

The Future of Manufacturing

How technology is fuelling Australian innovation, driving productivity gains and creating new models for growth.



IMAGE: ISTOCK

Global shifts – bringing on new models for growth

Welcome to The Future of Manufacturing: A special report that shines a light on a world of innovation and opportunity.

THE MANUFACTURING industry is undergoing rapid transformation as the fourth industrial revolution sweeps across the globe. A fusion of technologies – artificial intelligence, robotics, 3-D printing, the Internet of Things, materials engineering and more – is changing the manufacturing landscape, fuelling innovation, driving productivity gains and creating new models for growth.

Science and technology are changing what it means to be a manufacturer today.

Manufacturing specialisation was once dependant on a country's access to raw materials, or strategic government investment. The automotive industries of Germany and Japan, for example, were supported by the desire for military strength in the early 20th Century; while China's emergence as the world's biggest manufacturing nation was largely driven by economic reforms, trade liberalisation and rural-to-urban migration of a low-cost workforce.

However, science and technology are changing what it means to be a manufacturer today. They are also driving the exciting re-emergence of manufacturing in countries like Australia, observes Matthew Kelly, Head of Manufacturing and Wholesale at St.George. Manufacturers who use new technology or advanced business models are increasingly being termed 'advanced manufacturers'. A significant number of Australian companies, including the case studies in this report, have already embraced the evolution. And they are blazing an impressive trail for others to follow.

Australian manufacturing industry snapshot

\$100 billion

Annual **contribution to Australian GDP** by the industry¹

1.27 million

Number of **jobs supported by the industry**, both in workforce and purchased inputs²

Sources: 1. Australian Bureau of Statistics; 2. AMGC, *Advanced Manufacturing: A New definition for a new era.*

St.George's Matthew Kelly is Head of Manufacturing and Wholesale.



IMAGE SUPPLIED



Why manufacturing is looking up Down Under

Investments in industrial capability throughout the 20th Century created a golden era in Australian manufacturing.

THAT ERA PEAKED in the late 1950s when the sector accounted for around 25 per cent of gross domestic product. By the 1970s, however, a combination of high wages, geographical remoteness, a small domestic market and a segregated national agenda caused manufacturing to stagnate, as the services industry gathered speed.

Over the past 30 years, the nation's manufacturers have been challenged by low-cost competitors from emerging economies, lower tariffs and rapidly changing technologies.

However, a new generation of manufacturing, backed by smart technologies and propelled by the pioneering spirit that drove early industry success, is emerging.

"The manufacturing sector in Australia has seen positive growth over the past couple of years," says Michael Sharpe, National Director - Industry, at Australia's Advanced Manufacturing Growth Centre. "That's now the longest expansion in manufacturing in over a decade. It's on the up-and-up right across the nation."

Drivers of change

In 2015, the **Advanced Manufacturing Growth Centre (AMGC)** was formed as part of the Federal Government's Industry and Innovation Agenda to drive productivity and competitiveness across Australia's manufacturing industry.

Michael Sharpe says every manufacturer in Australia has the potential to be advanced because the definition relates to the sophistication of processes, rather than the products that are made. Australia's high levels of education, strong research sector, abundant natural resources, agile SME sector and our reputation for quality are in our favour.

"Australian companies have a potential global audience of more than seven billion customers, in addition to the 25 million here in Australia," says Sharpe.

"Opportunities for smart companies who embrace new technologies have never been better. More manufacturers are looking at the opportunities for export. That's our future for Australia."

Advanced manufacturing traits

The most successful manufacturing companies in the industrialised world are characterised by:

Advanced knowledge



- Higher spend on R+D
- Higher information communication technology intensity
- Larger patent portfolio
- More collaboration with research institutions and other manufacturers
- Higher relative wages and salaries
- Better qualified employees
- More staff with STEM skills

Advanced processes



- Greater capital intensity
- Newer equipment
- More automation
- Smarter inventory management
- Better energy efficiency
- Better water efficiency

Advanced business models



- Higher product value density
- Higher marketing expenditure
- Higher trade intensity (exports)
- More extensive backward links
- Larger geographical reach
- Greater share of services in total revenue

Prevalence of advanced characteristics in more successful Australian manufacturing firms in 2017*:



Patent use:
73% more prevalent



Automation:
72% more prevalent



Trade intensity:
19% more prevalent

Source: AMGC, *Advanced Manufacturing: A New definition for a new era.* *Success measured by labour productivity.



Advanced manufacturing's good news story

Australia has advanced manufacturers across the spectrum - from textiles to biomedicine, construction and aerospace.

NSW MANUFACTURERS produce almost 30 per cent of Australia's total manufacturing output and generate about A\$33 billion in industry value.

They also directly employ around 253,000 people, which represents almost a third of jobs in the manufacturing sector in Australia.

Matthew Kelly, Head of Manufacturing and Wholesale at St.George, says the much-publicised closure of the automotive sector has resulted in many good news stories being overlooked.

"Manufacturing in Australia has had a bad rap in recent times, but it's far from a fading industry," he says. "It's a hive of innovation. I see this in the high-tech facilities that I visit, and I hear it from the smart manufacturers who are harnessing new technologies to move their business forward."

Start-ups and innovators

New technologies are bringing a whole new generation into the manufacturing sector.

"Drone manufacturer JAR Aerospace is a good example," says Kelly. "It was started by four young guys just a couple of years ago and they've already scored contracts with the Australian Defence Force."

"Manufacturing in Australia has had a bad rap in recent times, but it's far from a fading industry."

Matthew Kelly, Head of Manufacturing and Wholesale, St.George

It's not only emerging players making waves in advanced manufacturing, Kelly points out. Some well-established companies are reinventing themselves through investment in automation, advanced data analytics and artificial intelligence.

Opportunities for advancement

There is still significant room for Australian manufacturers to increase adoption of advanced characteristics.

Advanced characteristics exhibited within Australian manufacturing firms in 2014-2015:

Advanced knowledge:



9%
of firms **use patents** to protect their IP

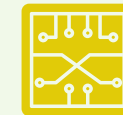


4%
of firms **collaborate on research and development**



12%
of firms **adopt general collaboration**

Advanced processes:



19%
of firms **increased their information communication technology expenditure**

Advanced business models:



24%
of firms had a **new product offering** in the previous year



8%
of firms had a **new service offering** in the previous year



25%
of firms used **new marketing methods** in the previous year

Source: AMGC, Advanced Manufacturing: A New definition for a new era.



JAR Aerospace: A soaring start

DRONE MANUFACTURING business **JAR Aerospace** was founded in 2017 by four science and engineering graduates – Sam Lewinson, Jack Cullen, Daniel Moscaritolo and Lachlan Burke. It got off to a flying start by securing its first contract in 2018 to build the Australian Defence Force's next generation of reconnaissance drones. From humble beginnings in a backyard garage, it is now a 20-person team based in Sydney's Caringbah.

"Our ambition was to influence the aerospace industry in Australia," says Chief Operating Officer Sam Lewinson. "We started off with around fifty grand in the bank from our combined savings and used that to start prototyping a large drone to carry around 20-30kg."

The company's subsidiary business, **JAR Education**, aims to close what Lewinson describes as "a big gap between industry and education" by showing school students how to build drones.

"For our education business, we deliver around 300-400 drones a year," says Lewinson. "We're still in the R&D stage for our defence contract, so we haven't gone into manufacturing our designs yet, but we've developed around five concepts." He says the development of composite

materials and greater automation are driving advances across the manufacturing industry.

"If you don't push things right to the edge, you don't really know what you can achieve."

**Sam Lewinson, Chief Operating Officer,
JAR Aerospace**

Australia's high minimum wage makes it hard to compete with lower-wage countries, Lewinson explains. "It requires a strategy of using the most innovative technology so that you can compete on a global scale ... If you don't push things right to the edge, you don't really know what you can achieve."

"As an eight-month-old company, we won our first defence contract. I'm not going to say that it was all ice creams and rainbows along the way. Every small business will tell you that cash flow is one of the hardest things to manage. But we're starting to lockdown contracts and are on track to secure an education deal that will see 7,500 drones delivered to air force cadets. It's a really exciting prospect when you can start forecasting more than three to six months ahead."

*Flying high:
JAR Aerospace
takes Australian
technology to
the skies.*



IMAGE: JILLIE ADAMS/NEWSPIX



A hub for innovation

As the third largest economic region in Australia, Western Sydney is in the box seat to lead manufacturing's transition to Industry 4.0.

AS PART OF THE **Western Sydney City Deal**, a state-of-the-art Aerospace and Defence Industries Precinct is being developed adjacent to the new Western Sydney Airport at Badgerys Creek. The billions of dollars of infrastructure investment planned for the region is also supporting development of advanced manufacturing processes and business models across the construction industry.

"Western Sydney is literally being put on the map with a pipeline of new investment that will deliver a brand new 21st Century airport for the region and a supporting Aerotropolis right next door," says David Borger, Executive Director of the **Western Sydney Business Chamber**. "The industrial development that may build up the Aerotropolis presents a lot of opportunities, especially for food and beverage manufacturers due to a new agribusiness precinct. We've also got global players, like aerospace company Northrop Grumman planning to build a centre of excellence at the airport precinct."

Western Sydney is the site of some of the nation's big manufacturing success stories, including Vitex Pharmaceuticals,

a family-owned business that manufactures vitamins for companies, like Blackmores and Swisse, and which recently opened its new A\$100 million manufacturing facility at Eastern Creek. Quickstep Technologies is another example – a manufacturer of advanced composite components, it is making parts for the Joint Strike Fighter from its A\$30 million Bankstown plant.

"We have a young, educated population, a dynamic and aspirational migrant base and a strong community of entrepreneurs to help drive the sector forward."

**David Borger, Executive Director,
Western Sydney Business Chamber**

Agile SMEs are helping to drive advanced manufacturing across the region. "Manufacturing is a tradition in the region and we're starting to see some really interesting and exciting things happening," says Borger. "We have a young, educated population, a dynamic and aspirational migrant base and a strong community of entrepreneurs to help drive the sector forward."



How collaboration drives innovation

Key partnerships are being formed that focus on solving for industry pain points, such as cashflow and business sustainability.

INNOVATION DOES not happen in isolation. To succeed in the face of disruption, advanced manufacturers require connections to research and development, a team of skilled workers and access to financial instruments to help them manage today and plan for tomorrow.

St.George's Matthew Kelly explains the bank has been working continuously with manufacturers to provide wide-ranging support encompassing both day-to-day financials and help to build capabilities towards a tech-powered advanced manufacturing future. **St.George Invoice Discounting**, for example, helps manufacturers improve cashflow to grow their business by allowing them to access up to 85% of the value of cash tied up in unpaid invoices, as and when they need it; without additional real estate security*.

A high energy industry

Partnerships are also being formed to focus on industry pain points, such as rising energy prices. One example is the partnership between St.George and energy services company **Verdia**, which aims to give the bank's manufacturing customers a

tailored financial solution for solar and other energy programs.

"We develop energy projects that address specific manufacturing challenges and structure the commercials so they have positive cashflow from day one."

John Werner, General Manager, Project Advisory, Verdia

"Energy efficiency is a growing priority for manufacturers as costs have substantially risen," says John Werner, General Manager, Project Advisory at Verdia. "We develop an energy project that structures cashflow so that they're ahead from year one."

Werner notes there is often a lack of confidence about the right technology for their business. "We are able to offer that level of expertise. Manufacturers need to be on the front foot to protect against future price increases because it is such an energy intensive industry."

*Credit criteria, fees and charges and terms and conditions apply and may vary from time to time. For more details, or to see if anything has changed, refer to stgeorge.com.au/manufacturing, or speak with a Relationship Manager.



Open access opportunities for Australian manufacturers

New links between the research and manufacturing industries are being established through open access hubs such as Australia's centre for innovation in metallic additive manufacturing **Lab22**, where companies can access 3D printing technologies, and the **Australian National Fabrication Facilities (ANFF)**.

There are also industry collaboration spaces, such as **FLEDGE Innovation Labs**, located in the Macquarie Technology Corridor, that provides low-cost access to collaborative working spaces, laboratory facilities, scientific equipment, and business support.



Innovation's catalytic impact

Australia's research sector will play a critical role in the future of Australian manufacturing to drive future prosperity.

A NEW COLLABORATION between St.George, scientist and engineer Professor Veena Sahajwalla, and AMGC aims to help Australia unlock its competitive edge in manufacturing. "Our manufacturing customers tell us that they want greater collaboration and a sense of connection," says St.George's Matthew Kelly. "They know there are grants out there, for example, but how can they access them? How can they get closer to the country's leading tech researchers? We want to close that gap for our manufacturing customers by partnering with organisations like AMGC, who can help them navigate things such as grant applications."

AMGC's Sharpe says the partnership will forge the industry ahead by helping manufacturers to think more laterally about how they can use technology to scale their businesses and seek new revenue opportunities both onshore and overseas. "We have some of the greatest research minds here in Australia, but they're locked away in universities," says Sharpe. "We need to get those professors out onto the factory floor to share their knowledge."

Manufacturing gets SMaRT

Professor Veena Sahajwalla is Director of the **Centre for Sustainable Materials Research and Technology (SMaRT)** at UNSW Sydney and Director of NSW Circular, an organisation that brings manufacturers, industry, governments and researchers together to help develop the circular economy.

Along with her SMaRT team Sahajwalla has developed manufacturing processes to create building materials from old textiles, paper and glass and high-quality 3D filament feedstock and other plastic products from electronic waste items. She believes her work is benefiting from closer collaboration with manufacturers.

"I'm finding that a simple conversation might just sow the seeds of some exciting new ideas, but the challenge is increasing connectivity to relevant stakeholders to achieve better supply chains and circular outcomes. The manufacturers I'm speaking to are very open to thinking about new opportunities coming down the pipeline and this is vital for long-term survival and sustainability. Hence the creation of NSW Circular."

SMaRT thinking: Materials scientist and engineer, Professor Sahajwalla invented polymer injection technology, which converts old rubber tyres to metal alloys to make Green Steel.

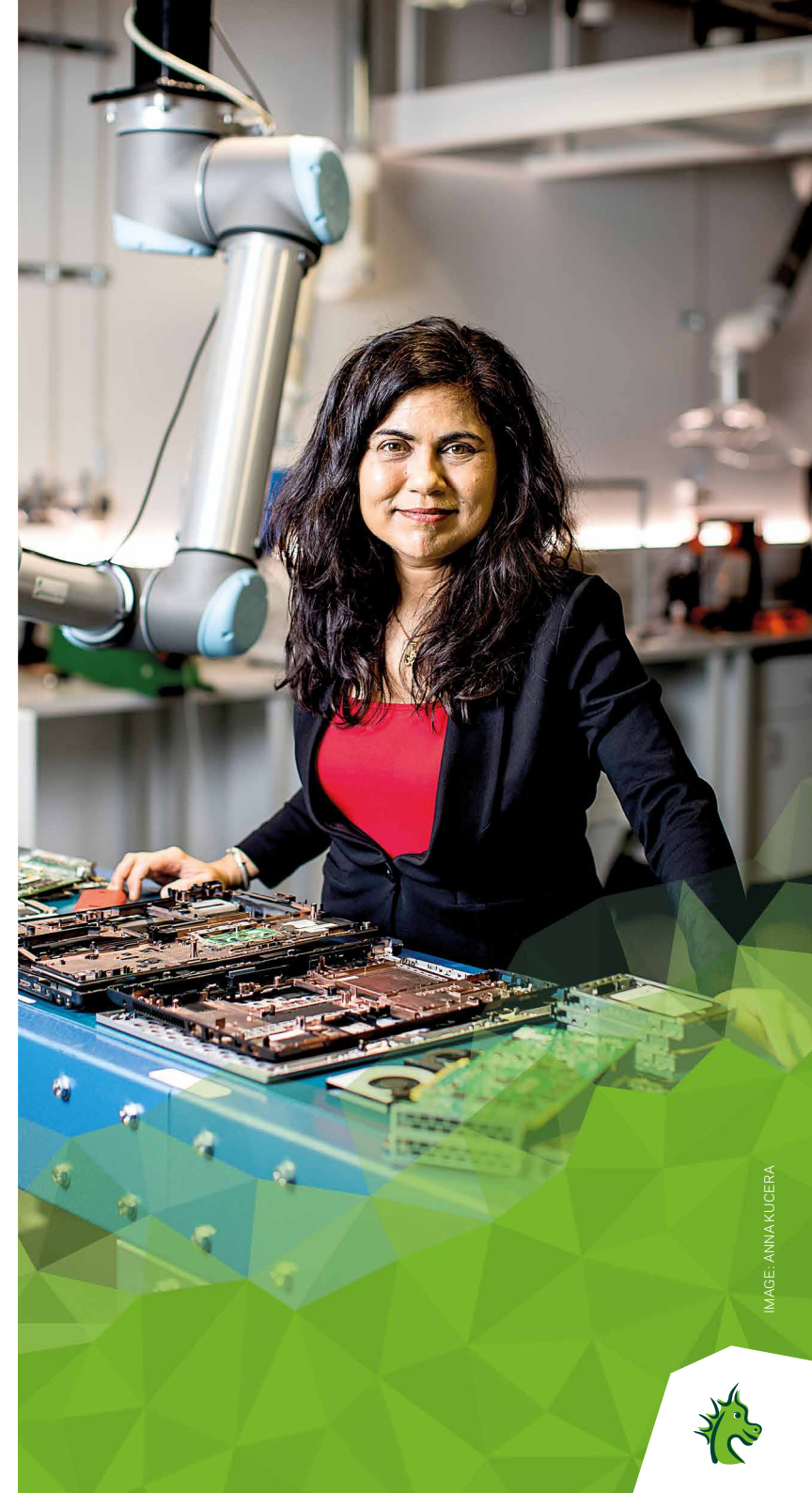


IMAGE: ANNA KUCERA

Genneral Staircase: Robots step up efficiencies

WHEN GLEN GENNER took over the family business, **Genneral Staircase** in 1996, he never expected that robots would be part of his future production line, or that data science would help to fuel its growth.

However, Genner, who signed on as an apprentice at the staircase and balustrading manufacturer in 1989, has always had an eye for innovation. In 1998, he began investing in technology to streamline processes. Today, the business employs 133 people, including artisanal wood turners, metal workers, data analysts and software engineers.

“Analysing data has probably been the biggest game-changer for us,” says Genner. “It’s helped us to plan future work, identify stock gaps and show any weak points in the business. It makes you make better decisions.”

The staircase design and quoting system Genner spent 15 years working on with the developer is now used globally. “It’s virtually impossible to get the off-the-shelf stuff to fit with what you want,” he says.

“When I started in the business, we used to cut out and route a staircase by hand. We still have wood turners working here, but it’s almost all designed in specialist

“Analysing data has probably been the biggest game-changer for us. It’s helped us to plan future work, identify stock gaps and show any weak points in the business. It makes you make better decisions.”

Glen Genner, owner, Genneral Staircase

software and sent straight to a machine that routes it all out for you.”

Thanks to Genner’s tech investment, the business can manufacture 30 to 40 staircases a day. “Before we were supported by software, we could probably push out two a day,” recalls Genner.

“Advances in technology mean you’ve got to evolve a lot faster than before. But, at the end of the day, the customer still wants the same things – price, performance and product quality. If I can keep customers happy, it allows me to keep reinvesting in my business – and make them even happier.”

Data driven:
Genneral Staircase owner Glen Genner uses a bespoke design and quoting system called **StairBiz** that he worked on with the developers for 15 years to get it to where it is today.



A DIY talent pipeline?

To remain competitive companies must attract highly-skilled talent as well as upskill existing staff to work in new ways.

SKILLS TRAINING is coming from a variety of places. In the education sector, for example, TAFE Enterprise has developed SkillsPoints industry hubs, which design training tailored to industry needs.

Manufacturers are also upskilling workforces onsite. “We invest in technology so that we can grow,” says Glen Genner. “But we also put so much into training and developing our people. We recently put one of our sales estimators through a software engineering course at uni. He has so much knowledge of our product. Imagine how useful he’s going to be if he can marry that with software engineering?”

JAR Aerospace is also committed to building a pipeline of STEM (Science, Technology, Engineering, and Mathematics) skills talent through its subsidiary business, JAR Education.

Its program aims to make STEM subjects more engaging by teaching school students how to build and operate drones, says Sam Lewinson, Chief Operating Officer, JAR Aerospace.

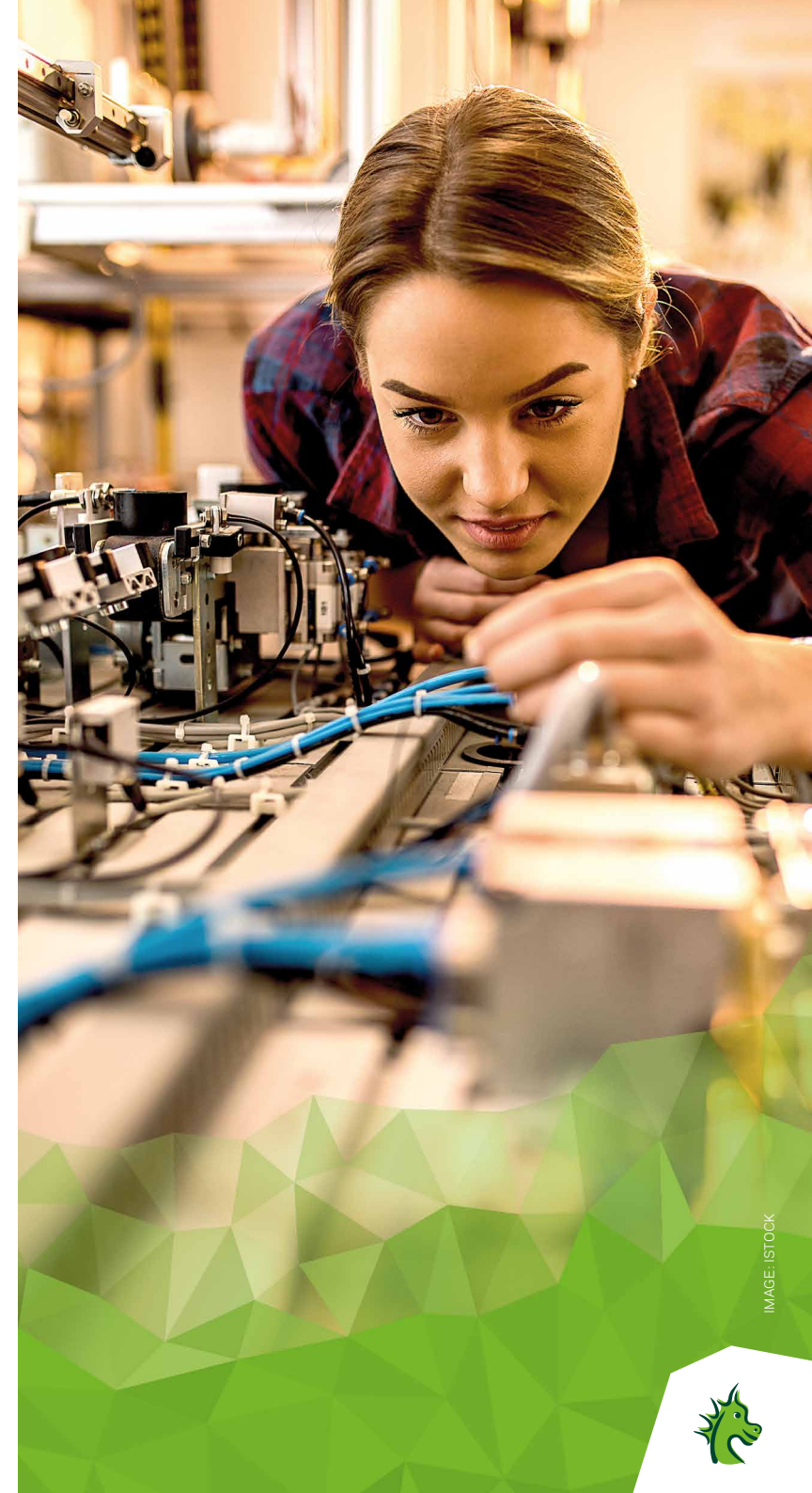
STEM skills are vital to Australia’s future economic competitiveness, yet the country’s STEM teaching and learning results are in decline.

“Everybody wants really good employees that come out of school with industry skills,” Lewinson says. “But there are so few programs for students to complete that are engaging and that use technology that is current.

“We want to get students excited about the possibility of what’s out there in the technology industry. You never know, some of them may end up working with us one day.”

**Sam Lewinson, JAR Aerospace
Chief Operating Officer**

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Sharing the smarts – manufacturing the future together

The future of manufacturing in Australia looks increasingly vibrant.

THERE ARE HUGE opportunities for growth in Australia’s manufacturing sector.

While technological innovation by public and private research communities can help to make this a reality, manufacturers must transform the way they run their businesses by investing in knowledge and new business practices, such as greater collaboration between industry and research.

“I see the essence of advanced manufacturing as collaboration – across different sectors and within the industry.”

Michael Sharpe, AMGC

While there is no one-size-fits-all strategy for advanced manufacturing, the trailblazers in Australia share a number of these characteristics.

“I see the essence of advanced manufacturing as collaboration – across different sectors and within the industry,” says AMGC’s Sharpe. “A lot of businesses, especially SMEs, are willing to share their innovations and gain new insights.”

Other sectors can take lessons from the approach of advanced manufacturers, says St. George’s Matthew Kelly. “They aren’t necessarily new tech companies. They are well-established businesses that were smart enough to see the future coming. They are practical in their approach. They work hard and they are willing to invest in new ways of doing things and that’s what we want to support.”





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