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Composites steal edge in tough stakes

Composite materials are spreading their wings from boats and planes to new resources and industrial uses, writes **Peter Roberts**.

In the US, UK, Australia and other developed economies, manufacturing is in decline. Most cars today are made in emerging economies such as China; the world's largest steel producer, Arcelor Mittal, began in India; and the number of people in Australia working in manufacturing has fallen 8 per cent over the past decade to just under one million.

But entrepreneurs such as Aaron Begley are betting their careers on what they believe is a major shift in how many goods, from furniture to jet aircraft, are going to be made in the future — with composites.

Composites are engineered products made by bonding different materials together. Surf boards are made from composites — glass fibres encased in plastic resin. Boeing 787s are made largely of carbon fibre composites.

Some composites were once viewed as little more than a lightweight substitute for steel. Now, advances in engineering are making composites that are cheaper and stronger than many traditional materials used in manufacturing.

Globally, the industry employs 400,000 to 450,000 people and generates about $60 billion in revenue, according to JEC, a Paris-based company that promotes composites use. Industry Minister Kim Carr estimates there are more than 950 businesses making modern composites in Australia, with output valued at more than $3 billion.

"[These are] defining materials for 21st century manufacturing," Carr says.

But Begley, the chief executive of Perth-based Matrix Composites & Engineering, says demand for his products is growing 50 per cent a year. Some of his clients use composites for drilling equipment capable of surviving the crushing weight of the ocean kilometres beneath the surface.

"It has taken 10 years to get here," he says. "One of the reasons demand for our composite technology has increased is the move into ultra-deep water more than 3000 metres deep. At that depth we are pushing the limits of conventional materials."

On the sea floor components face enormous pressures and their weight can be difficult to support from floating rigs. Breakdowns can spell the type of disaster that destroyed BP's Deepwater Horizon platform in the Gulf of Mexico, triggering the worst oil spill in US history.

Matrix has $250 million of orders for buoyancy structures made from "syntactic foam" for oil and gas wells and remote-controlled underwater vehicles. It also makes polymer "bend restrictors", which reduce bending in the flexible pipes that bring oil and gas to the surface.

"I think there is going to be an increase in the use of composites to replace traditional steel components, and not just in our industry," says Begley.

Wider industrial use of composites is driving a rare boom in manufacturing. Matrix has doubled the capacity of its Perth factory while two other companies are building plants in Geelong to make composite power poles and pipes.

Modern composites were initially used as lightweight replacements for metal parts. Demand is rising as manufacturers increasingly chose composites reinforced with fibre or minerals because of their resistance to corrosion, light weight and cost compared with conventional metal parts.

"People are comfortable with steel and there is still some resistance to composites," says Phil Teakle who recently left CSIRO to found his own composites business.

"But in many areas we are seeing the risks being outweighed by the benefits."

Based in Brisbane, Teakle makes complex parts for a high-tech scramjet engine being developed by the University of Queensland, and a rocket motor being developed by BAE Systems, a giant European defence contractor.

"A lot of the technology is adopted first in high-technology uses and is dribbling down to the industrial and R&D [research and development] sectors," says Teakle, who has also developed composite underground drill rods and borehole liners.

The federal government is investing money to help the industry grow. Carr recently committed $37 million towards a research centre at Deakin University in Victoria called the Australian Future Fibres Research and Innovation Centre.

One area of composites poised to take off is in engineered structures. Toowoomba-based Wagners Composite Fibre Technologies is manufacturing and installing a dozen composite road bridges and 20 footbridges in Australia and the US. The company claims to have built the world's first composite public road bridge, over the Orara River at Coutts Crossing in northern NSW.

"The main advantage is our bridges have no corroding elements," says Wagners CFT general manager, Michael Kemp.

Regulation is also an issue. Australia has few national standards for composite structures. This is changing gradually with Sydney's Warren Centre of engineering developing the country's first standard for composite bridges.

Wagners, which has 1000 employees and is involved in concrete and steel engineering, has road-tested its own composite semitrailer for more than 100,000 kilometres. The composite trailer is two tonnes lighter than a steel trailer.

"It is part of our own road fleet and it is performing very well," says Kemp.

Dulhunty Power is building a new factory to make fibreglass-reinforced concrete power poles to complement its range of composite hardware and insulators used in electricity transmission. The new poles will not conduct electricity, avoiding a problem with timber and steel-reinforced concrete poles. As well as reducing the chances of fire, the composite poles will be priced between the traditional alternatives.

"The new plant will be finished by the end of June and we have been marketing them [the poles] in anticipation," says Jack Roughan, a Dulhunty director. "We have a number of trial orders and have sent some samples to Integral Energy. There is a lot of interest in them."

RPC Technologies' new Geelong factory, also under construction, will make glass-reinforced plastic pipes in sections up to 12 metres long. The company makes composite pipes in Newcastle and Indonesia and is building its own machinery to equip the Geelong plant.

"We were targeting sales to the new Victorian desalination plant but we haven't won very much of that work," says RPC managing director, Tony Caristo. "We made the decision to go ahead even if we didn't win any."

Formerly part of the Transfield group, RPC turns over $50 million a year making a range of composite products for industrial and defence use. Civilian uses include train interiors and components for mineral processing and waste-water treatment facilities, while defence projects include radar and sonar domes.

"I would still call it a niche market," says Caristo. "It is not a constant market — it can be very project oriented."

Composite use in aerospace is rapidly becoming the norm. Boeing Aerostructures is supplying major components for the 777 and the largely-composite 787. The company recently announced it would close its Sydney plant in 2012 and shift operations to Melbourne, where it has eight autoclaves capable of producing composite components up to 15 metres long.

The country's leading defence composite manufacturers, Australian Aerospace and Quickstep Technologies, have built capacity on the basis of government purchasing.

Australian Aerospace, a division of the European EADS group that builds Airbus aircraft, made the composite fuselages for the 66 Tiger ARH and MRH90 trooplift helicopters it has assembled in Brisbane.

"We are making a number of [composite] components which are going into our global supply chains," says Rob Hunter, vice-president of fixed wing and operations. "That has established a base workload for our operations. We plan to leverage off that."

Most recently the company is offering the NH90 helicopter, which shares components with those already supplied to Defence, as replacement helicopters for the Navy's Anzac class frigates. While the NH90 would be assembled in Brisbane, the competing helicopter from Sikorsky would come from the US.

Australian Aerospace employs 1100 people in manufacturing and maintenance and its composites technologies have the capability to supply and support future military aviation needs.

"One hundred years ago aeroplanes were made from rag and wood, then metals had the market," says Hunter. "The future is going to be plastics."

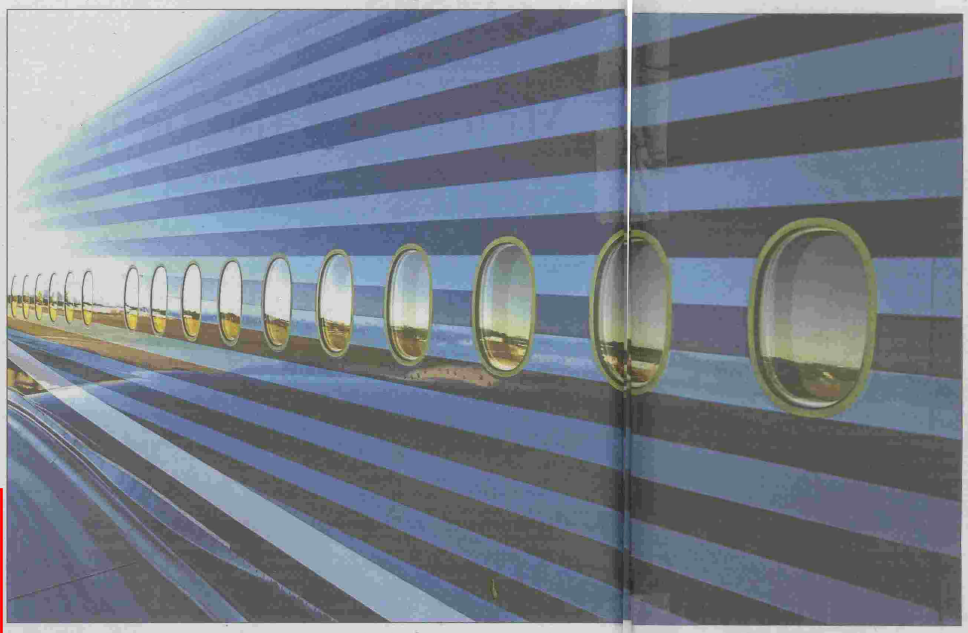
While Australian Aerospace has its origins in defence offsets obligations, Perth-based Quickstep Holdings received a leg-up with Australia's order of the joint strike fighter, known as the JSF. While offsets require work to be performed locally, Australia's investment in JSF provides an entree for local companies into the JSF global supply chain where they compete for orders on a commercial basis. Quickstep has been rewarded with a memorandum of understanding with Lockheed Martin and Northrop Grumman to produce 21 composite components for the JSF in a deal that could be worth $700 million.

"The MOU was signed in November and is progressing in a very positive manner," says Quickstep managing director, Philippe Odouard. "We will start producing the first bits and pieces in the next few weeks and should be in series production early in 2012."

Quickstep was founded by the Graham family, who designed and built Australia's first all-composite aircraft, the Eagle, in the 1980s.

While initial parts for the JSF will be made using traditional autoclave techniques, Quickstep is hoping its own manufacturing technologies that do not need heat to cure will be used for the JSF. The company and its US partner, Vector Composites, are working on two US Department of Defence R&D contracts to evaluate the process for military aircraft

"We can get the same high-quality results in ways that are cheaper to do," says Odouard. "The tooling is less expensive and it takes a fraction of the time and a fraction of the heat."



Composite use in aerospace is rapidly becoming the norm. Boeing Aerostructures is supplying major components for the 777. Photo: ROB HOMER

IT TAKES TWO

What are composite materials?
Composites is a generic name given to materials engineered by bonding together two or more different materials.

What are they made from?
Traditional composite materials include mud-brick and steel-reinforced concrete. Modern engineered composites are usually made from glass, carbon or kevlar fibre or woven reinforcement held in a matrix resin made from plastic, vinyl, epoxy or phenolic.

How are they made?
The reinforcement is placed in a mould or wound around a pre-prepared pattern such as the shape of a pipe. Resin is introduced into the mould and hardened under vacuum or pressure, or exposure to light or heat in an autoclave, a kind of vessel that can withstand the high pressures and temperatures of chemical reactions.