation between project teams to deliver a highly resilient and connected precinct, with direct links to the public domain and all major transport hubs," he said.

"The central location of 4 Parramatta Square made site access extremely challenging, as it's surrounded by Parramatta Railway to the south, the Sydney Water building and University of Western Sydney to the east and several existing developments along Macquarie Street."

Challenging geotechnical ground conditions due to the existence of a large igneous dyke running diagonally through the precinct also posed problems, said Peter Whyte, Built Construction Director.

"This resulted in the requirement for a diaphragm retention wall and a permanently anchored hydrostatic basement structure to deal with the high groundwater pressures," he said. "These conditions would typically add a significant period of time to a construction program."

A "JUMPSTART" SOLUTION

To mitigate these challenges, and others, a "jumpstart" methodology using structural steel was employed.

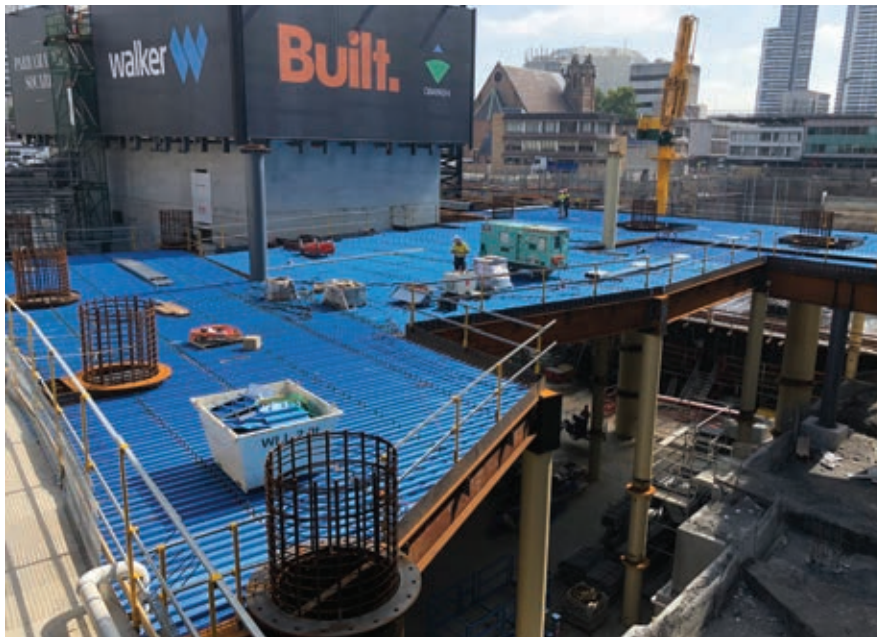
"The site had no direct access, being bounded by a large commercial building to the east, the existing Parramatta train station and rail corridor to the south, as well as the large excavation zones for the balance of the precinct to the north and west," said Polomka.

"The team had to create through access to the site, which meant we had to rapidly build to street level."

These conditions, coupled with a construction program that couldn't be met with a conventional build, meant BOJV had to implement innovative methods, said Whyte.

"Four Parramatta Square was run as a competitive tender. Due to early handover requirements,

"THE SITE HAD NO DIRECT ACCESS, BEING BOUNDED BY A LARGE COMMERCIAL BUILDING TO THE EAST, THE EXISTING PARRAMATTA TRAIN STATION AND RAIL CORRIDOR TO THE SOUTH."



BY THE NUMBERS: PARRAMATTA SQUARE

SITE AREA 3 ha

COMMERCIAL AND RETAIL NET LETTABLE AREA 290,000 m²

PUBLIC SPACE 6000 m²

OCCUPANTS 23,000

COMBINED PRECINCT VALUE $2.8 billion

HEIGHT (6 AND 8 PARRAMATTA SQUARE) 223 m

SUSTAINABILITY RATING 6 Star Green Star As Built

"WE TOOK ADVANTAGE OF THE BUILDING'S IMPRESSIVE ELEVATED PODIUM LEVEL DESIGN TO REACH THE TYPICAL FLOORS EARLIER, REMOVING A TOTAL OF SIX SUSPENDED LEVELS PLUS THE 1.5 M THICK HYDROSTATIC SLAB."

BOJV had to realise opportunities through clever construction sequencing that reduced the overall construction duration and associated plant and labour costs to ensure we remained competitive so we could secure this coveted project," he said.

"[We] took advantage of the building's impressive elevated podium level design to reach the typical floors earlier, removing a total of six suspended levels plus the 1.5 m thick hydrostatic slab off the critical path."

Adopting a sequence of work that accelerates upper floors of a building through the use of three to four-storey high concrete-filled steel tube columns – a jumpstart technique that bypasses intermediate floors – allowed a structural steel floor plate to be constructed earlier than if built floor by floor from the basement up, said Richard Hodgett, Engineering Manager, Built.

"By repeating the jumpstart sequence, BOJV were able to install ground floor framing, level one [and] then level three in quick succession, resulting in a triple jumpstart," he said.

Once the team had progressed to level three, the tower's typical floor structure could then progress to completion using conventional post-tensioned and concrete floors.

"The program remained on the critical path while the lower floors were 'filled in' underneath concurrently with the upper floors, saving a significant amount of time – approximately 12 weeks – compared to a conventional build," said Hodgett.

Through extensive use of structural steel for both the vertical and horizontal structures, the jumpstart technique also facilitated the construction of elevated floors without extensive high-strutting form and falsework, markedly reducing the on-site labour required to erect the structure.

"The expansive podium design with inclined columns in steel could be constructed concurrently in a safer manner with the tower floor levels which were on the critical path," he said.

ABOVE: The jumpstart approach was the first of its kind to use inclined columns.

LEVERAGING THE TECHNIQUE

Following the success of the 4 Parramatta Square jumpstart methodology, BOJV used a similar technique at 6 and 8 Parramatta Square to again reduce the overall build program, said Hodgett.

"The installation of triple-height steel columns allowed the team to essentially jump the structure to the lower ground floor, and then ›

Get ready! Registration becomes mandatory for mechanical engineers in Victoria on 1 December.

ENGINEERS AUSTRALIA

What does this mean for you?

If you're a profesional mechanical engineer working on projects in Victoria, you need to be assessed against competency standards to be registered by the 1 December deadline.

We can help

Find out how these registration changes affect you and start your assessment process with us today.

As a member, you may already meet the requirements for registration.

Find out more →

engaus.org/GetAssessed

Coates

ENGINEERING SOLUTIONS

5 reasons to choose Quadshore™ 150 over conventional propping systems

Designed by engineers at Coates and Monash University, Quadshore 150 is the lightest, heavy-duty propping solution in the world. Here's why you should consider hiring it for your next project.

1. Stronger, yet lighter than conventional systems

Conventional propping systems are often costly and inefficient due to their low capacity-to-weight ratio and bolted module-to-module connections. Quadshore 150 uses lightweight, high-strength steel elements to provide extra-high load-bearing support of up to 170 tonnes. The working load limit-to-weight ratio of a 3m assembly is at least 1.7 times higher than conventional systems.

2. Faster and easier to install and de-install

Quadshore's patented boltless connectivity eliminates the need for consumables. As a result, assembly and disassembly time is at least 60% quicker than conventional systems with the same capacity. A range of end sections means adjustments are faster and easier, too. These include an unloading jack that enables the screw jack to be disengaged with zero manual effort.

3. Safer due to less manual handling

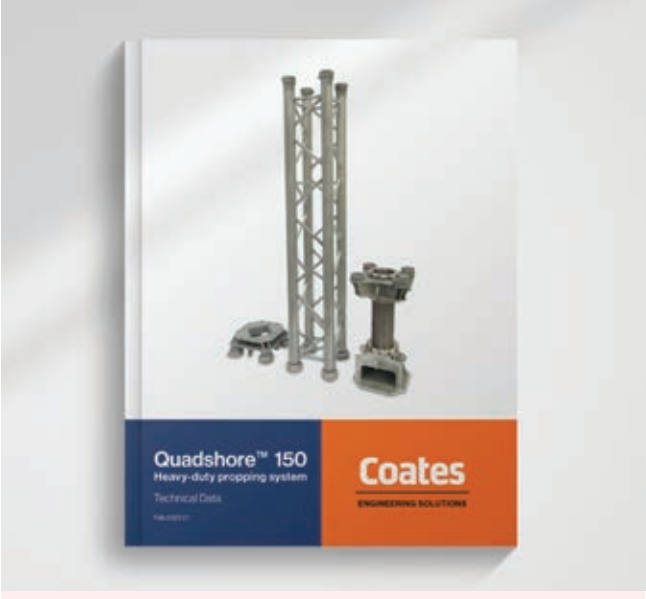
Conventional propping systems pose challenges around safety due to the need for manual handling and heavy machinery or equipment to unload and install it. As Quadshore 150 is considerably lighter with no bolted connections between its modular beams and a smaller site footprint, Coates expects the number of lost time injuries reported by customers will be dramatically reduced.

4. Reduced costs for labour, transport and consumables

Compared with a conventional propping system, Coates estimates that Quadshore 150 will reduce transport costs due to its lighter weight and higher capacity, which means less equipment, machinery and labour are required on site. The boltless design will also result in significant cost savings on consumables throughout the entire lifecycle of the product.

5. Lower carbon footprint due to less transport

Quadshore 150 is more environmentally sustainable than conventional propping systems in a number of ways. As it is made with higher-grade steel, there is less material used in its manufacture and less energy is required for its transportation. Boltless connections mean less waste of any kind of steel componentry.



Learn more

To request a copy of the Quadshore 150 technical brochure, or to book a Lunch & Learn session for your team, email engineeringsolutions@coates.com.au or call (02) 8796 5000.

“THE JUMPSTART METHODOLOGY HELPED 4 PARRAMATTA SQUARE ACHIEVE ITS TWO FUNDAMENTAL PROJECT GOALS OF BEING DELIVERED ON TIME AND UNDER BUDGET ON A SIGNIFICANTLY CONSTRAINED SITE.”

again up to level one, enabling construction to start the typical cycles of the commercial floor slabs then drop back to infill the basement and podium slabs off the critical path,” he said.

To install these columns safely and efficiently, the team adopted 3D modelling to simulate the process, using tower cranes to lift the steel while working around the jump-form core construction to ensure access was maintained at all times.

“The modelling allowed the team to identify clear pathways to install each column weighing up to 25 t each,” said Hodgett.

NEW HEIGHTS

At the time of construction, the project’s jumpstart methodology was one of the biggest in Australia – and the first of its kind with inclined columns, said Polomka.

“The jumpstart methodology helped 4 Parramatta Square achieve its two fundamental project goals of being delivered on time and under budget on a significantly constrained site,” he said.

“Using this methodology, we reached the typical floors earlier which allowed work to start on multiple levels, helping us achieve the tower’s extremely tight 24-month delivery timeframe for the base completion and interior fitout, which is a significant feat for a 40-level building.” ●

ABOVE: The tower at 6 and 8 Parramatta Square is the largest commercial building in Australia by net lettable area.

MEMBERS HAVE FREE ONLINE ACCESS TO ENGINEERS AUSTRALIA'S SEVEN TECHNICAL JOURNALS AT:
portal.engineersaustralia.org.au/content/library-resources-and-services

STAY CURRENT

HIGHLIGHTS FROM AUSTRALIA'S MOST UP-TO-DATE ENGINEERING RESEARCH

A PARAMETRIC DESIGN FRAMEWORK FOR TIMBER FRAMING SPAN TABLES

Journal: *Australian Journal of Civil Engineering*
Authors: J. Jiang, L-M. Ottenhaus & J. M. Gattas

Structural sawn timber is widely used in timber-framed residential housing, but a range of short and long-term supply chain pressures is causing market demand to significantly outpace the available supply. This paper examines how existing timber-framing span tables can be improved to reduce the over-specification of timber products in housing construction and thus improve supply use.

ANALYSIS OF THE PERFORMANCE OPTIMISATION PARAMETERS OF SHELL AND TUBE HEAT EXCHANGER USING CFD

Journal: *Australian Journal of Mechanical Engineering*
Authors: A. Hanan, U. Zahid, T. Feroze & S. Z. Khan

Heat exchangers have found extensive applications in the engineering sector owing to the crucial need for heat transfer and temperature regulation in the process industry. This research shows how the performance optimisation parameters of a shell-and-tube heat exchanger affect its performance in terms of the extent of heat transfer achieved and fall in the shell outlet temperature.

SWARM OF RECONNAISSANCE DRONES USING ARTIFICIAL INTELLIGENCE AND NETWORKING

Journal: *Australian Journal of Multi-Disciplinary Engineering*
Authors: A. A. Jain, A. Saraogi, P. Sharma, V. Pandit & S. R. Hiremath

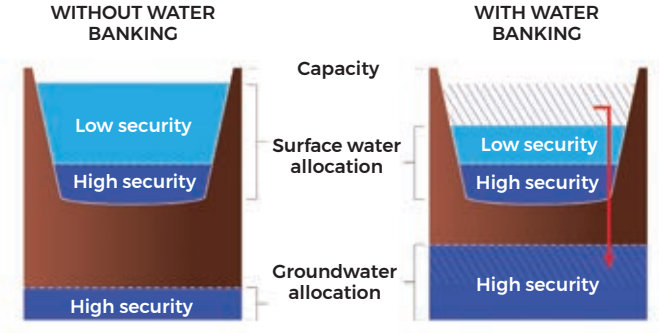
This paper proposes a novel system for search and recognition in flood-affected areas using a swarm of autonomous drones. The system is based on a combination of machine learning, artificial intelligence and networking technologies. The drones are equipped with cameras and sensors to identify victims, assess damage and provide real-time updates to rescue crews.

Water banking in aquifers as a tool for drought resilience in the Murray Darling Basin

Journal: *Australasian Journal of Water Resources*
Authors: D. W. Page, D. Gonzalez, T. Clune, Y. Colton & G. D. Bonnett

Water banking in aquifers is an internationally proven, low-cost solution that could improve drought resilience across the Murray–Darling Basin. While significant potential for water banking through managed aquifer recharge (MAR) or conjunctive use of surface and groundwater resources has been identified in the Murray–Darling Basin Plan, there is a need to establish clear policy and institutional foundations to incentivise adoption. This paper clarifies principles and frameworks to secure water rights for recharge, storage and recovery within the sustainable limits of water resources currently set under law.

BELOW RIGHT: Storage of low security surface water to high security groundwater through water banking.



Engineering Trends
Member access to exclusive papers

CONFERENCES & EVENTS | OCTOBER 2023 – FEBRUARY 2024

11-13 OCT 2023
SEVENTH WORLD ENGINEERS CONVENTION

Location: in-person *Prague, Czech Republic*
Website: *wec2023.com*
The global engineering community will reunite to explore the breakthrough technologies and capacity development focused on the United Nations Sustainable Development Goals.
Register now

07-09 NOV 2023
IMC INTERNATIONAL MARITIME CONFERENCE

Location: in-person *Sydney*
Website: *indopacificexpo.com.au/IMC2023*
Conference delegates will be involved in discussions concerning the latest developments in naval architecture, marine engineering and maritime technology in the areas of defence and commercial shipping.
Register now

12-15 NOV 2023
HYDROLOGY AND WATER RESOURCES SYMPOSIUM 2023

Location: in-person *Sydney*
Website: *engineersaustralia.org.au/hwrs2023*
Innovation, collaboration and engineering excellence come together for HWRS 2023, with this year's theme "Living with extremes". Topics cover the spectrum of engineering hydrology and the progress made in understanding the uncertainties facing water resources managers now and in coming decades.
Early-bird registrations close 15 September 2023

07-09 FEB 2024
11TH AUSTRALASIAN CONGRESS ON APPLIED MECHANICS (ACAM 2024)

Location: in-person *Brisbane*
Website: *engineersaustralia.org.au/acam2024*
ACAM 2024 aims to bring together engineers, academics, postgraduate scholars and industry managers to share research and development in all aspects of applied mechanics for a resilient and sustainable future.
Register now

ENGINEERS AUSTRALIA EXCELLENCE AWARDS GALA DINNER

29 November 2023

Location: Crown Towers, Melbourne
Website: *engaus.org/excellenceawards*
Join us in Melbourne this November for the highly anticipated gala event as we celebrate and recognise the national winners of the 2023 Engineers Australia Excellence Awards.

29-30 NOV 2023

Climate Smart Engineering Conference 2023

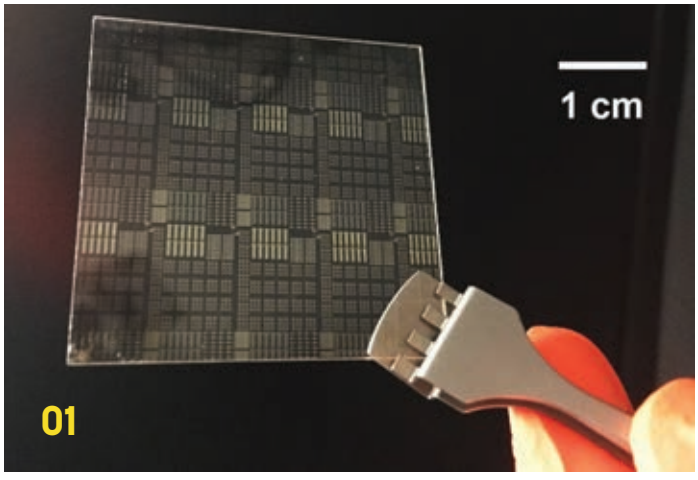
Location: in-person *Melbourne*
Website: *engineersaustralia.org.au/cse*

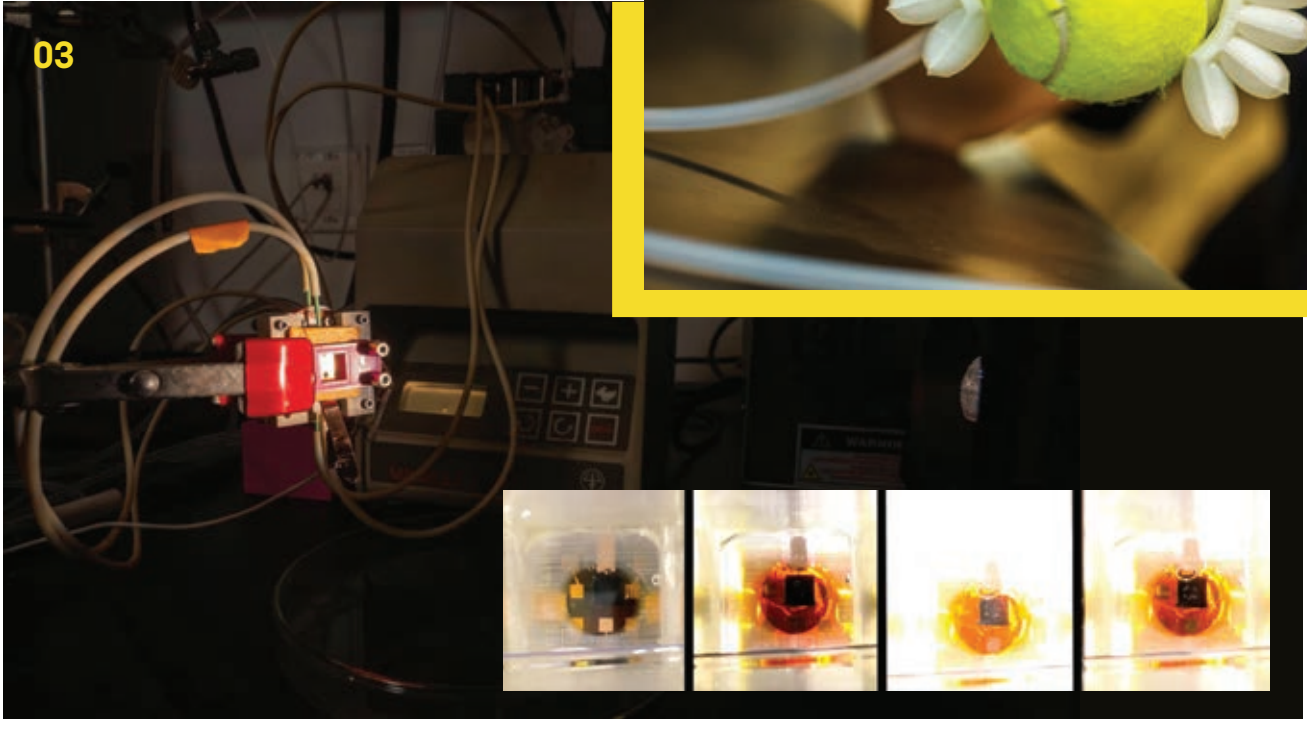
Gain insights, knowledge and practical solutions for addressing climate change at CSE23. Attendees will benefit from expert-led sessions, networking opportunities and innovative ideas, empowering them to make a positive impact in the fight against climate change.

The program for CSE23 includes some of the profession's brightest and boldest minds as well as key leaders across government and industry offering diverse perspectives on climate mitigation and resilience, the clean energy transition and opportunities in the circular economy.

Plenary speaker line-up includes:
Dr Alan Finkel AC, *former Chief Scientist of Australia*
Ruby Heard *CPEng, Director, Alinga Energy Consulting*
Eytan Lenko, *Chief Executive Officer, Boundless Earth*
Lisa McLean, *CEO, Circular Australia*
Kane Thornton, *Chief Executive, Clean Energy Council*
Professor John Thwaites AM, *Chair, Monash Sustainable Development Institute and Chair, Climateworks Centre*
Register now

THE LATEST DEVELOPMENTS FROM AROUND THE WORLD.





01

Source-gated transistor

This transistor is more energy-efficient and could be used in medicine, computing and in large-area displays. Image: University of Surrey

Researchers at the UK's University of Surrey have developed technology that could see the creation of new low-cost, energy-efficient and flexible displays. The advance concerns source-gated transistors — special devices that use less power than traditional transistors while producing high-signal amplification and are reliable under different conditions. Source-gated transistors consist of a thin-film transistor with a metal-semiconductor contact but have encountered problems maintaining heat stability. "We used a rapidly emerging semiconductor material called IGZO or indium-gallium-zinc oxide to create the next generation of source-gated transistors," said Dr Radu Sporea. "Through nanoscale contact engineering, we obtained transistors that are much more stable with temperature than previous attempts. Device simulations allowed us to understand this effect." More effective source-gated transistors could be useful in medicine and computing and are suitable for large-area electronics.

02

Quantum "jellybean"

An artist's impression of how a "jellybean" configuration can keep qubits separated. Image: Tony Melov/UNSW

Engineers at the University of New South Wales working on quantum computing have developed a way to keep qubits — units of quantum information — far enough apart so that they can be integrated into silicon chips with enough space for wires to run between them. Quantum computers arrange electrons into series of "quantum gates" that represent binary values; two-qubit gates implement quantum algorithms with electron pairs in which one particle is dependent on the state of the other. This requires them to be placed just 10s of nanometres apart, and the jellybean configuration keeps the particles close to one another, but not too close. While the concept has been used before, this is the first time it has been demonstrated with silicon. "It's only when you go to larger numbers of electrons, say 15 or 20 electrons, that the jellybean becomes more continuous and homogeneous," said PhD student Zeheng Wang. "That's where you have your well-defined spin and quantum states that you can use to couple qubits to another."

03

Green hydrogen

The photoreactor splits water molecules to generate hydrogen. Image: Mohite lab/Rice University; Gustavo Rakosksy/Rice University

New efficiencies in generating hydrogen from solar energy have been achieved at the US's Rice University via a new photoreactor that brings electrocatalysts together with halide perovskite semiconductors. Using an anticorrosion barrier to insulate the device's semiconductor from water, the team was able to convert solar energy to hydrogen with a 20.8 per cent efficiency. "All devices of this type produce green hydrogen using only sunlight and water, but ours is exceptional because it has record-breaking efficiency and it uses a semiconductor that is very cheap," said Rice University doctoral student Austin Fehr. "We designed a system that absorbs light and completes electrochemical water-splitting chemistry on its surface." The team's breakthrough came when it produced a barrier with two layers: one to protect the semiconductors in water and another to facilitate a continued flow of electrons.

04

Pneumatic gripper

A high-pressure gas is used to operate this soft, 3D-printed gripper. Image: "Yichen Zhai's pneumatic gripper bot", UC San Diego Jacobs School of Engineering, https://flickr.com/photos/jsoe/53087292098/in/album-72177720310197003/, CC BY 2.0

Roboticists at the University of California San Diego have devised a soft gripper that is 3D printed and can be operated without electricity. Able to pick up, hold and release objects, the tool can be mounted on to a robotic arm and operates via power from a bottle of high-pressure gas. "We designed functions so that a series of valves would allow the gripper to both grip on contact and release at the right time," said postdoctoral researcher Yichen Zhai. "It's the first time such a gripper can both grip and release. All you have to do is turn the gripper horizontally. This triggers a change in the airflow in the valves, making the two fingers of the gripper release." The team produced an extra-soft gripper by developing a 3D-printing method that traces a continuous path and produces the device in a single extrusion, preventing the leaks and defects that contribute to the material's stiffness.

Dr Jun Sugawara

CPEng, Director (Geotechnical) Department of Transport and Main Roads, Queensland

WHEN IT COMES TO HIS WORK AS A GEOTECHNICAL ENGINEER, JUN SUGAWARA IS NOT AFRAID TO GET HIS HANDS DIRTY.

WHEN DR JUN Sugawara was growing up in Japan, he and his school mates were fascinated by motorcycles and auto racing — the products of the country's engineering talents at companies like Suzuki and Yamaha.

This boyhood tinkering encouraged him to pursue a degree in mechanical engineering, and although those days are long behind him — he now works as a geotechnical engineer for Queensland's Department of Transport and Main Roads (TMR) — he still values hands-on experience.

"Although I'm director of the Geotechnical Section in TMR, I still consider myself as one of the engineers and I try to build a very flat organisation: no hierarchy, very transparent, very fair," he told *create*.

"I really enjoy not only the office work but also the work in the field."

For a state the size of Queensland, that means a lot of travel and, by way of example, Sugawara mentions an arterial road slope-remediation project he worked on in Cairns.

"There were very heavy, prolonged rainfall events in early 2019 that caused a major slope failure … along the Cairns West Arterial Road," he said.

"This failure caused significant damage to the road embankment and the sugar cane rail track located at the toe of the embankment. Very urgent slope remediation on the rail track restriction was required to maintain the road safety."

03 TIPS FOR SUCCESS

1 Every day is an opportunity to learn.

2 Learn from the people around you, be they senior colleagues, industry, academics – or even Google.

3 Don't get other people to do your thinking for you: try to figure out your own solutions for the problems you encounter.

The project team completed the work in four months — in time to reopen the rail line for the sugar cane harvest season.

Sugawara has applied this experience internationally too, working with the United Nations Development Programme in Bosnia and Herzegovina after flooding in 2014.

"That caused more than 3000 landslides throughout the country, resulting in the destruction of approximately 2000 houses," he said. "I was responsible for the development of a situational analysis and training needs assessment — related, in particular, to slope or landslide risk management. Then I designed and delivered a comprehensive and tailored training program."

Sugawara's efforts were recognised by the Japanese Government, and with good reason: he drew from his experience in Japan, a country where landslides are common, to propose technical solutions not in use outside the country.

Sugawara is a Chartered engineer, and he sees the qualification as important to gaining professional recognition as well as building his future career.

"That will give you another path to become an APEC Engineer — so that you have the opportunity to work outside Australia as well." ●

IMAGE: RUSSELL SHAKESPEARE

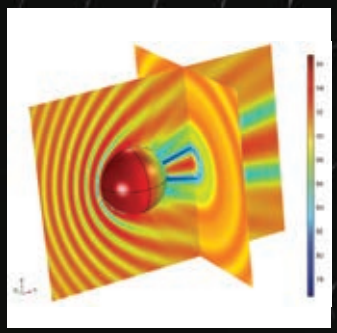

More predictive.
More productive.
Take the complexity out of industrial automation
with the combined expertise of Telstra,
Aqura, Alliance Automation and Quantium.
telstra.com.au/industrial-automation

FINITE ELEMENT ANALYSIS

VERIFY AND OPTIMISE YOUR DESIGNS WITH COMSOL MULTIPHYSICS®

Simulate real-world designs, devices and processes with multiphysics software from COMSOL.

The Acoustics Module provides tools for modelling acoustics and vibrations. Visualize acoustic fields. Build virtual prototypes of devices and components.



TECHNIC PTY LTD

Technic Pty Ltd
admin@technic.com.au
+61 (03) 6224 8690
technic.com.au/try

Come and try the full version for 30 days **technic.com.au/try**