Issue 50 • July 2019

Connection

The official magazine of Composites Australia

Inside

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President's letter

To thrive in business, industries need to perpetually renew themselves through entrepreneurship and start-ups. For this reason, this edition features articles on a few of the next generation composite practitioners, Tim Corbett from Carbon Revolution and Tristan Alexander from The Smart Think. Both have undertaken extensive R&D and developed technology and precision engineered machinery. Owning their own IP gives them a market edge and protects them from competition. In the case of Carbon Revolution, it currently has 41 patents covering its manufacturing processes and designs, with another 14 pending.

The story of Pathfinder is equally inspiring, having forged a global niche supplying automated cutting systems designed and manufactured in Australia. The company's' customer list and product range continues to expand and diversify and now includes some of the world's most advanced manufacturing firms in aerospace, automotive, rail, marine and defence.

Nowadays, composites are a preferred solution when longevity and corrosion resistance is are key requirements. It is therefore heartening to see our very own Corrosion Technology Australia providing the filament wound composite maintenance shafts for the West Gate Tunnel Project, all designed, engineered and made in Dandenong, Victoria.

When bringing these inspiring stories to you by way of this magazine, the challenge is always a dance between informing our readers and protecting the very information that embodies the owners' IP. So for the **Composites Australia** team, it is always a privilege to hear these stories and acknowledge the generosity of those who share them with us.

This edition also features an article on our annual conference that was held in Sydney during early April. The event is always an ideal platform for our industry to meet, share and exchange knowledge on the latest innovations and expertise in composites manufacturing and technology and it was energising to see the connections being made between the delegates.

Industry comradery was a feature of the conference dinner that was held in the Sunset Room at Luna Park. Needless to say, the uninterrupted twilight views of Sydney Harbour Bridge and the Sydney Opera House were breathtaking.

The **Composites Australia** annual conference remains a unique event, providing a strategic insight into a wide range of aspects associated with operating and growing a composites business and collaborating with composite companies across the range of product lines, material supplies, tooling and equipment, new technologies, education, and design and engineering. The Composites Australia board members are busy planning for next year so keep an ear open for details of dates and venue, soon to be announced.

We are also busy planning for an Australian pavilion at JEC Asia 2019, in Seoul, South Korea between 13th and 15th November. This is a great opportunity for **Composites Australia** members to collaborate in a strategic market entry initiative into East Asia, with support from Austrade and the Australian Federal Government. More details in the magazine – happy reading.

Leona Reif
President

Fellowship leads to step-change preforming technology

Unveiled at the Geneva Motor Show on 6 March 2018, Ferrari's remarkable 488 Pista featured a set of optional 20-inch carbon fibre wheels made by Carbon Revolution in Geelong. The beautiful aerodynamically efficient supercar was already 91kg lighter than its predecessors, and by using Carbon Revolution wheels, Ferrari was able to save an additional 40% in weight on its wheels alone.

So what is the secret of a company that ascended from a start-up in a Geelong garage a mere 12 years ago, to supplying "the most technically advanced wheel on the planet" to global car makers like Ford and Ferrari – all of it achieved against the backdrop of a cost sensitive and conservative supply chain?

In the case of Ferrari, the marketplace requirements for an optional wheel on a road-going supercar are Herculean. The 488 Pista is said to have a top-speed of 340 km/h; accelerating from 0–100 km/h in 2.85 seconds 0–200 km/h in 7.6 seconds. The wheel is attached to a vehicle that weighs just over 1.5 tonnes. The wheel takes all the forces from the road through the tyre and into the car structure. It must handle hundreds of horsepower from the drivetrain and sustain extreme forces from hitting potholes and curbs. Inside the wheel sits a brake disc and calipers, which can reach temperatures of up to 1,000 degrees Celsius, just a few centimetres from the wheel.

To deal with this level of extreme fatigue over a lifespan of more than 300,000 kilometres, the wheel needs a lightweight, fibre and polymer-based carbon fibre composite component that is precision engineered and of aerospace quality.

Kerryn Caulfield and ISS Institute Fellow Dr Tim Corbett

Dr Tim Corbett, an Engineering and Doctoral (PhD) graduate of Deakin University and a foundation employee of Carbon Revolution, believes that the company's secrets to success are its investment in continuous research and development in step change efficiency technologies, global partnerships, an active patent strategy ...and testing, testing and more testing...

Technical Specialist with Carbon Revolution, Tim was awarded an International Specialised Skills Institute (ISS Institute) Fellowship in 2016 to examine and understand state-of-the-art RTM systems for 3D parts, direct tow handling and fibre placement, novel preforming technologies, as well as carbon fibre conversion processes used in the advanced manufacturing R&D institutions in Europe.

Carbon Revolution's "most technically advanced wheel on the planet"

Carbon Revolution's 3000m² Waurn Ponds manufacturing facility is being expanded by 7,000m² to allow the company to lift its output from 10,000 wheels a year to half a million wheels per year in the long term

Prior to his Fellowship, Tim had been working on a revolutionary new concept for preforming dry carbon fibre material. His quest was to unlock very rapid tooling throughput, injection and cure cycle times, without losing surface quality on all moulded surfaces, as well as to address resin shrinkage through thick section composites, particularly where those sections lie perpendicular to the mould closing axis. Another area of investigation was to understand and benchmark resin richness in complex 3D structures that can result from various different preforming technologies. Resin richness, he notes, are pockets of a laminate in concave areas that are not properly filled with fibre. He found that many preforming processes were surprisingly susceptible to resin richness, particularly in challenging parts. Tim's findings drove fundamental design decisions about this bespoke invention, which is now a principle process in manufacturing the company's carbon fibre wheels. The innovative new preforming machine is in the genre of additive manufacturing and delivers carbon fibre material (kgs per hour) at a capital efficiency far better than competing preform technologies. Importantly, the technology has resulted in a ~1kg reduction in wheel mass over the company's pre-existing design.

"One of my conclusions after examining all that was on offer in Europe, was that to produce consistent, repeatable, dimensionally accurate, high-quality carbon fibre automotive components with precisely finished surface aesthetics we had to develop our own technology and build our own machines", explained Tim. "While this wasn't the cheapest or fastest route to market, it was the surest for tooling optimisation and for reducing material usage and cycle times."

During its 12 year journey, Carbon Revolution was able to attract funding to industrialise and automate its unique processes as well as fuel its expansion. Local private investors, Acorn Capital, global wheelmaker Ronal AG of Switzerland, Deakin University and the federal Clean Energy Finance Corporation have supported the company thus far. An ASX listing has been mooted "inside a year" that will propel Carbon Revolution to the next level of development

The company has announced a $100 million expansion of its Waurn Ponds manufacturing facility, which will eventually add 500 workers to the payroll. The expansion adds 7000 square metres to Carbon Revolution's 3000m² footprint and will allow the company to lift its output from 10,000 wheels a year to half a million wheels per year in the long term.

One consequence of the company's success is competition from rival carbon fibre wheel technologies. Tim believes the company is fortified by developing its own manufacturing processes and equipment and owning its own IP. Indeed, Carbon Revolution currently has 41 patents covering its manufacturing processes and designs, with another 14 pending.

It is safe to speculate that there will always be markets for automotive components that make a car go faster. Reducing unsprung mass helps a car's suspension work more effectively. Reducing rotating mass will make the car accelerate and stop faster and conversely reduce fuel consumption. All this makes the future promising for lightweight carbon fibre automotive components with beautiful finished surface aesthetics.

Like the legendary style of the Ferrari brand, Australia's own Carbon Revolution's is on the rise and capturing attention all over the world.

Written by Kerryn Caulfield, Executive Manager of Composites Australia Inc.

Further information on the International Specialised Skills Institute and its Fellowships can be found at http://www.issinstitute.org.au.

Starting-up and commercialising technology for a lighter, higher-performing ballistic helmet

Thriving industries need perpetual renewal through entrepreneurship and start-ups. One of Australia's most promising start-ups is The Smart Think, which has developed a new composite forming technology to produce lighter, safer and higher-performing ballistic helmets for the global defence market.

At a mere 30 years of age, Tristan Alexander, CEO of The Smart Think, has already completed a Bachelor of Applied Science and a Bachelor of Commerce in Nanotechnology and Financial Banking at Deakin University. He then worked as a Research Scientist focusing on researching ceramic and carbon fibre based armour systems.

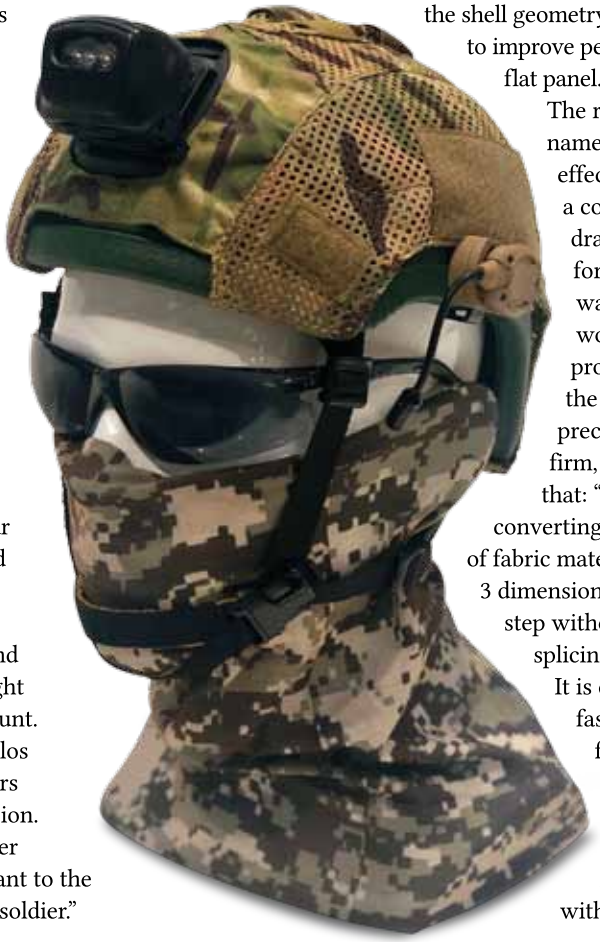
In parallel, Australia's Defence Science Technology Group (DSTG) and Defence Materials Technology Centre (DMTC) collaborated to develop a vision to create cost effective technologies that could revolutionise existing armour systems. After ten years of research by seven scientists, Tristan and his company are on the cusp of commercialising DMTC's initial generation of composite forming technology known as 'Double Diaphragm Deep Drawing' (D4) that has been adapted and advanced for scalable production.

'Lightweighting' is a priority for armed forces worldwide, to ensure they are protected, deployable and agile. In 2009 at the height of the Afghanistan war, the load carried by a US soldier was more than 43 kilos. Tristan advises that the weight of a standard UHMWPE helmet is 1.25 kilograms: "Night vision goggles, torches, communication gear and counterweights also add weight. With temperatures ranging from an oppressive 40 celsius during summer and overnight lows of zero, weight and ergonomics are paramount. Additionally, more than 2 kilos on your head for over 4 hours results in spinal decompression. Any weight saving, no matter how many grams is significant to the wellbeing and agility of the soldier."

Traditionally, helmets were made by cutting a piece of fabric into a pinwheel shape, then hand laying into the helmet mould layer by layer. There are inherent shortcomings with hand layup including expense, human error and material wastage from splicing. Non-homogenous distribution of material through overlap can introduce gas inclusions and be responsible for unnecessary weight. Capital equipment and tooling is also expensive. Ballistic textiles are less than ductile and/or elastic. Splicing and curvature create wrinkles dictated by weave geometry.

Through computer simulation and testing, the DMTC and Deakin developed a method of applying external positive pressure and the addition of a mechanical method for application of planar tension within the laminate stack sufficiently suppressed 'out of plane movement' i.e wrinkling. Secondly, they used the shell geometry and fibre orientation to improve performance compared to flat panel.

The resulting technology named D4 is a unique cost-effective method that uses a combination of deep drawing and vacuum forming. The D4 machine was designed by those working in the research program and built by the Melbourne-based precision engineering firm, Marand. Tristan says that: "The process works by converting a 2 dimensional stack of fabric material into a deep-drawn 3 dimensional object in a single step without the need for fabric splicing or extra handling. It is currently the world's fastest and most advanced forming machine with an automated lay-up, cure and ejection cycle producing A-class composites within 2 – 5 minutes."



The Smart Think military helmet

Kerryn Caulfield holding a carbon fibre helmet shell with Tristan Alexander, CEO of The Smart Think

Helmets produced through D4 technology are 30% lighter than comparable helmets and have increased structural and ballistic performance. "Backface deformation (BDF) - the amount of deformation when hit by a projectile – for our competitors is about 22mm, whereas our helmets are achieving 8mm BDF. This is a result of our hybrid resin system coupled with homogenous distribution of material. We have greater control over our quality and the ability to co-form thermoplastic and thermoset resins."

The odds against start-ups are considerable. Capital is a rapidly depleting resource and tender and procurement systems are dominated by global giants. Defence procurement is acutely risk averse, has long tender cycles and there is always pressure to support sovereign capability. An added challenge is that defence procurement in Australia changed in the last decade to a prime vendor model whereby tendering is grouped into a supply line of multiple products and incidental services with little scope for a single product. Tristan says that "To realise our vision to scale up to supply into the largest defence forces in the world, we had to attract venture capital. We took advantage of the federal government's Australia-Singapore Comprehensive Strategic Partnership program to identity worthy partners." The Smart Think is now a Singapore-Australian company with a charter to transform the defence industry through cutting edge technologies to produce state-of-the-art defence products.

Tristan's entrepreneurial spirit is undaunted. He says that "The future looks promising with procurement agencies such as the Australian Special Forces, Singapore and Indian armies and the Bangladesh Defence Force. There are also potential applications for the technology beyond combat helmets for military use including F1 and motorcycle helmets and also vehicle armour." While the intent is to manufacture from Geelong, The Smart Think is also open to the option of installing precision engineered production lines around the world.

Written by Kerryn Caulfield, Executive Manager of Composites Australia Inc.

2019 Composites Australia Annual Conference

Delegates arriving from all over Australia to attend the 16th Composites Australia conference were greeted with spectacular views of Sydney Harbour filtered through the lush growth of Wendy's Secret Garden. Held in Lavender Bay in North Sydney from 2nd to 4th April, this year's conference was dedicated to people who make things as well as those who provide services to the composites sector. The annual conference is always an ideal platform for our industry to meet, share and exchange knowledge on the latest innovations and expertise in composites manufacturing and technology.

The event opened with Tony Caristo, Managing Director of RPC Technologies which is a leader in the design, engineering and manufacturing of fibre composites and advanced materials. RPC employs over 500 skilled staff and supplies to the defence, infrastructure, renewables, environment, pipe systems, resources, energy and transport sectors. Tony provided a candid view on the major issues affecting procurement practices in Australia.

A thriving industry needs to perpetually renew through entrepreneurship and startups. This was the theme of the conference which featured new products and innovative uses of composites. Mark Buchbach, Special Projects Manager with the Toowoomba based Wagners CFT Manufacturing – a company described as "intrepidly entrepreneurial" – presented the details of the recent rebuild of the wharf at Pinkenba (QLD). This extraordinary project is a step-change for composites in infrastructure and involved engineering, manufacturing and installing an entire deck made from FRP deck units, topped with concrete reinforced with FRP rebar. The Omni Tanker journey, presented by Drs Daniel Rogers, Omni's Managing Director and Luke Djukic, Chief Technical Officer, gave an overview of the company's project to internationally commercialise a lightweight carbon fibre composites tanker. Manufactured outside Sydney at Smeaton Grange using carbon fibre composites for a seamless polyethylene thermoplastic interior, the tanker has a high degree of chemical resistance (suitable for Class 8 corrosive liquids) as well as food grade compatibility.

Other extraordinary presentations of products likely to sustain the sector included a dual address by the indefatigable Alan Steber, General Manager for Steber International and Robert Dane, Founder of Ocius. The unique unmanned surface vessel the, Ocius Bluebottle, was developed for wide area ocean surveillance and once fully commercialised has the potential for high volume production.

David Inggall, Founder of DIDesign shared an account of material choices for his bespoke engineered subsea inspection and intervention mini workhorses for the company's oil and gas clients. DIDesign's new generation of remotely operated

Women in composites - Anita Berim, Sales Manager, Poetters Ind.; Nicola Stanistreet, Pacific Resins; Virginie Murphy, Engineering Manager, RPC Technologies; Kerryn Caulfield, Composites Australia; Leona Reif, FDP Composites; Elizabeth Lane, Lane Press; Lucy Baker, PATH; Louise Lane

Dr Shaun Smith Research Group Leader, Fibre Innovation and Composites, Manufacturing, CSIRO; Dr Jasjeet Kaur, Research Scientist CSIRO and Kerryn Caulfield

Dr Daniel Rodgers, Managing Director, Omnitanker; Michael Sharpe, Director - NSW/ACT AMGC; Dr Luke Djukic, Chief Technical Officer, Omnitanker and Kerryn Caulfield

Stefan Nikolas demonstrating Alan Harper Composites reusable vacuum membrane technology

underwater vehicles (ROVs) feature a myriad of materials including composites and carbon fibre-reinforced 3D components.

The Smart Think, one of Australia's most promising start-ups, has developed composite forming technology to produce lighter, safer and higher-performing ballistic helmets for the global defence market. At 30 years of age, its CEO Tristan Alexander represents the new breed of entrepreneurs cracking local and offshore composites markets with unique and patented technology.

David Busby-Wright's expertise in composites was forged in the Formula One, defence and mining industries. This experience led him to the position of Senior Designer for Australian Engineering with Weir Minerals - one of the world's leading mining services engineering firms. David outlined the challenges and opportunities for composites in the Australian mining industry.

The state-of-the-art air vehicle and ground transportation composite development project presented by Dr Rodney Thomson, Engineering Manager at ACS Australia, proved that composites are good for rocket science.

Dr Lucy Baker, Materials Scientist and Director of PATH, outlined the ugly consequences of using the wrong materials for tanks, gas cooling towers and pressure pipelines.

Left. Tony Caristo, MD PRC Technologies & Leona Reif President Composites Australia

Below. James Ledingham, Design Engineer for GURIT; Saamiul Bashar, Team Manager, Western Sydney University; Gerard Laffan, Regional Sector Lead Auto & Ind. PAC Gurit; David Joughin, Gutrit; and Max Mammone, Assistant Team Manager, Western Sydney University

CSIRO's Dr Jasjeet Kaur, Research Scientist and Dr Shaun Smith, Research Group Leader, Fibre Innovation & Composites Manufacturing, impressed the audience with CSIRO's irreverent tilt at cracking the carbon fibre code for the world.

Geoff Germon, Founder and Chief Industrial Designer for Talon Technology also had a crack at the carbon fibre business model and the unnecessary obsession with "pretty" applications.

James Ledingham, Design Engineer for Gurit, detailed how his company, along with the team from Western Sydney University, used design, simulation software and their expertise in composite engineering to produce the award-winning 'Unlimited 2.0' single-seat solar vehicle. This vehicle won the 2017 Bridgestone World Solar Challenge – the nine day 2,800 kilometre race across four American states, from Nebraska to Oregon.

A preconference workshop was presented by the indomitable Dr Rik Heslehurst on the fundamental failure modes of bolted composite structures and the conditions that cause these failure modes.

The audience was also treated to product pitches from Leap Australia (Accurately simulating the performance and manufacturability of composite structures); Potters (Hollow Glass Microspheres); Quin Global (Adhesives in the resin transfer moulding (RTM) process); 3M (Adhesives for the composites industry).

Blaise Visconti, Applications Specialist for Alan Harper Composites travelled from the UK to co-present on reusable vacuum membrane technology. Together with Martin and Stefan Nikolas, of Marky Industries, Blaise shot an automotive part in a remarkable live demonstration to show how the system cuts down on wastage, time and costs by using resin-morphing runners (which leave no trace and need no peel ply) combined with moulded inflow mesh.

Demonstrating Alan Harper Composites reusable vacuum membrane technology

Industry comradery was a feature of the conference dinner that was held in the Sunset Room at Luna Park. Needless to say, the uninterrupted twilight views of Sydney Harbour Bridge and the Sydney Opera House were breathtaking.

The Composites Australia annual conference remains a unique event, providing a strategic insight into a wide range of aspects associated with operating and growing a composites business and collaborating with composite companies.

Composites Australia is grateful to all our conference sponsors, presenters and participants for their attendance and generous support.

Written by Kerryn Caulfield, Executive Manager of Composites Australia Inc.

A composite solution for Melbourne sewers

Sewer networks that collect and safely transport waste away from population centres are among the most important infrastructure assets in modern cities. For Melbourne, Victoria more than 320,000 million litres of sewage enters its sewerage system each year. This labyrinth of huge brick-lined sewers that snake underground relieving the city of its waste was mostly constructed in the late 1890s after the 1888 Royal Commission into Melbourne's public health and sanitation crisis. Now managed by Melbourne Water, the North Yarra Main Sewer, which is 2.8 metres in diameter and located 13-15 metres below the ground, has recently been diverted to make way for the West Gate Tunnel Project. This vital piece of infrastructure carries 20% of Melbourne's sewage. Diverting the sewer will protect it from tunnelling and prevent disruptions to sewerage services across Melbourne's north and west during the tunnel project.

The diversion of 600 metres of the North Yarra Main sewer pipe featured filament wound composite maintenance shafts designed, engineered and made by Victorian based firm, Corrosion Technology Australia Group (CTA). The company has been an authority on corrosion technology for over 25 years, and specialises in filament wound piping, ventilation and storage systems such as dual laminate tanks and vessels for petro-chemical plants, water and sewage treatment and energy plants as well as the food processing industry.

Alex Brown, CEO of CTA says: "Under certain conditions hydrogen sulphide, which occurs particularly in sewage, is converted into sulfuric acid by the action of sulphur bacteria. The presence of hydrogen sulphide gas (H2S) in sewers can result in an accelerated corrosion of assets, particularly concrete which has a limited lifespan under such circumstances. The old brick-lined sewer has done a sterling job for 100 years. Nowadays, composites are a preferred solution when longevity and corrosion resistance is a key requirement."

Corrosion resistant fibreglass reinforced composites have had a long and impressive history in infrastructure projects. Although well established in Europe and North America and the Middle East, where they are routinely used for applications with a design life of 100+ years, the uptake in Australia has been modest. More recently there has been a gradual increasing interest in Australia in exploring composite applications where concrete has been the traditional material of choice. Alex Brown says: "These applications cannot be fully realised without sound engineering design, material selection and high quality fabrication which is key to providing the longevity required by the infrastructure sector."

Bespoke complex shaped, corrosion resistant fibreglass reinforced piping for Melbourne sewers

There are no specific Australian Standards for these types of projects and very few standards relate specifically to composites. CTA's Alex Brown says: "A lot of the details are refined through close collaboration with the client and using tools such as Finite Element Analysis and 3D modelling to ensure the final product meets not just the service loads, but also meets the particular requirements of the contractor working underground, installing this type of equipment in arduous conditions."

While our sewer systems are a less than glamorous theme, their role and significance in keeping our communities healthy is undeniable. Alex maintains that "Composite pipes often have a higher premium upfront, but the advantages are bespoke complex shaping coupled with lighter weight that reduces field installation costs, and corrosion resistance properties all of which equates to minimal maintenance and a long service life – an all-round cost effective solution".

Written by Kerryn Caulfield, Executive Manager of Composites Australia Inc

Transporting a composite maintenance shaft from Corrosion Technology Australia Group's Dandenong facility

Composites Technology reducing the risk to our military personnel

Tim Wheeler, Managing Director, BAC Technologies Pty Ltd with Steve Auch-Schwelk, Managing Director and Eric Freund, Engineering Manager both of Simbiant, at the Australian International Airshow and Aerospace & Defence Exposition

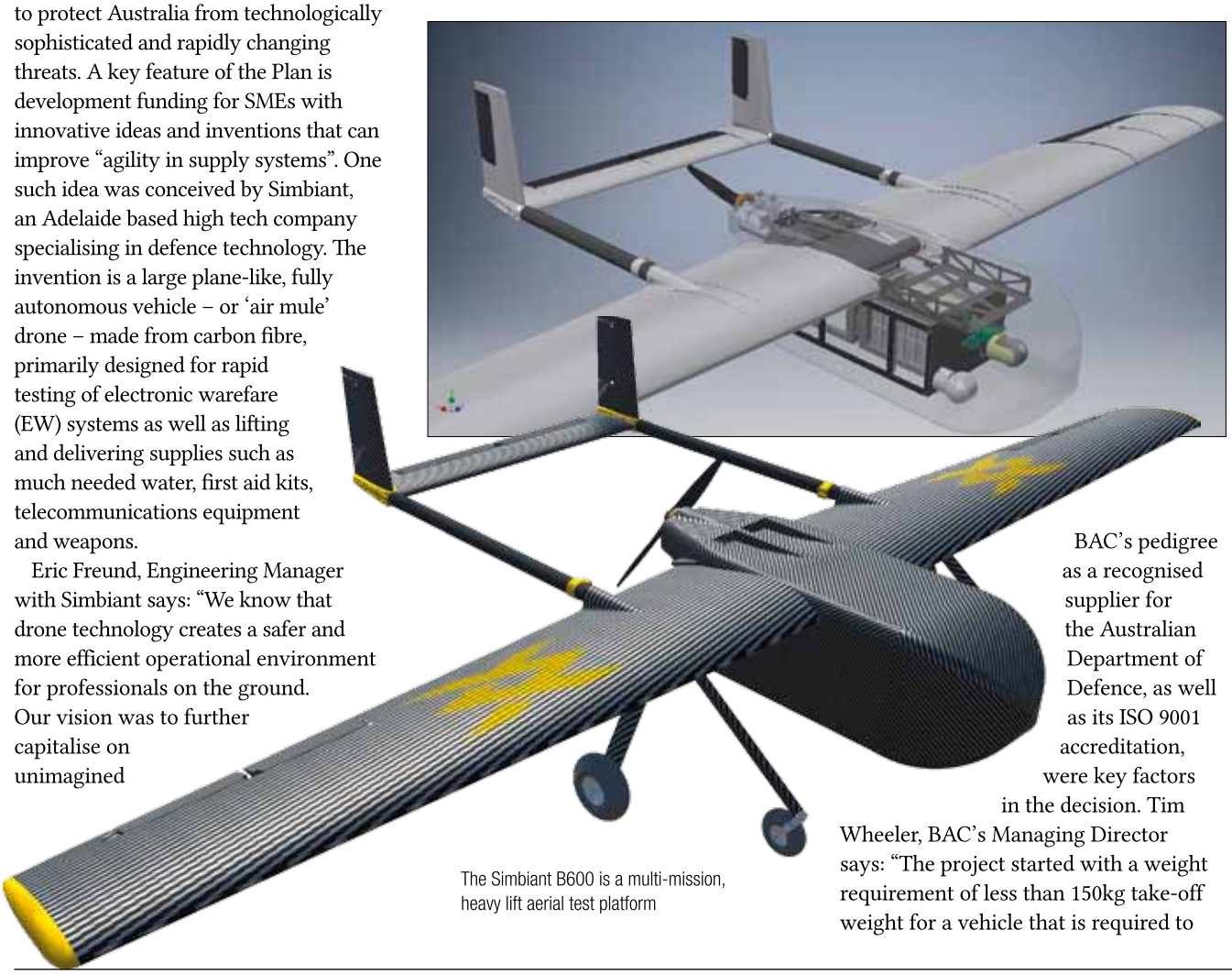
Plan Jericho was launched by the Royal Australian Air Force in 2015 as a means to transform the Air Force for the information age. Its purpose is to give our Air Force the edge to protect Australia from technologically sophisticated and rapidly changing threats. A key feature of the Plan is development funding for SMEs with innovative ideas and inventions that can improve "agility in supply systems". One such idea was conceived by Simbiant, an Adelaide based high tech company specialising in defence technology. The invention is a large plane-like, fully autonomous vehicle – or 'air mule' drone – made from carbon fibre, primarily designed for rapid testing of electronic warefare (EW) systems as well as lifting and delivering supplies such as much needed water, first aid kits, telecommunications equipment and weapons.

Eric Freund, Engineering Manager with Simbiant says: "We know that drone technology creates a safer and more efficient operational environment for professionals on the ground. Our vision was to further capitalise on unimagined possibilities of the 'air mule' drone."

The Simbiant B600 UAV is a carbon fibre composite, multi-mission, heavy lift vehicle with a wing span of 6.5 metres and an empty weight of 70 kilograms (kg).

The B600 is designed to take off swiftly to support the Royal Australian Air Force. It can travel for 500km at speeds of up to 125kp/h, with a cruising altitude of 1.5km, and is designed for quick and easy load changes. The removable payload box located on the underside of the fuselage measures100x65x45cm and is able to carry up to 50kg. The drone can carry different types of payload boxes, from standard enclosed boxes to boxes that can open mid-flight to release their contents.

To build the B600 UAV, Simbiant chose Toowoomba based BAC Technologies as its production partner.



The Simbiant B600 is a multi-mission, heavy lift aerial test platform

BAC's pedigree as a recognised supplier for the Australian Department of Defence, as well as its ISO 9001 accreditation, were key factors in the decision. Tim Wheeler, BAC's Managing Director says: "The project started with a weight requirement of less than 150kg take-off weight for a vehicle that is required to

carry up to a minimum of 50kg. We built what is essentially a small aeroplane from scratch, including making the moulds, all of which presented technical issues to be overcome, particularly given the fine tolerances."

Carbon fibre was the material of choice, given its strength to weight and stiffness-to weight ratios, the latter being the deciding factor given a wing span of 6.5 metres. "We also had to find an engineered solution to suppress drumming and the noise from harmonics motion," said Eric Freund. "The large flat fuselage is designed for transport, but its flatness also presented a construction challenge. The required rigidity was achieved with a series of strategically placed ribs within the fuselage made with 3mm carbon fibre foam core."

The Simbiant B600 UAS on display at the Australian International Airshow and Aerospace & Defence Exposition earlier this year

There is no doubt that military drones are revolutionising operations in conflict zones. They are increasingly used to perform hazardous work that was once performed by military personnel, including monitoring and aerial mapping; gathering battlefield intelligence; undertaking surveillance; monitoring telecommunications infrastructure and delivering humanitarian aid, medical equipment and supplies.

Tim Wheeler says "With drone technologies consistently improving, our effective use of them will only increase. They are a worthy application for composites technologies that can achieve the required payloads, strength and weight for airborne electronic machinery. We at BAC are delighted to be part of developing products that are a service to our defence forces by reducing the risk to our military personnel."

UNSW redefining the relationship between universities and industry

Since the 1990s, the creation of new knowledge through university-based academic research has been considered by government as an industry like any other. Often called the process of 'academic capitalism', universities have become more entrepreneurial as they are forced to focus on knowledge less as a public good than as a marketable commodity in profit-oriented activities.

L to R: Donavan Marney, Centre Manager for ARC Training Centre - Chemical Industries; Prof Martina Stenzel, NSW -ARC Centre Director; Dr Anastasios Polyzos, VIC ARC Centre Director; Kerryn Caulfield and Prof. Scott Kable, UNSW - School of Chemistry

Like financial assets, education yields an income and myriad other benefits. According to a recent London Economics study, from an investment of $6.7 billion in public funds in 2016, Australia's 'group of eight' leading universities returned over $66 billion to the nation in the four areas of research, teaching and learning, educational exports and direct university expenditure. That is a 10-fold return on government investment.

To that end, there are compelling reasons for governments to encourage and enable university–industry collaboration on research projects they perceive will assist companies become more competitive. However, the impasse has always been that collaborative projects require financial co-contribution from participating companies, yet the universities, which are often funded by grants, expect to retain the intellectual property (IP).

Against this backdrop, the recently launched Australian Research Council (ARC) Training Centre for the Chemical Industries is redefining the relationship between universities and industry by enabling industry to own the IP on collaborative research.

The Centre fosters transformative and innovative research in Australia's chemical and advanced manufacturing sectors through an industry-led research training program developed through partnerships between industry and universities. It brings together three leading universities (The University of Melbourne, The University of New South Wales and Swinburne University of Technology), chemical industry companies and Chemistry Australia in a unique collaboration that aims to supply the chemical industry's need for highly skilled STEM graduates with relevant industry skills and experience.

During the 2-year course, postgraduate candidates run a significant research project with a chemical company, usually at their site and working with their staff, giving a minimum of 12-months' experience as an industrial R&D chemist. These research projects can be supported by an academic but led and directed by participating companies that have more control of the developed IP as well as full access to university laboratory, analytical and characterisation infrastructure.

This program is an opportunity for companies with a costly and time consuming industrial/production challenge to resolve; or a strategic development project that requires time to explore before lift-off.

Written by Kerryn Caulfield, Executive Manager of Composites Australia Inc.

For further information, call Dr. Donavan Marney, Centre Manager, ARC Training Centre for the Chemical Industries, University of NSW on 0491 080 178.

Pathfinder – supplying Australian made, innovative, reliable cutting room technology to world markets

Under the flight path of Melbourne's Tullamarine Airport is precision engineering firm, Pathfinder Cutting Technology – a specialist manufacturer of CNC machinery for flexible materials.

Co-founding Directors, John Hollo and Ross Kaigg formed the company in 1996 in a marketplace that was dominated by international firms including Gerber and Lectra, who had decades of experience and global market penetration. From the beginning, the partners realised that their point of difference would come from the development of technologies that require very low maintenance and eliminated high operational costs.

"The expensive maintenance contracts whereby machinery suppliers rely on service, spare parts and maintenance for post commission income is less of an option for us down under" says co-founder John Hollo. "We build machines to last so that our customers are self-sufficient. Our focus has always been on next generation technologies for new and emerging markets."

That approach has proven to be a winner and now twenty two years later, Pathfinder has customers around the world with sales/support offices and distributorships in 13 countries.

The company's customer list and product range continues to expand and diversify and now includes some of the world's most advanced manufacturing firms in aerospace, automotive, rail, marine and defence.

L to R: John Hollo with Bruce Abraham (Hanes Aust COO) and Ross Kaigg with a Pathfinder K-Series cutter after 20 years of operation

According to John, a major factor in Pathfinders' continued success is "that manufacturers in all sectors are under pressure to find technology solutions to optimise material usage and lower reliance on skilled labour". To that end, the company has developed 16 multi-ply variants and 12 single ply models which can be optioned up to nearly 300 configurations to suit very specific end applications.

The L-Series (Low Ply) Pathfinder handles dry woven unidirectional and bidirectional composites, prepregs, leather hides and the full swathe of technical textiles

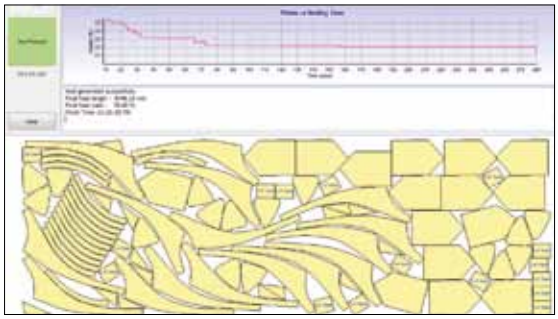
Wayne Walker, Operations Manager for Pathfinder maintains that "Carbon fibre, fibreglass, and Kevlar® fibres are harsh on traditional cutting equipment. Minimising fibreglass dust and contamination, while achieving a finished piece free of distortion, burring, or the harsh damaged edges by investing in advanced cutting equipment is a cost effective solution."

Cutting software

The full power of automated cutting systems are realised through nesting and kitting functions resident in the software that drives the cutters. Computerised nesting of shapes, rather than marking out templates by hand which can consume days, eliminates error and imprecision. Ply placement or fibre direction is also considered within the nest to ensure accurate fibre orientation and integrity.

Ancillary Equipment

Pathfinder also manufactures a range of spreading; roll feeding and conveyorised tables that are synchronised to the cutting machine. This enables markers of virtually unlimited length to be processed while requiring a very small footprint on the factory floor. All roll feeding devices and conveyor tables are fitted with unwind/rewind control which dramatically simplifies roll handling. Considering OH&S standards, the company has a range of semi-automatic and fully-automatic spreaders that enable a single operator to handle rolls weighing up to 120kg and deliver aligned, tension free material to the cutting machine.



Above: Nesting – the process of laying out cutting patterns to maximise usage and minimise the raw material waste – is done by algorithms programmed into the CAD CAM software

Connectivity

For a company based in Melbourne, the tyranny of distance is a limiting factor when servicing machines in overseas markets. Pathfinder's remote monitoring service maximises machine uptime and productivity, by enabling service and support professionals based in Tullamarine to diagnose and fix issues in real time via a secure internet connection to manufacturers all over the world.

Wayne maintains that "Innovative reliable cutting room technology, with fewer moving parts and thus less-frequent replacement of worn parts, composite manufacturers can profitably compete with lightweight metals process competitors."

Written by Kerryn Caulfield, Executive Manager of Composites Australia Inc. and David Hughes, Marketing Manager for Pathfinder

Composite Engineer's Viewpoint
By Rik Heslehurst PhD, MEng, BEng (Aero) FIEAust, FRAeS, FSAMPE, CPEng
Composites Australia (Honorary Member)

Part 14- Non-Destuctive inspection of Sandwich Structures

Following sandwich structure fabrication or as a result of in-service damage, non-destructive inspection (NDI) can be used to characterise a defect/damage. Such NDI tests range from very simple visual inspection to the more extensive through-the-thickness non-destructive interrogation methods. The requirements of NDI are to determine the presence of any non-conformity, in particular debonds and delaminations, porosity, damaged core and internal foreign objects (i.e. fluids). A summary of NDI methods applicable to the composite facings, facing-to-core bondline and core integrity for sandwich structures are listed below.

	NDI POST FABRICATION METHODS / DEFECT	Visual	Penetrants	Tap	Bondtester	Pulse-Echo	Through-Transmission	X-Ray	Dielectric	Thermography	Interferometry	Microwave	Neutron Radiography	Mechanical Impedance
Laminate	Delaminations	1,21	✓	✓	✓	✓	3		✓	✓			✓	
	Macrocracks	1,2	2	✓	✓			3		✓	✓			
	Fibre Fracture							√		2,3	2,3			
	Interfacial Cracks									2,3	✓			
	Microcracks		1	2	2					✓	✓			
	Porosity	1		2	2	✓	✓	✓		2	✓			
	Inclusions	1			2	2	2	✓		✓	✓			✓
	Heat Damage	1		2	2				2		2			
	Moisture							2	✓		2	✓	✓	
	Voids				2	✓	✓	✓		✓	✓			
	Surface Protrusions	✓								✓	✓			
	Wrinkles	✓									√			
	Improper Cure								✓	2	2		✓	
Bondline	Debonds	1,2	1	✓	✓	✓	✓	✓		✓	✓			✓
	Weak Bonds									2	✓			
	Cracks	1,2	1	2	2	2	2	3		✓	✓			
	Voids			✓	✓	✓	✓	✓		✓	✓			✓
	Moisture							✓	√		2	✓	✓	
	Inclusions			2	2	2	2	✓		✓	✓			✓
	Porosity				2	✓	✓	✓		✓	✓			
	Lack of Adhesive			✓	✓	✓	✓	✓		✓	✓			
Sandwich Panel Core	Blown Core			✓	✓	✓	✓	✓					✓	✓
	Condensed Core			2	2		2	✓					✓	
	Crushed Cure			2	2		2	✓					✓	
	Distorted Core							✓					✓	
	Cut Core			✓	✓		✓	✓					✓	
	Missing Core			2	2	2	2	✓					✓	✓
	Node Debond							✓		2	✓			
	Water in Core			2	2		2	✓				✓	✓	
	Core Filler Cracks			2		2	✓	3		2	2			
	Lack of Filler			2	2	2	✓	✓		2	2		✓	

1. Open to surface. 2. Unreliable detection. 3. Orientation dependent.

Visual Inspection. A simple visual inspection can identify gross non-conformities such as bulges, warping and surface ply direction. Needless to say visual inspection is only useful for the outer surface of the sandwich structure and not core issues.

Acoustic Resonance. The simplest acoustic resonance method is the 'coin tap test'. This method has been used for many years and provides qualitative information of near sub-surface debonds or delaminations. The tap test method is most useful on thin-skinned sandwich structures.

Ultrasonic Inspection. The implementation of ultrasonic inspection is probably the most extensively used of the NDI methods currently available. The ultrasonic inspection methods provide details of depth and size of the non-conformity, or full details of the topography of sub-surface defects. However, for thin skinned sandwich structures, the identification of laminate and core-to-skin anomalies can be challenging.

Thermography and Optical Methods. Three relatively new methods of full-field NDI are shearography, holography and thermography. All three methods provide a visual, quantitative measure of the effects of skin sub-surface and core defects on the component under load. Whereas most other NDI methods indicate the size and shape of the non-conformity, these optical and thermal methods also show the component's response to load. Therefore, the criticality of the defect can be more easily assessed. Due to the poor response of core materials to other NDI techniques, the optical and thermographic methods have significant improvements in sub-surface defect assessment.

Radiography. Particularly x-ray radiography (and with the more user-friendly digital x-ray systems) interrogation of foam and honeycomb cores provides detailed imagery and assessment of the core conditions.

Dynamic Response. Vibration frequencies and damping characteristics have recently shown favourable outcomes in detecting localised water in hollow core sandwich structures.

All articles published in Engineer's Viewpoint are available on the Composites Australia website (www.compositesaustralia.com.au/industry). Rik welcomes questions, comments and your point of view by email to rikheslehurst@gmail.com. The next and final article on composite sandwich structures will cover Sandwich Structure Repairability and how to restore functionality.

Steber scores major marine export award

Alan Steber, latest AIMEX trophy in hand, is dwarfed by the prop of the 60ft fisheries research vessel under construction for the government of Mauritius

Steber International's strong export performance has been acknowledged with a major award win at the annual Australian Superyacht Marine Export Conference.

The conference featured the Australian Marine Industry Export Awards, Commercial Marine Industry Awards and Superyacht Awards with Steber's picking up the 2019 AIMEX Marine Industry Export Performance - Large Exporter.

Steber general manager, Alan Steber said the company has been steadily increasing export sales in recent years ranging from a series of 38 ftrs, through to 52ftrs and now a 60ftr under construction and due for delivery later this year.

The Taree fibreglass boat manufacturer is no stranger to award wins on the national stage. Over the last few years Steber's have been named Australian Commercial Marine Group (ACMG) Commercial Manufacturer of the Year (twice), as well as ACMG Industry Champion and AIMEX Export Champion - Alan Steber, and AIMEX Young Achiever of the Year - Jim Bolton.

> **"At the start of the year we had 13 commercial vessels on order, including Navy boats, Marine Rescue, commercial fishing and our first 60ftr for export."**
> – Alan Steber, General Manager

In accepting the award in front a packed house at the Intercontinental Sanctuary Cove Resort, Mr Steber noted: "At the start of the year we had 13 commercial vessels on order, including Navy boats, Marine Rescue, commercial fishing and our first 60ftr for export". "Production is at an all time high and we are also finalising several quotes for both Australian and overseas clients, while our research and development program has a couple of exciting projects in the pipeline. During May we delivered a 38ft flybridge resort vessel to Hayman Island, and the second of five 38ft Navy vessels is currently undergoing final fit-out and sea trials prior to delivery."

"Proud to say we currently have nine apprentice shipwrights on our books and over the years we have trained over 150 apprentices", Mr Steber concluded.

INVITATION TO JOIN THE AUSTRALIAN PAVILION

JEC ASIA 2019

International Composites Event

November 13-14-15, 2019 | SEOUL COEX, REP. OF KOREA

Composites Australia will be hosting an Australian Pavilion at JEC Asia 2019

A select number of Australian composites manufacturers and fabricators seeking to build relationships and develop export markets in East Asia are invited to join us to share the booth. JEC Asia offers a comprehensive program that includes the trade show as well a conference, site visits and tailored business meetings.

East Asia is home to one-fifth of the human population. The region's location on the Pacific Rim, coupled with Australia's recent Free Trade Agreement (FTA's), provide access to an unprecedented industrial environment and interaction with Asian economies.

This Activity received funding from Austrade as part of the Free Trade Agreement Market Entry Grant Program. The grant partially covers the cost of exhibiting, making the joint approach to exhibiting cost effective for participating organisations.

While this mission is limited, it is initially open to Australian Advanced Composite SME's, R&D and Industrial Design Agencies on a first come, first served basis.

Location

COEX Convention & Exhibition Centre. Seoul, South Korea http://www.jec-asia.events/

For more information

To lodge interest, simply send an email to kerryn@compositesaustralia.com.au or call +61 3 9429 9884.

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ARTIFICIAL INTELLIGENCE IN TECHNICAL TEXTILES & COMPOSITES - NEURAL NETWORKS, GENETIC ALGORITHMS & FUZZY LOGIC

PRESENTED BY DR DIETER VEIT
VICE-DIRECTOR OF THE INSTITUT FÜR TEXTILTECHNIK OF RWTH AACHEN UNIVERSITY, GERMANY

The use of mathematical modelling and computer simulation can vastly improve the quality, efficiency and economic success of textile technology and downstream use in composites. This technology clinic will provide an understanding of how the working principles of the human brain can be mimicked in computer algorithms, forming artificial neural networks (ANN).

Dieter will provide an introduction to the backpropagation algorithm which is the most widely used type of artificial neural networks (ANNs). He will demonstrate how to best prepare data and how to apply the backpropagation network to predict properties of technical textiles and composites based on the machine settings and vice versa.

Dieter will also explain how genetic algorithms are used to find optima of complex functions and how they can be used to find innovative solutions which cannot be solved analytically.

Fuzzy logic is also a tool to operate and control technical processes based on imprecise information and imprecise rules. It can be used to convert an expert's knowledge into a process control system. The theoretical background behind fuzzy logic will also be covered as well as how to easily design your own model.

DATE: **Thursday 22nd August**

TIME: **10.00am to 4.30pm**

VENUE: **Deakin University, 75 Pigdons Road, Waurn Ponds, VIC 3216**

G GTP Meeting Room, NA Building, Room NA 1.418 Seminar Room 1B

PARKING: **Parking is available onsite at $6.00 maximum per day.**

Limited free parking is also available subject to availability.

CATERING: **Meals and snacks are included in each registration.**

COST (inc GST): **MEMBERS: $290 • NON-MEMBERS: $390 • STUDENTS: $110**

Register online at www.compositesaustralia.com.au

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